SCIENCE NEWS
THE WEEKLY NEWSMAGAZINE OF SCIENCE
SEPTEMBER 1, 2007 PAGES 129-144 VOL. 172, NO. 9

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mimics, cheats, and fakers
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WHY COUNTRIES STAY POOR

THE WEEKLY NEWSMAGAZINE OF SCIENCE

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This Week

THIS WEEK ONLINE
http://blog.sciencenews.org/

Food for Thought People are accumulating flame-retardant chemicals from food, breast milk, and perhaps even house dust.

MathTrek A mathematical optimization strategy could result in more patients getting kidney transplants.

Of Note

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Cover An entrepreneur traffics in empty oil drums in the Nigerian port of Warri. Mathematical analysis of the connections among industries explains some of the difficulties that face developing countries trying to expand and diversify their economies. (George Steinmetz/Corbis) Page 138

SCIENCE NEWS is printed in the United States on process chlorinefree paper containing 90% recycled fiber with 30% postconsumer waste.

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

POSTMASTER Send address changes to **Science News**, P.O. Box 1925, Marion, OH 43306. Two to four weeks' notice is required. Old and new addresses, including zip codes, must be provided.

Printed in U.S.A. on recycled paper.

EDITORIAL, BUSINESS, AND ADVERTISING OFFICES 1719 N St. N.W., Washington, D.C. 20036 202-785-2255; scinews@sciencenews.org.
LETTERS editors@sciencenews.org

SUBSCRIPTION DEPARTMENT P.O. Box 1925, Marion, OH 43306. For new subscriptions and customer service, call 1-800-552-4412.

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Share Alike

Genes from bacteria found in animals

Some insects and roundworms pick up DNA from bacteria living within their cells, new research shows.

The DNA transfer occurs in the animals' egg cells, so the genetic modification passes between generations. The mechanism therefore provides an alternative to mutation of existing DNA as a way for the species to acquire new genetic traits.

Gene swapping is ubiquitous among bacteria and other single-celled organisms. Even plants and fungi are known to occasionally adopt a piece of foreign DNA. But scientists thought that multicellular animals picked up genes from bacteria only rarely.

"Our data are indicating that [DNA transfer] is going on all the time," says John H. Werren of the University of Rochester in New York, who led the research team.

The discovery challenges the prevailing view of animal evolution, in which genetic information is passed exclusively from parents to offspring. The transfer of DNA from bacteria means that an individual could acquire and pass on genes that it had not inherited.

"We're sort of on the edge of a transformation in the field" of animal evolution, comments Laura A. Katz of Smith College in Northampton, Mass. "These sorts of data allow us to redefine the field to capture this other process going on."

Werren's team looked at several species of insects and roundworms infected by a parasitic bacterium called *Wolbachia pipientis*, which afflicts about 20 percent of insect species as well as many other invertebrates. The bacterium lives inside the animals' cells, including their egg cells, giving it ready access to the chromosomes that are passed on to the animals' offspring.

"I think that physical access is the key to allowing this [DNA transfer] to happen," Werren says. The way in which animals' bodies insulate their eggs and sperm from foreign bacteria is the main barrier to heritable-DNA transfer in animals, he says.

The researchers compared the genetic code of the bacterium with the code of 11 other species: four roundworms, four fruit flies, and three wasps. The team found that all but three of the fruit fly species had segments of the bacterium's genetic code embedded in their DNA. The report appears online and in an upcoming *Science*.

Some of this transferred DNA is active in the host species' cells, the researchers found, but they didn't determine whether the genes serve a biological function in the host.

The team also scanned an archive of published genomes for 21 other invertebrate species and found bacterial genes in nine of them.

Such bacterial genetic code is routinely ignored during the sequencing of animals' genomes because most scientists have assumed that the foreign DNA is a sign of contamination, Werren says. However, the new research rules out the possibility of contamination, Katz says. "I think it's a really beautifully done, elegant study."

Julie C. Dunning Hotopp, a member of the research team and a scientist at the J. Craig Venter Institute in Rockville, Md., says that the mechanism by which DNA leaves the bacteria and becomes inserted into the host species' chromosomes remains uncertain.

While in-cell parasites such as *W. pipientis* are common among invertebrates, none is known to infect people or other mammals, Werren says. —P. BARRY

Barely Alive

Ancient bacteria survive in the slow lane

Microbes in 500,000-year-old permafrost breathe, although at a very slow pace, and show other signs of life, according to a new report. If confirmed, the findings would be the first evidence of metabolism remaining active over geologic time scales.

Previously, researchers had extracted bacteria from 250 million-year-old minerals and coaxed them to grow in the lab. Such bacteria probably survived in a dormant, sporelike state (*SN: 6/12/99, p. 373*).

The new report hints that some types of bacteria instead remain metabolically active over hundreds of thousands of years. "Our evidence suggests there are some living bacteria [in the permafrost]," says lead researcher Eske Willerslev of the University of Copenhagen. "But there is definitely a time limit to how long they can live."

The researchers found evidence of viable bacteria in samples of Canadian and Siberian permafrost ranging from 7,000 to 500,000 years old, but they saw no such signs in cores older than that, they report online and in the Sept. 4 *Proceedings of the National Academy of Sciences*.

Willerslev's multinational team used two techniques to detect signs of life. Both methods showed declining evidence of viable bacteria in progressively older samples.

To detect respiration, a hallmark of active metabolism, the researchers looked for carbon dioxide emissions from permafrost

D. FROESE

PERMA-LIFE **Bacteria found in Canadian permafrost may have remained metabolically active for hundreds of thousands of years.**

samples. They first sealed the samples in airtight chambers for 3 months to allow trapped atmospheric gases to dissipate. Throughout the following 6 months, they measured minute but steady carbon dioxide emissions from 25,000-year-old and 500,000-year-old samples. Tests detected no such gas from 740,000-year-old permafrost. The team says that its laboratory setup eliminated any incidental sources of carbon dioxide, such as plastic tubing, leaving live bacteria as the only source of the gas.

In the second test, Willerslev's team searched for a segment of DNA, 4,000 base pairs long, variations of which occur in all bacteria. In the youngest samples, the researchers found many variants of this marker, indicating that the ice was teeming with bacteria of many species. The oldest samples, by contrast, yielded just a few copies. "That's a hard pattern to explain by contamination," Willerslev points out.

The presence of these stretches of DNA, which are much longer than snippets typically found in ancient cells, suggests that the microbes were continuously repairing DNA damage, says Willerslev.

Russell V. Freeland of West Chester (Pa.) University says that finding such long stretches of DNA is impressive. However, he doubts that it proves long-term DNA-repair activity. It's possible, Vreeland suggests, that the DNA never degraded in the first place. Scientists disagree over the extent to which DNA decays over millennia and longer periods.

"I'm caught between the fact that I believe there are viable organisms in the

[permafrost], but I don't believe that this data shows it," says Freeland.

Willerslev asserts that future missions to Mars should search for bacteria in that planet's permafrost. "If there had been a similar bacterial community on Mars, you can push their survival time way back now," he says. —B. VASTAG

Cretaceous Corsages?

Fossil in amber suggests antiquity of orchids

The first undisputed fossil of an orchid part has enabled scientists to estimate that the prized flowers appeared on the botanical scene around 80 million years ago.

With more than 25,000 species, orchids are the largest and most diverse group of flowering plants. Although most are found in the tropics, orchids grow on every continent except Antarctica and in every habitat except deserts. Scientists have assessed genetic differences among a variety of orchid species to develop a family tree that includes five subgroups.

An absence of orchid fossils, however, has prevented researchers from putting dates on the family tree by calibrating orchids' mutation rates, says Santiago R. Ramírez, an evolutionary biologist at Harvard University. The pollen and dust-grain-size seeds of orchids are thin walled and typically don't fossilize well, and many of the orchids' leaves resemble those of other plants.

Now, in the Aug. 30 *Nature*, Ramírez and his colleagues describe the first fossil that definitely comes from an orchid. The 1-millimeter-long fragment of a pollen-bearing structure, or pollinarium, rests on the back of a stingless bee that became trapped in amber about 15 million to 20 million years ago. Amber, a hardened form of tree sap, is one of the few substances that can preserve delicate fossils such as feathers (*SN: 3/30/02, p. 202*) and spider silk (*SN: 8/30/03, p. 141*).

Because the pollinarium fragment appears to be stuck in the middle of the bee's back, the researchers speculate that the insect had to crawl into the orchid's flower to pollinate it. That would suggest that the flower was long and tubular, says Ramírez.

Characteristics of the pollinarium fragment place the ancient orchid in the subgroup Goodyerinae. That classification enabled the researchers to estimate that the ancestor of all modern orchids appeared between 84 million and 76 million years ago. Other teams' estimates of the orchid group's age have ranged from 26 million to 110 million years.

"This is pretty darn neat," says Norris H. Williams, a botanist at the University of Florida in Gainesville. "Finally, we've got a fossil that gives us a good date."

"This is a really exciting [finding]," echoes Kenneth M. Cameron, an orchid specialist at the New York Botanical Garden in New York City. "A lot of us have been waiting for a piece of evidence like this for a long time," he says.

A few years ago, when producers of the BBC series *Walking with Dinosaurs* were filming the jungle backgrounds for their animations, they took special care to exclude orchids or other plants thought to have evolved after the dinosaurs had died out, says Mark W. Chase, an orchidologist at the Royal Botanic Gardens in Kew, England. The fact that Ramírez and his colleagues have now found that the showy flowers lived alongside dinosaurs "is pretty funny," says Chase. "Maybe [the BBC] should go back and add a few orchids in there after all." —S. PERKINS

RAMÍREZ

TOGETHER FOREVER The grainy structure (at center) stuck to this bee, which is trapped in amber that's 15 million to 20 million years old, holds orchid pollen. The structure, called a pollinarium, is the first undisputed fossil remnant of an orchid.

Oxygen Rocks

Volcanoes spurred early atmospheric change

The young Earth supported little multicellular life until its atmosphere acquired a healthy portion of oxygen. That change has been credited to the rise of cyanobacteria, known as blue-green algae, that produce oxygen by photosynthesis. Now, scientists argue that oxygen couldn't have built up in the atmosphere until a crucial geological mechanism kicked in and set the scene for the rise of more-complex forms of life.

By relating atmospheric composition to the chemistry of various ancient rock types, geologists have inferred that Earth went from largely oxygenfree to oxygen-rich 2.4 billion to 2.5 billion years ago (*SN: 1/24/04, p. 61*). But the fossil record shows that cyanobacteria existed about 2.7 billion years ago, leaving scientists to wonder why 200 million to 300 million years of oxygen production by these bacteria resulted in no accumulation of the gas.

The answer, says Lee Kump of Pennsylvania State University in University Park, is that during that time, Earth's oceans and land acted as a "chemical sink" that mopped up oxygen as fast as cyanobacteria produced it. What eventually permitted oxygen to accumulate in air was a broad change in the location and nature of volcanoes, Kump and Mark Barley of the University of Western Australia in Perth propose in the Aug. 30 *Nature*. After examining geological data on the composition, age, and by-products of volcanoes from different eras, the researchers concluded that around 2.5 billion years ago, there was a general shift from underwater volcanoes to volcanoes on land.

That this shift was followed by a rise in an oxygen-rich atmosphere is more than coincidence, Kump says. His and Barley's analysis shows that rocks of the Archean eon, which are more than 2.5 billion years old, formed when gases such as hydrogen sulfide and methane were abundant. Underwater volcanoes, whose eruptions don't attain such high temperatures as their above-water counterparts, spew those gases profusely. In both the oceans and the atmosphere, these reactive gases create "oxygen-

hungry" conditions, says Kump, preventing that gas from accumulating.

The start of the next eon, the Proterozoic, was marked by changes in rock formation that favored thicker, lighter crust and in particular, "the development of large, stable continents," says Kump. With higher eruption temperatures, volcanoes on these burgeoning continents would have ejected gases such as carbon dioxide and sulfur dioxide directly into the atmosphere. These gases don't readily react with oxygen, Kump says, which would have allowed it to build up.

The move to an oxygen-rich atmosphere is "an Earth-system event," says Kump, that "reflects the interplay between biological and nonbiological factors."

Geochemist Tim Lyons of the University of California, Riverside, who wrote an editorial accompanying the new study, says that "Kump and Barley have put together a really elegant tectonic argument." Up-and-down swings in the amount of oxygen in the atmosphere might have preceded the volcano-induced transformation to a stable, oxygen-rich world, Lyons adds. —C. BARRY

No-Fight Zones

School programs reduce violence in all grades

As students head back to school this week, violence will follow a sizable number of them. Roughly 13 percent of public high school students report having had a fight on school property during the past school year. About 8 percent say that they were threatened or injured with a weapon at school, and 7 percent were bullied.

In some schools, however, a variety of violence-prevention programs have fostered substantial reductions in violent and disruptive behaviors, according to two new, independent research reviews. This positive effect occurs in all grades, from prekindergarten through high school, and in all schools, from the poorest to the wealthiest.

"These school-based programs improve learning and make the classroom a more peaceable kingdom," says epidemiologist Robert A. Hahn of the Centers for Disease Control and Prevention in Atlanta.

The new reviews, published in the August *American Journal of Preventive Medicine*, counter assertions by some educators and researchers that violence-prevention programs pack little practical punch.

Hahn directed the first review, which assessed 53 studies of violence-prevention programs delivered to all children in a particular grade or school. Most of the studies were conducted within the past 20 years. The prevention programs were classroom based and conducted primarily by teachers or researchers.

The programs focused on various approaches, including problem-solving skills and emotion-control strategies, rewards for good behavior, conflict resolution, and peer mediation. Some programs provided individual or family counseling and parent-skill training.

On average, the programs led to a 15 percent reduction in violent and aggressive behavior, Hahn's group found. Most studies charted this decline for 6 months after a program's completion. A few longer studies noted that the programs' violence-dampening effects had weakened slightly several years after completion.

Comparable findings emerged from a second, broader review. Sandra Jo Wilson and Mark W. Lipsey, psychologists at Vanderbilt University in Nashville, analyzed data from 249 studies of school-violence–prevention programs. Some of the programs had been delivered to all students. Others had been given to select students identified by teachers as disruptive or to students in special education classes.

The reviews overlapped in that Wilson and Lipsey's analysis included about half of the programs evaluated by Hahn's team.

The researchers found slightly greater declines in violence and aggression from programs designed for selected, "problem" students than from programs for all students. Both types of programs also promoted truancy declines and improved academic achievement, the reviewers report. Programs for special education students achieved smaller, but statistically significant, declines in violence rates.

Federal-government data suggest that about 20 percent of students engage in some sort of violent or disruptive behavior in a typical school year. Universal and select-student programs would, on average, reduce that proportion to around 15 percent and 13 percent, respectively, Wilson and Lipsey estimate.

The two new reviews offer encouraging news, even if they left critical questions unanswered, concludes criminologist Denise C. Gottfredson of the University of Maryland at College Park. For instance, she says, investigators need to examine more closely, and for longer periods, whether school-based programs lower criminal violence, such as assault and rape. —B. BOWER

PHOTODISC

TEACHING TRANQUILLITY Two new reviews concur that a variety of violence-prevention programs in public schools reduce students' violent and aggressive behavior.

Dawn of a Disk

Water vapor pours down on embryonic star

Even as it forms within a cloud of gas and dust, a nascent star develops a doughnut-shaped disk around it. This is the "protoplanetary disk" that might spawn planets. Using an infrared telescope to peer inside a dusty stellar womb 1,000 light-years from Earth, astronomers say that they have found evidence of such a disk in one of its earliest stages of development.

The observations suggest that large amounts of water from the star-making cloud are crashing onto the disk, spurring its growth and providing a source of water that might later be incorporated into planets. If liquefied, the water would fill Earth's oceans five times over, Dan Watson of the University of Rochester in New York and his colleagues report in the Aug. 30 *Nature*.

Watson's group found the infalling water vapor while surveying 30 of the youngest known stars—each still residing at the core of its natal cloud—with the orbiting Spitzer Space Telescope. Only one of the embryonic stars, known as

NGC 1333–IRAS 4B, shows a strong infrared signal indicative of water.

The temperature of the water molecules indicates that they are closer to the natal cloud's warm stellar core than to its distant icy reaches. Moreover, the strength of the signal indicates that the vapor is spread over a large region.

The most likely explanation for the infrared signals, Watson's team says, is that they arise from ice in the cloud falling onto a large disk circling the budding star. The heat generated by the collision would turn the ice into steam.

"We believe ... that we're seeing material raining down on a protoplanetary disk" early in its development, says Watson. Until now, he adds, "we didn't know anything about [the material] in disks at such an early age."

The team calculated that the disk is about as big as Pluto's orbit around the sun and has an average temperature of 170 kelvins. Accumulating in the disk at the rate of one ten-thousandth of the sun's mass per year, the water quickly refreezes. As ice, it could be incorporated into asteroids, comets, and planets, if the disk lasts long enough for such objects to form. In our own solar system, astronomers say, asteroids and comets delivered water to the early Earth.

Although the notion of water delivery described by the researchers may be intriguing, "the real value of what they have found is [in] using the water vapor as a diagnostic of disk formation," says theorist Alan Boss of the Carnegie Institution of Washington (D.C.). Spitzer isn't a powerful enough telescope to image the disk of NGC 1333–IRAS 4B. But its observations, combined with the team's modeling, "make a strong case" that the water vapor comes from star-forming material slamming into a disk, Boss adds.

The vapor is merely a tracer for much larger amounts of infalling molecular hydrogen, notes Watson. Such an infall may last only 10,000 years, explaining why just one of the observed young stars showed the water. In addition, the orientation of NGC 1333–IRAS 4B provides a dustfree line of sight to Earth, which helped Spitzer pick up the watery signal. —R. COWEN

Bad Bug

Microbe raises stomach cancer risk

Some strains of a common bacterium harbor a gene that may underlie a huge share of stomach cancers, a new study finds.

The bacterium, *Helicobacter pylori*, has been linked to gastritis, ulcers, and stomach cancer. But while *H. pylori* infects, by some estimates, more than half the global population, there are only about a million people worldwide with stomach cancer. Apparently, therefore, not all strains of the microbe have malignant potential. Over the past decade, scientists have traced this discrepancy to *H. pylori*'s genetic makeup (*SN: 11/30/02, p. 341*). In particular, they've zeroed in on strains that carry a gene dubbed *cagA*, for cytotoxin-associated gene.

In the new study, researchers obtained frozen tissue samples snipped from the stomach linings of 2,145 people participating in a cancer-screening program in Venezuela. The samples revealed that 16 percent of the volunteers didn't have an *H. pylori* infection. Of the 84 percent with *H. pylori*, roughly half had a strain that harbored *cagA*.

By coordinating these data with those from other tests on the volunteers, the researchers found that people with *H. pylori* carrying *cagA* were 16 times as likely to have dangerous premalignant stomach growths as were people with *H. pylori* lacking the rogue gene or with no *H. pylori* infection at all. The researchers report the findings in the Sept. 5 *Journal of the National Cancer Institute*.

"Our results show that it matters what kind of *H. pylori* a person has," says study coauthor Ikuko Kato, a cancer epidemiologist at Wayne State University in Detroit. "It affects the risk of developing these precancerous lesions." People with these lesions, called dysplasias, are up to 100 times as likely to develop stomach cancer as are people without them, she says.

"This is the kind of work that needs to be done ... in populations at high risk of gastric cancer," says Martin J. Blaser, a physician and molecular biologist at the New York University Medical Center. Recent estimates attribute two-thirds of all stomach cancer to *H. pylori* infections.

Blaser, whose research team discovered *cagA* in the early 1990s, estimates that roughly 60 percent of *H. pylori* infections in the United States and 80 percent in China are caused by microbes harboring *cagA*.

Past studies have established that *cagA* is part of a group of genes that encode proteins that make a "molecular syringe" that injects the microbe's compounds into the cells of the stomach lining, Blaser says. These injected bacterial products change internal signaling in the cells.

This change could have multiple and complex effects, he says. For example, *cagA*-positive *H. pylori* may suppress stomach-acid production.

Stomach cancer rates have been declining in industrialized countries, possibly as the result of high use of antibiotics that cure *H. pylori* infections. Meanwhile, the prevalence of reflux disease and related cancer of the esophagus is increasing in those countries, Blaser says.

That more people are living longer without the microbe might explain these increases, Blaser hypothesizes. So wiping out the infection might solve one problem while creating another. —N. SEPPA

R. HURT, JPL-CALTECH/NASA

STEAMY SCENARIO Artist's illustration shows a developing disk (billowing dark ring) around a young star, both inside a cocoon of gas and dust. Water is among the materials falling onto the disk, which has the potential to make planets.

Explore the "Evolution" of Evolution …

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Professor Edward J. Larson, an award-winning teacher at the University of Georgia and Pulitzer prize-winning author, leads you through the "evolution" of evolution, with the goal of enhancing your understanding of the development of the theory itself and the roots of the controversies that surround it.

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- Examine the history of evolutionary science after Darwin, including the re-discovery after 35 years of Gregor Mendel's work on genetic variation, and the unearthing of pre-hominid, or early human, fossils by Raymond Dart in 1925 and by the Leakey family in the 1950s
- Trace the history of religious objections to evolution, from those of Darwin's own time to contemporary efforts to teach creation science in American schools.

You will also hear a detailed discussion of the notorious Scopes "monkey trial," a staged media event designed to create publicity for the town of Dayton, Tennessee. Dr. Larson won the Pulitzer Prize in History for his book on this controversy, *Summer for the Gods: The Scopes Trial and America's Continuing Debate over Science and Religion*.

Even within the scientific community, the fine details of the theory of evolution have long been a matter of passionate dispute. In the last third of the 19th century, the principal objections were scientific, not religious. Aside from concern about gaps in the fossil record, both proponents and critics wondered how altruistic human qualities such as love and generosity could possibly have evolved through natural selection. Evolutionary theory has caught up with these quandaries, but new disputes have arisen over the degree to which evolution drives human behavior.

Meanwhile, large segments of the American public reject current evolutionary thinking. Nine out of 10 Americans believe in spiritual causes for life, with only 10 percent accepting the purely naturalistic explanations espoused by evolution. Strikingly, these statistics are almost exactly the reverse among the scientific community.

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RETHINKING BAD TASTE

How much mimicry is outright cheating?

BY SUSAN MILIUS

Talking to evolutionary biologists Hannah Rowland and Mike Speed can shake your faith in a supposedly settled area of science. Generations of textbooks have presented animal mimicry as one of the marvels of evolution, allowing two species to confound their predators by looking alike. Marvel of evolution it is, but surprisingly for such a high-profile example, researchers still have a lot of questions about how mimicry works.

In the usual classroom explanation, there are equal partners and fakers among the mimics. The equal partners are, for example, two butterflies that look like each other and that both carry a foul-tasting toxin. A bird that bites either one of them gets a lesson in what not to eat. Since there are two species, not as many of either one have to get killed or injured to educate the latest generation of local birds. The two species share the cost of training the predators.

Then there's the toxic-and-cheater pair. One of them carries a foul-tasting toxin while the other tastes just fine but looks like the toxic species. The cheater gets benefits: Birds that associate the warning colors with a disgusting mouthful avoid the tasty species. But some birds without an adequate culinary education catch the cheater and get a confusing message: that the butterfly's colors say, "Come and get it."

These birds are more likely to attack the genuinely bad-tasting species. The cheater thus undermines the protection that the other species is creating for itself. Both cases are in line with conventional mimicry standards. But Speed, of the University of Liverpool in England, has raised questions about pairings that don't fit either scenario: One species is vile, but the mimic is neither toxinfree nor totally bad tasting. Are these mimicry pairs still helping each other, or is the milder-tasting one cheating? And do any two species ever really have the same degree of bad taste? Other biologists have proposed that following that line of argument to the end might mean that in the real world, there aren't any truly equal mimicry partners.

Testing these questions has been tricky. Speed, Rowland, also of Liverpool, and other researchers have turned to a whole novel world of artificial prey to get at the story behind mimicry.

CHOOSE ONE — A *Pseudoceros* flatworm (top) has some chemical defenses of its own but also scares away predators by looking like the more noxious sea slug *Chromodoris preciosa* (bottom).

GOSLINER

COPYCAT CLASSICS In 1862, British entomologist Henry Walter Bates published a discussion of distinct butterflies with similar wing markings that he had seen in the Amazon. Today, biologists use the term Batesian mimic for a clear-cut cheat—a tasty creature that borrows warning colors from a foul one.

In the late 1870s, Fritz Müller described how vile species that look alike could share the costs of repelling predators. Today, biologists call these look-alike nasties Müllerian mimics.

Butterflies inspired early ideas about defensive mimicry, but biologists have spotted apparent mimics among many other creatures. For example, Terry Gosliner of the California Academy of Sciences in San Francisco has discovered marine flatworms with the colors of better-defended sea slugs. Birds and certain snakes may also be deploying mimicry.

The idea applies to more than just visual similarities. For example, a North Carolina research team has argued for both Batesian and Müllerian forms of mimicry in the clicking sounds that certain moth species make as a bat swoops toward them to attack.

Speed's work in the early 1990s didn't specify any particular species. He developed a mathematical model that attempted to update mimicry theories to include new data on learning. In Speed's Pavlovian world, for instance, a predator can learn to avoid an extremely nasty-tasting kind of prey after just one encounter. However, the predator continues to eat prey that tastes less disgusting in small amounts.

For the extreme case of two terrible-tasting prey, Speed's model confirmed the classic theory that equally foul-tasting mimics benefit from each other's presence. His model also showed that as one of the mimics' repellent qualities diminish, protection erodes. In 1993, Speed proposed the category of quasi-Batesian mimics.

His work set off volleys of criticism. Two biologists studying mimicry, James Mallet of University College London and Mathieu Joron of the University of Exeter in England, questioned whether quasi-Batesian mimicry was likely to exist in the real world. They said that Speed's model didn't correctly account for the way that changing prey abundance would affect prey survival rates.

In the late 1990s, Angus MacDougall and Marian Stamp Dawkins of Oxford University in England created a computer model of a predator that would sometimes misidentify various species of prey. Based on studies of learning and behavior, the model assumed that an animal tends to better discriminate among distinct items, including prey, the fewer categories it has to cope with.

Since mimicry reduces the number of apparent prey species available, the predator makes fewer mistaken attacks. The model indicated that improving the predator's accuracy in this way should save the lives of some of the prey and compensate for the effects of mimicry cheats.

TESTING, TESTING In spite of a century of scientists' theorizing about mimicry, there had been few experiments testing the idea. The hang-up was that to test basic ideas about how a predator

learns, researchers needed prey that no bird had ever seen before. They needed to observe predators attacking something for the first time—a tough assignment to pull off in nature or even in the lab.

In the early 1990s, Speed and his colleagues decided to construct fake species for real predators to sample in the wild. The mimics would be made of colored cards and pastry dough.

The researchers dyed portions of dough with yellow, green, blue, or red food coloring and placed them on cards of contrasting colors. To make nasty-tasting species, the team dosed some of the pastry with mustard and quinine. To make the less-repellent and even yummy creatures, they simply reduced the additives' doses.

An invented prey species was a fat slug of one of the doughs at the center of a triangular card. The study thus included a variety of fake species ranging from fully edible to really foul.

In the spring of 1995, the researchers set out the dough creatures on two lawns in Liverpool. On each of 40 consecutive days, they distributed 85 of the artificial prey at each site and watched blackbirds, sparrows, robins, and starlings drop by to dine. The team repeated the experiment the following spring.

In a 2000 publication, Speed's team reported that during one period, when the array included equal numbers of a highly nasty dough creature and its half-nasty mimic, the nasty ones suffered more attacks than did another nasty species without a look-alike. Abundant mimics that are only semirevolting can weaken more-noxious prey's protection, the researchers concluded.

NOVEL WORLD Results depended on what kinds of birds happened to drop by, and some unexpected effects during certain weeks might have come from a surge of birds new to the area. To get more control, Speed needed an artificial world, and while he'd been working with pastry, a research team in Finland had been inventing one.

In the mid-1990s, Johanna Mappes and Rauno Alatalo of the University of Jyväskylä developed what they call a "novel world" with artificial prey species that birds could hunt inside a large room. A paper-covered floor creates an artificial environment in which artificial prey can nearly disappear or stand out (*see sidebar*).

The Jyväskylä researchers have used the setup to experiment with predator behavior of birds captured from the surrounding forest. Before Speed's team tested its hypothesis in the novel world, the Finland-based researchers investigated what birds might do when confronting Speed's nasty and half-nasty pairs.

Eira Ihalainen set out dozens of invented prey made of almond slices inside small paper envelopes that blended into the paper-carpet background. But also included were boldly marked envelope species dosed with a bitter solution and, sometimes, look-alikes with a less-terrible taste. The half-nasty species didn't seem to slow birds' learning to avoid the mark for nasty flavor, Ihalainen and her colleagues found.

The work, reported in the March *Journal of Evolutionary Biology*, suggested that the half-nasty mimics weren't the menace that Speed had discussed, but the Ihalainen team's study focused on the predator, not the prey.

Rowland and Speed joined Ihalainen and others at the Jyväskylä facility to set up an explicit test of whether half-nasty mimics undermine the protection cultivated by nasty-tasting species.

The combined team set out various numbers and kinds of mimic-envelope species and tallied the first 50 envelopes that a bird chose. When they mixed the worst-tasting species with a milder-tasting look-alike, both species enjoyed a benefit, the researchers report in the July 5 *Nature*. So, Speed didn't find his quasi-Batesian effect.

Circumstances may still exist where the effect would turn up, says Rowland. Says Speed: "There are different ways of running the experiment, and these seem to give us different results."

For example, the dough tests in Liverpool held the number of total prey constant, but the almond-envelope-prey experiment in Finland used variable numbers.

The debate over mimicry, especially that of the quasi-Batesian type, has become "obfuscated," says Speed. So he's going back to design new experiments and to review the theory. The question about whether half-nasty mimics are cheaters "seems a good one, and one worth answering," he says. "If my initial hypotheses were dead wrong, then that's actually fine with me: We'll have understood the system." ■

Making a Novel World

Use lots of glue

Johanna Mappes and Rauno Alatalo got interested in experiments that they couldn't do in this world, so they invented another one. In the mid-1990s, Mappes, of the University of Jyväskylä in Finland, had become interested in the warning colors, smells, or sounds that a foul-tasting animal typically displays. In theory, these signals are easy to notice and remember.

Testing ideas about the evolution of the signals is complicated by the fact that actual species have had a chance to evolve reactions to warning signals. Newly hatched chicks, for example, show an innate hesitation to peck at any object showing yellow and black stripes, which are common warning signals of creatures such as wasps and bees.

So Mappes and Alatalo, also of Jyväskylä, invented new prey species. They had to search for markings that would be unlikely to arouse any innate bias in birds. "Circles were out of the question since they resemble an eye," says Mappes.

Eventually, the researchers decided to go with an X for the basic prey that would be hard to spot against their artificial background. The "warning-signal" prey, intended to stand out, get bolder marks, such as black diamonds or squares.

The team creates prey by soaking sliced almonds in a bitter solution. Researchers tuck each slice between paper squares and glue the paper to form a little pouch. Each experiment takes thousands of these envelopes.

The Mappes team covers the floor of a 57-square-meter room with paper. To create a background for the prey to hide in or stand out from, the scientists mark the paper with a random scattering of Xs. To add a little depth to the background, they also glue on some cardboard Xs.

The predators that forage on this carpet of Xs are great tits caught in nearby forests for a research interlude. In a typical experiment, the birds get several days to adjust to indoor life and to learn how and why to open little paper envelopes. Finally, they get one session in the big room before returning to the forest from novel world. —S.M.

NOVEL LUNCH — A great tit surveys "novel world," set up here to test how good- and bad-tasting mimics affect each other's chances of being eaten. In the novel world, prey "species" are tiny envelopes.

L. LINDSTRÖM/UNIV. JYVÄSKYLÄ

THE WEALTH OF NATIONS

A country's competitive edge can spread industry to industry, like a disease

BY DAVIDE CASTELVECCHI

The economies of poor and developing countries often depend almost exclusively on a single product—perhaps timber or coffee—or on a handful of products at most. That's hardly a startling observation, but what's puzzled economists over the years is why it's been so difficult for these countries to start up new activities in the hope of spurring economic growth and lifting themselves out of poverty.

While there have been a few success stories, such efforts have often ended up consuming heaps of money to little lasting effect.

A team of economists and physicists is now proposing a new way to look at development. The researchers have shown that a country's competitive edge can spread from one kind of product to another along a well-defined network of links, much as disease epidemics tend to spread among people who are socially connected.

The newly charted map of products could help countries design good policies by indicating the most promising paths to creating new industries. The network's structure also presages the hurdles that many developing countries will face along that path.

Traditionally, economists have tried to link a country's commercial expansion to "factors of production," such as reliable transportation infrastructure or the availability of skilled and unskilled labor, explains Ricardo Hausmann, an economist at Harvard University. For example, says Hausmann's colleague and graduate student Bailey Klinger, conventional economic theory predicts that a country with the capacity for making computer chips should also be competitive in other industries that require skilled labor, such as vehicle manufacturing.

But when the two economists looked at actual data, such correlations often failed to show up. Many countries that export computer chips don't export cars, and vice versa. Building and shipping cars requires very different skills and infrastructure than making computer chips does, the researchers point out.

Instead, the two found correlations that standard economic reasoning didn't predict. For example, fish exporters are often successful at exporting fresh produce as well. That's because both activities require similar infrastructures—good roads, ports with refrigerated storage facilities, and bureaucracies able to monitor food safety—Hausmann and Klinger suggest. A country that has developed the means to generate and export one product can easily branch into the other.

PATH TO SUCCESS To refine their perspective on economic linkages, Hausmann and Klinger developed a new notion of closeness between products. By analyzing global export data on numerous categories of goods, the two economists calculated, for each pair of categories, the probability that if a country is good at exporting one type of product, it will also be good at exporting the other. When that probability is high, those two products have a short "distance" between them. When the probability is low, the products are far apart.

The researchers focused on export data because they are good indicators of high-quality production, and because they are the best global data available. While many countries don't compile reliable data on domestic production and consumption, exports are carefully recorded worldwide.

Hausmann and Klinger created a table listing the distance between each pair among 775 types of goods. To make sense of this mountain of data, Hausmann sought the help of Albert-László Barabási, a physicist at the University of Notre Dame in Indiana. Barabási specializes in applying the abstract theory of networks to real-life situations, such as the structure of the Internet or the degrees of separation between people.

Cesar Hidalgo, a graduate student working with Barabási, translated the distance data into a network. He represented each category of goods as a node and drew links between nodes only when they were close according to Hausmann's metric. Nodes that were strongly connected to many other nodes formed clusters, whereas those that had only a few connections straggled out toward the edge of the diagram. Hidalgo chose an arrangement of the nodes to spread out the network on a page as clearly as possible.

> "If you just had the data on a table, it would be impossible to see these patterns."
>
> — LUIS AMARAL, NORTHWESTERN UNIVERSITY

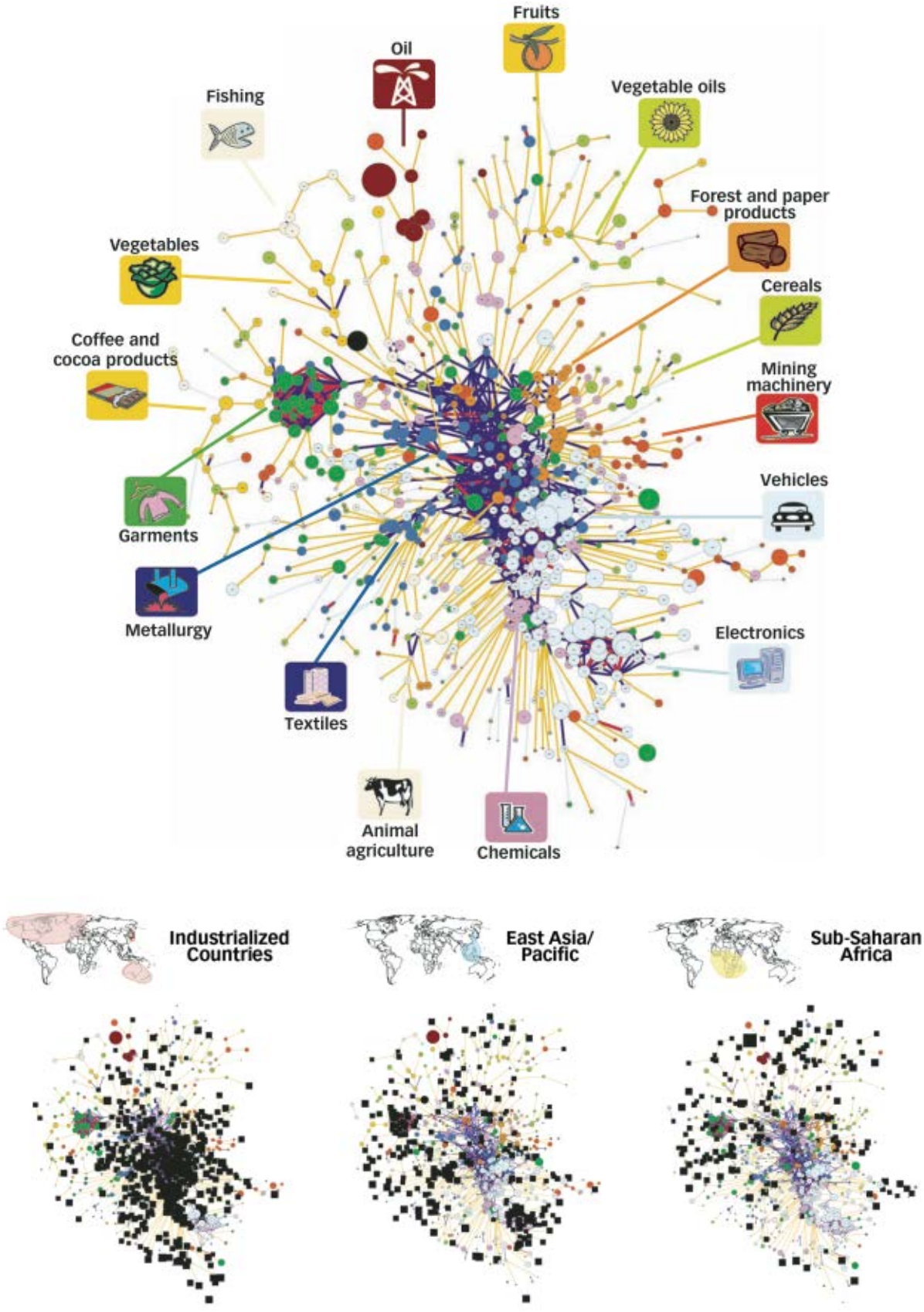
The resulting network, which the four researchers call the product space, maps out world exports. But it represents a kind of cartography that has nothing to do with the geography of the countries involved. Instead, the map shows how industries gather in clusters according to how likely it is that that those industries thrive in the same countries. The team's findings appear in the July 27 *Science*.

In the middle of the product space lies a large "continent" of products tightly connected to each other. These include the vast majority of industrial products, from machinery and steel to chemicals. Garments, textiles, and electronics form their own, smaller, clusters.

Farther out, almost in isolation at the network's periphery, are products such as oil, minerals, cereals, and coffee.

The rich countries of the industrialized world tend to have broad portfolios of industries, and accordingly occupy large areas of the product space, usually including much of the network's core. Fast-growing developing countries such as China, Thailand, and Hungary are strong in some of those central, well-connected regions. The poorest countries, especially those in sub-Saharan Africa, tend to specialize in a few of the peripheral products—such as oil for Nigeria and copper for Zambia.

The product space is a snapshot of the status quo in the global trade of goods. It represents empirical data, not an interpretation of the causes of the status quo or of its consequences. However, the researchers also argue that the network can help explain why some economies have grown, while others have not.



HIDALGO/SCIENCE

HIDDEN LINKS — In the product space network (top), nodes represent products. The more closely products are linked, the more likely they are to be produced and exported by the same countries. Each node's size represents the total world trade in that product, and the nodes' colors follow an older classification of products. At bottom, black squares mark products successfully exported. The industrialized countries' products (left) occupy the highly connected core of world trade. Goods from Southeast Asia and the Pacific region (center) cluster in the garment industry and in electronics, while sub-Saharan Africa's products (right) are mostly peripheral.

By crunching 2 decades' worth of data, the team showed that countries that have expanded into new industries have usually done so by stepping from one node to another one directly linked to it. The process is reminiscent of how information or diseases spread across a social network.

For example, the team looked at Malaysia's and Colombia's exports during the 1980s and 1990s. In those decades, both countries were successful at branching out into new industries close to those in which they were already competitive. Colombia widened its production of garments to include lingerie, while Malaysia expanded into cameras from other electronics products.

On the other hand, economic activities toward the periphery of the product space have fewer links. These tend to be industries, such as mining or the growing of certain crops, that require infrastructure or skills with few alternative uses. Historically, countries that rely on them have had a hard time branching out into new industries. The network's structure is a stark reminder of the difficulties that these countries face, and the four authors admit that it doesn't point to an easy solution. "Nevertheless," Barabási says, "it's important to understand what are the causes and the consequences of where these countries are."

TREASURE HUNTING Hausmann and his collaborators say that their new approach might help governments and aid organizations orient themselves when deciding how to invest money, though it won't point to specific policies. "It's kind of like having a map that allows countries to move around from product to product," Hausmann says. "But the map doesn't tell you where to go."

To emphasize the contrast between their model and standard economic theories, the researchers color coded the network's nodes using an existing classification that groups products according to the similarity of the factors of production they require. Nodes of the same color often ended up far apart, meaning that in practice, countries have rarely been able to move directly between them. "It's telling you that these factors of production are not [the factors] that matter" to predict how diversification can succeed, Hidalgo says.

"This is a highly original approach," says physicist Eugene Stanley of Boston University. "What makes it unique is that the network is not a network of countries, but of products."

"The analysis is pretty revealing," says Luis Amaral, a physicist at Northwestern University in Evanston, Ill. "If you just had the data on a table, it would be impossible to see these patterns at all." Amaral says that the team's methods might help economists understand the growth of companies as well as of countries.

> "Will the world converge, or will it continue to be a world of poor and rich countries?"
>
> — RICARDO HAUSMANN, HARVARD UNIVERSITY

Columbia University's Joseph Stiglitz, a recipient of the 2001 Nobel Prize in Economics, says that the team has come up with "a very interesting and appealing idea." He says that he emphasized the importance of product-specific skills over factors of production as early as 1969. That was before network theory and computers enabled economists to tackle extreme complexity.

For Hausmann, the ultimate question is, "Will the world converge, or will it continue to be a world of poor and rich countries?" In the past few months, he has been traveling around the world, invited by officials of developing countries and international organizations to brief them on his team's approach. At least two countries—South Africa and Colombia—have begun reviewing possible policy changes based on the new ideas. His team's research has highlighted how countries' potentials differ. Perhaps it will someday help countries figure out how best to exploit their potentials. ■

OF NOTE

BIOMEDICINE

When antioxidants go bad

Antioxidants are good for your health in many ways. But too much of them can lead to disease, new research shows.

People with an inherited mutation of a gene called *alpha-B crystallin* can suffer progressive heart failure, but nobody has known why. Now it appears that the mutation leads to an excess of natural antioxidants that damage heart cells.

Researchers led by Ivor J. Benjamin of the University of Utah in Salt Lake City inserted the mutant human gene into the DNA of mice. As in people with the disease called protein-aggregation cardiomyopathy, the mice developed enlarged hearts and abnormal clumps of the alpha-B crystallin protein in their heart cells. The mice eventually died of heart failure.

The mouse cells responded to the clumps by producing a natural antioxidant called glutathione, the team reports in the Aug. 10 *Cell*. Chronic overproduction of the compound changed the chemical environment in the cell from oxidative to the opposite, a reductive state.

"If you change to a reductive state, then the whole protein-folding mechanism is affected," explains coauthor Namakkal S. Rajasekaran, also of the University of Utah. Impairment of the cells' ability to make new proteins could be the reason that the inherited mutation causes heart failure, he says. —P.B.

BEHAVIOR

Believers gain no health advantage

Among depressed or socially isolated heart-attack survivors, those who hold spiritual beliefs, regularly attend religious services, or frequently pray or meditate experience new cardiac symptoms and die from various causes at the same rate as their nonreligious counterparts do, researchers find.

Intrigued by prior reports that religious involvement fosters physical health, a team led by psychologist James A. Blumenthal of Duke University Medical Center in Durham, N.C., studied 503 patients who were part of a larger investigation of individuals treated for heart attacks. The selected volunteers were depressed or reported having few social contacts. Participants completed a survey of religious attitudes and practices, and their health was assessed every 6 months for an average of 18 months.

Particularly religious patients—whether identified by self-reported beliefs, attendance at worship services, or a propensity to pray or meditate—showed no health or survival advantages over patients who lacked religious beliefs, the scientists report in the July/August *Psychosomatic Medicine*.

This finding held after the researchers accounted for volunteers' sex, education level, race, and physical status at the start of the study.

It's not clear whether findings from this group of depressed and isolated patients apply to heart attack survivors in general, the researchers caution. —B.B.

ZOOLOGY

Bats hum for sugar too

Researchers report for the first time that some nectar-feeding bats metabolize sugar at the same frantic rate as hummingbirds do.

Like hummingbirds, South American long-tongued bats (*Glossophaga soricina*) hover at flowers and feed on sugar-rich nectar. While other mammals, including people, convert sugars to glycogen and store it in body tissues for later use, the bats extract energy immediately from almost all the sugars. This "little metabolic trick," says coauthor John Speakman of the University of Aberdeen in Scotland, was previously seen only in birds, such as the hummingbird, and not mammals.

In their tests, the researchers kept bats on a normal diet of nectar, which contains several sugars, but then abruptly switched to a dose of pure sucrose, fructose, or glucose. By measuring sugar-breakdown products in the animals' breath, the team determined what percentage of exhaled molecules were from the old diet and what fraction came from the sugar that the bats had just consumed. The results indicated that the mammals began obtaining energy from the pure sugars within minutes of eating them.

In a separate experiment, the team found that a long-tongued bat burns almost 60 percent of its energy reserves each day. If the bat can't replenish that store, it will have "a window of a couple of days" before it dies of starvation, Speakman says. "It shows how dependent these animals are on the stability of their environment."

The findings appear online and in an upcoming *Functional Ecology*. —C.B.

C. VOIGT/LEIBNIZ INST., BERLIN

SUGAR FIX Long-tongued bats hover like hummingbirds and rapidly convert sugar to energy to maintain their high-powered lifestyle.

EARTH SCIENCE

Arctic snow was dirtier in early 1900s

The amount of soot wafting to the Arctic has increased significantly since the beginning of the Industrial Revolution but isn't nearly as high now as it was a century ago, an ice core from Greenland suggests.

Greenland has always received some soot from Canadian wildfires, says Joseph R. McConnell, a hydrologist at the Desert Research Institute in Reno, Nev. But the load increased around 1850, when mills and power plants in Canada and elsewhere in the Northern Hemisphere began burning coal in large quantities.

Industrial soot fell at its greatest rate between 1906 and 1910, McConnell reports. During the months of 24-hour Arctic sunshine, the darkened snow at that time probably absorbed about eight times as much solar radiation as it would have if it had been free of coal soot, says McConnell. That change in energy balance during the summer, in turn, warmed the snow and influenced climate in the region, he notes.

The team's data came from an ice core collected in west-central Greenland. However, the entire Arctic region probably received soot from coal-fired industrial activity throughout the Northern Hemisphere.

In the past few decades, regulations and improved technology have significantly decreased emissions of industrial soot. Over that period, nevertheless, Arctic snow has on average absorbed about 40 percent more of the sun's energy during summer months than it did before the Industrial Revolution began tainting the snow, the team estimates in the Sept. 9 *Science*. —S.P.

BIOTECHNOLOGY

Corny collagen

Slaughterhouse leftovers such as skin, tendons, bone, and cartilage are often processed into gelatin that's used in many products, including pill coatings and capsules. The primary protein in gelatin, collagen, can now be extracted from an engineered strain of corn, researchers report, suggesting that the pharmaceutical industry could go vegetarian.

In 2004, scientists at the company FibroGen in South San Francisco, Calif., spliced a collagen gene into corn and grew a small plot of the transgenic crop in Nebraska. But it took until now to develop a four-step procedure to recover and purify the small amounts of collagen in the corn, reports Iowa State University's Cheng Zhang, part of the team that collaborated with FibroGen to develop the process.

Unlike its animal–by-product cousin, the corn-derived collagen purified at Iowa State in Ames is uniform in composition and should be easier for drugmakers to work with, says FibroGen's Julio Baez. It also eliminates the danger of transferring animal viruses to people via the slaughterhouse product.

"Right now there are 1,000 cows in every cold capsule," Baez quips. After collagen extraction, corn waste could serve as a raw material for making ethanol or other products, he says (*SN: 8/25/07, p. 120*).

His team is now trying to boost the yield of corny collagen. The test crop generated just 3 milligrams of collagen per kilogram of kernels. —B.V.

GENE CONTROL

Light switch

Switching off a gene is now as simple as flicking on a light.

Working with zebrafish, a favorite model organism for biologists, Ilya A. Shestopalov and his colleagues at Stanford University showed that, once activated by ultraviolet light, a molecule called a photocaged morpholino can dampen a specific gene.

The molecule is made up of two parallel strips. One strip is an antisense molecule, which binds tightly to protein-coding RNA to shut down protein production. The other strip is an inhibitor that prevents the antisense molecule from doing so.

A light-sensitive bond connects the two strips. A 10-second pulse of ultraviolet light breaks the bond, liberating the antisense strip and allowing it to clamp down on the target gene product.

The Stanford team made a photocage to inhibit the gene *ntl*, known colloquially as "no tail" for the effect when the gene malfunctions. The researchers injected the molecule into zebrafish embryos, which are transparent, and then zapped the developing fish with ultraviolet light. Sure enough, the fish developed without tails.

In further experiments, the team used a tiny, focused beam to dampen the gene in only a small section of the developing zebrafish. Tissue in that section grew into odd shapes.

The team is now developing photocage gene silencers activated by infrared light, which penetrates deeper into tissue, for use in organisms that aren't transparent. —B.V.

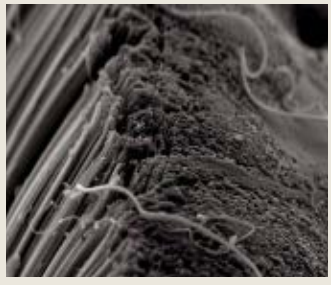
ENVIRONMENT

Tiny tubes, big pollution

A tiny industry has a big problem: pollution. In the first study of its kind, researchers have found that the manufacture of carbon nanotubes produces airborne carcinogens and other pollutants.

Thousands of times thinner than a human hair, carbon nanotubes are extremely strong and lightweight. A fledgling industry already produces several tons of the tiny tubes each year to strengthen baseball bats, tennis rackets, and sailing masts. Scientists expect future applications to range from biomedical devices to an elevator reaching into space.

Desirée L. Plata, a postdoctoral student at the Massachusetts Institute of Technology and Woods Hole (Mass.) Oceanographic Institute, constructed a benchtop nanotube factory. She injected a carbon compound and a metal catalyst into a container, heated the mixture to 1,000°C, and collected the output.



NANO NO-NO The manufacture of carbon nanotubes, like those stacked here, produces carcinogens and other pollutants.

A.J. HART

Along with each gram of nanotubes, the procedure made 0.6 gram of toxic compounds called polycyclic aromatic hydrocarbons (PAHs). Known carcinogens, PAHs typically waft from burning cigarettes and automobile tailpipes. Plata and her colleagues also detected a second category of pollutants called volatile organic compounds, commonly found in smog.

The team is now working with nanotube manufacturers to help them clean up their act before production skyrockets. "Some factories use [emissions] scrubbers, but most of this stuff just ends up in the air," says Plata. "We're hoping small changes now will prevent big problems in the future." —B.V.

PUBLIC HEALTH

Urine tests for cities

A new method of analyzing sewage may offer near real-time monitoring of community-level drug use. The technique can detect mere nanograms of drugs or drug-breakdown products per liter of wastewater.

Environmental chemist Jennifer Field of Oregon State University in Corvallis, who developed the technique with graduate student Aurea Chiaia, says that the method could help public health and law-enforcement officials focus resources on areas found to have high drug use.

For the pilot study, the researchers tested water samples from the intakes of sewage-treatment plants in 10 cities. Plant workers collected the samples, froze them, and shipped the ice to Oregon State.

Analysis of the samples revealed distinct weekly usage patterns. Cocaine breakdown products peaked on the weekend, in a "recreational roller coaster" pattern, says Field. In contrast, amounts of methadone, a synthetic opiate prescribed for heroin addiction, and methamphetamine, an illegal stimulant, remained relatively constant throughout the week.

Wastewater from one city, which Field declined to name, contained measurable amounts of the hallucinogen LSD. Two cities registered the drug known as ecstasy.

The pilot tests looked for evidence of a total of 14 illegal and often abused prescription drugs.

Field says privacy concerns preclude collecting samples further upstream. "We don't intend to go any closer to the urinal than the wastewater-treatment plant," she says.

The method employs high performance liquid chromatography, a standard technique for identifying chemical components in a sample. Field and Chiaia modified the method to analyze relatively large samples in about 30 minutes. —B.V.

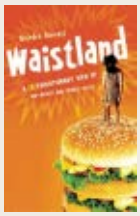
Books

A selection of new and notable books of scientific interest

WAISTLAND: The (R)Evolutionary Science behind Our Weight and Fitness Crisis

DEIRDRE BARRETT

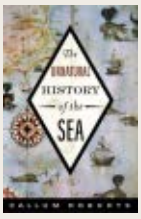
The incidence of obesity in the U.S. population is greater than ever. In this book, Barrett, a Harvard psychologist, describes why maintaining a healthy weight is often a losing battle and suggests why more-radical approaches to weight loss may be easier to follow than common-sense measures. The human body evolved to survive in the food-scarce environment of our hunter-gatherer past, she explains. For our ancestors, the physical exertion associated with foraging for food kept weights down. Today, most of us lead sedentary lives. Fast foods and supermarket convenience foods not only seem more appealing than unprocessed foods but also require little time to prepare. Barrett offers psychological perspectives for changing how we view food and weight loss and ways of incorporating exercise into our daily routines. She even suggests methods for rewiring the reward circuitry of the brain to reinforce healthy eating habits. ***Norton, 2007, 262 p, b&w illus., hardcover, $24.95.***



THE UNNATURAL HISTORY OF THE SEA

CALLUM ROBERTS

The modern fishing industry has reached a level of unprecedented efficiency. Overfishing, however, is not new; it began in 11th-century Europe. Roberts, a professor of marine conservation in England, recounts the history of fishing, beginning with merchant explorers of the 18th century who found in the Atlantic waters an unimaginable abundance of fish. These men soon fanned out to the Caribbean and the Pacific Ocean. Roberts describes the explosion of the whaling industry, the exploitation of seals, and the development of trawling techniques. Many marine animals have become virtually extinct in European waters, forcing modern fishers to travel to other locations and exploit those waters as well. Roberts ends with suggestions on how to combat the devastating effects of overfishing. ***Island Press, 2007, 435 p., b&w illus., hardcover, $28.00.***



TALKING HANDS

MARGALIT FOX

This book takes readers to a living laboratory for the study of language and the ways in which its acquisition reflect the workings of the human brain. Fox focuses on the difference between spoken and nonauditory communication. The research site is the Bedouin community of al-Sayyid in Israel, where the incidence of deafness is unusually high. Residents have developed an indigenous sign language, and everyone in the village "speaks" sign language. Fox, a reporter for the New York Times, traveled to the village with researchers. She reviews the study of language throughout history as well as the history of sign language in the United States and Europe. Sign language is not merely a translation of spoken language, she asserts; it is a distinct mode of communication with its own grammatical rules. Fox explains the differences between spoken and sign language and describes researchers' ongoing attempts to uncover the rules of the al-Sayyid language. ***Simon & Schuster, 2007, 354 p., b&w plates, $27.00.***

THE NEW TIME TRAVELERS: A Journey to the Frontiers of Physics

DAVID TOOMEY

H.G. Wells' classic 1895 novel *The Time Machine* sparked the imaginations of millions of people. Among them were a handful of scientists who took Wells seriously and decided to explore the possibility of time travel. Einstein's theory of relativity posits that time travel to the future is impossible. But what about traveling to the past? Toomey recounts scientists' efforts to explore the notion of time travel and the conditions under which it would be possible. Among the scientists are an American, Kip Thorne, who in 1985 proposed that time travel might be possible through worm holes, and Igor Novikov, a Russian who in 1979 showed that a traveler to the past could not alter it. These and similar hypotheses about time travel soon began to appear in well-respected journals, and they even became the topic of discussion at a 1992 workshop for physicists held at the Aspen Center for Physics. Toomey ends by considering some perennial questions about time travel, none of which is more tantalizing than the following: If inventing a time-travel machine is indeed possible, why hasn't anyone ever seen a time traveler? ***Norton, 2007, 391 p., b&w plates and illus., hardcover, $25.95.***

DON'T TRY THIS AT HOME: The Physics of Hollywood Movies

ADAM WEINER

Many of the sequences in today's action movies, which feature such escapades as driving a car on an asteroid, drilling to the core of Earth, or surviving a horrific crash with little more than bumps and bruises, leave the viewer asking one question: "Is that really possible?" In a book that will appeal to movie buffs and physics students alike, Weiner offers humorous insights into the physics behind famous action scenes in movies such as *Mission: Impossible*, *Star Wars*, and *Armageddon*. Also a primer on basic physics, the book introduces such topics as Newton's laws, the conservation of momentum and energy, circular motion, thermodynamics, and quantum mechanics. Within this context, Weiner then explains the physics at work in various movie scenes and reveals what is possible and impossible. The book concludes with additional film reviews and a brief look at physics in popular fairy tales and cartoons. ***Kaplan, 2007, 264 p., b&w illus., paperback, $17.95.***

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LETTERS

Risk reversal?

"Diabetes drug might hike heart risk" (*SN: 6/23/07, p. 397*) reports 86 heart attacks among 15,560 rosiglitazone (Avandia) users, versus 72 others in a control group of 12,283. A study coauthor then says that "after statistical adjustment, that yields a 43 percent higher risk of heart attacks among rosiglitazone users." Simple arithmetic would seem to indicate it was the *control* group that had a slightly higher risk.

VINCENT FECHER, SAN ANTONIO, TEXAS

The study reported was based on data from diverse trials. Simply adding all the numbers to reach a risk calculation would require that the studies be identical in design. Since they were not, scientists had to account for various differences. But it's fair to say that the results appear counterintuitive. —N. SEPPA

Let's be careful

"Crossing the Line: Technique could treat brain diseases" (*SN: 6/23/07, p. 387*) describes attaching a drug molecule to a molecule from the rabies virus that enables the drug to cross the blood-brain barrier. This suggests a possible danger if the ability to produce the molecule could be transferred to the genomes of disease organisms in the wild. If the field of genetic engineering for drug production doesn't already have guidelines to cover such risks, now might be the time to develop them.

KENNETH TIMONER, EDINA, MINN.

By the book

Your review of Alex Vilenkin's book *Many Worlds in One: The Search for Other Universes* (*SN: 6/30/07, p. 411*) contained an often-made error. In Guth's inflation model, during the first "zillionth of a second," the universe did not inflate "to cosmic scale." It inflated to about the size of a large grapefruit. Then it began its slow expansion.

MARTIN GARDNER, NORMAN, OKLA.

Gems with impact

With respect to the article on kimberlites, diamonds, and mantle fractures ("A Gemstone's Wild Ride," *SN: 6/30/07, p. 412*), may I suggest that the fractures in question emanate from hypervelocity bolide impacts on Earth. There is ample spatial correlation between impact craters formed by oblique impacts with crustal-fracture systems that propagated outward along the direction of impact.

GREGORY C. HERMAN, NEW JERSEY GEOLOGICAL SURVEY, TRENTON, N.J.

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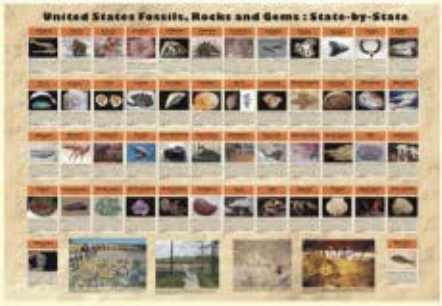
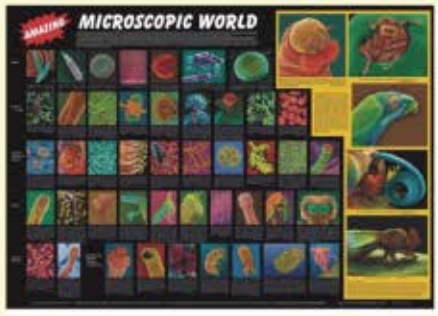


United States Fossils, Rocks and Gems: State-by-State Poster - The United States Fossils, Rocks and Gems State Poster (state-by state) has all 50 states *state fossils, state rocks, and state gems* shown with information and picture available for each. Features 54 images about state fossils, state gems, state stones/ rocks, and minerals. Featured National Parks include: Clayton Lake State Park, New Mexico; Crater of Diamonds State Park, Arkansas; Dinosaur National Monument, Utah; and The Mammoth Site Museum, South Dakota. Information about many other national parks is included. Great in-color pictures with plenty of interesting description. This poster should be in every earth science classroom, national park gift shop, natural history museum, and science center. Comes with info sheet. Size: 26" X 38" Laminated, Copyright 2007 ***Order #JPT-8012, Cost $24.95***



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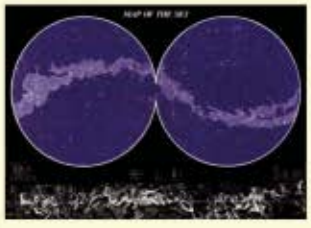

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