

SCIENCE NEWS

THE WEEKLY NEWSMAGAZINE OF SCIENCE

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opening up the stent debate
beyond the brain barrier
resurgence of river blindness?
building a better biofuel

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**a look in
the eye**

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Cover A series of flights by heavily instrumented aircraft into the heart of Hurricane Rita (seen here on Sept. 21, 2005), as well as missions into Katrina and Ophelia earlier that year, has yielded new insights into how hurricanes evolve. (J. Desclotres/NASA Goddard Space Flight Center) [Page 392](#)

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Crossing the Line

Technique could treat brain diseases

For the first time, scientists have selectively ferried a drug across the blood-brain barrier to treat a neurological disease in mice. The new method could eventually make new treatments possible for a wide range of brain disorders, such as Alzheimer's disease.

The walls of capillaries that carry blood into the brain control whether molecules larger than a few hundred atoms, such as antibodies and proteins, can pass into the spaces between neurons. This capillary barrier can stymie doctors' efforts to cure neurological diseases because most medicines can't get through.

However, some viruses, including rabies, have molecules that trick the barrier into allowing them to pass. Researchers attached a molecule from the rabies virus to a drug and found that the coupled molecules got through the capillary walls and into the brain. A drug delivered in this way kept 80 percent of mice infected with Japanese encephalitis alive for at least 30 days, while all of the experiment's untreated mice died, the scientists report online and in an upcoming *Nature*.

"I think the potential [of this technique] is enormous," says Manjunath Swamy, senior researcher for the group at the Immune Disease Institute at Harvard Medical School in Boston.

The molecule from the rabies virus acts as a key that corresponds to keyhole molecules on the surfaces of the capillary walls. When a key nestles into a keyhole—called a nicotinic acetylcholine receptor—the key molecule triggers a poorly understood process that moves it through the wall, carrying the drug with it.

"This [research] has enormous ramifications for many neurological-disease categories," comments Robert H. Brown, a neurologist at the Massachusetts General Hospital in Boston. The drug molecule used by the researchers is a kind of RNA

that can block the activity of a gene. These RNAs, called short-interfering RNAs (siRNAs), can be custom tailored to target virtually any disease-causing gene or protein. Scientists are developing siRNAs to treat Alzheimer's, Huntington's, and Parkinson's diseases, among others.

Currently, the only way to get an siRNA into a mouse's brain is by direct injection. Other techniques for overcoming the blood-brain barrier exist, but they involve opening the barrier to all large molecules in the blood, not just the desired drug molecules.

Many questions remain before the new technique can be used on people, scientists say, such as whether some regions of the brain receive more of the drug than others and whether a person's immune system might eventually neutralize the rabies molecule. —P. BARRY

Mapping a Medusa

The Internet spreads its tentacles

After enlisting the help of thousands of volunteers to track how digital information weaves around the world, researchers can offer a new simile: The Internet is like a medusa jellyfish. It has a dense core surrounded by a highly connected body, from which tentacles dangle.

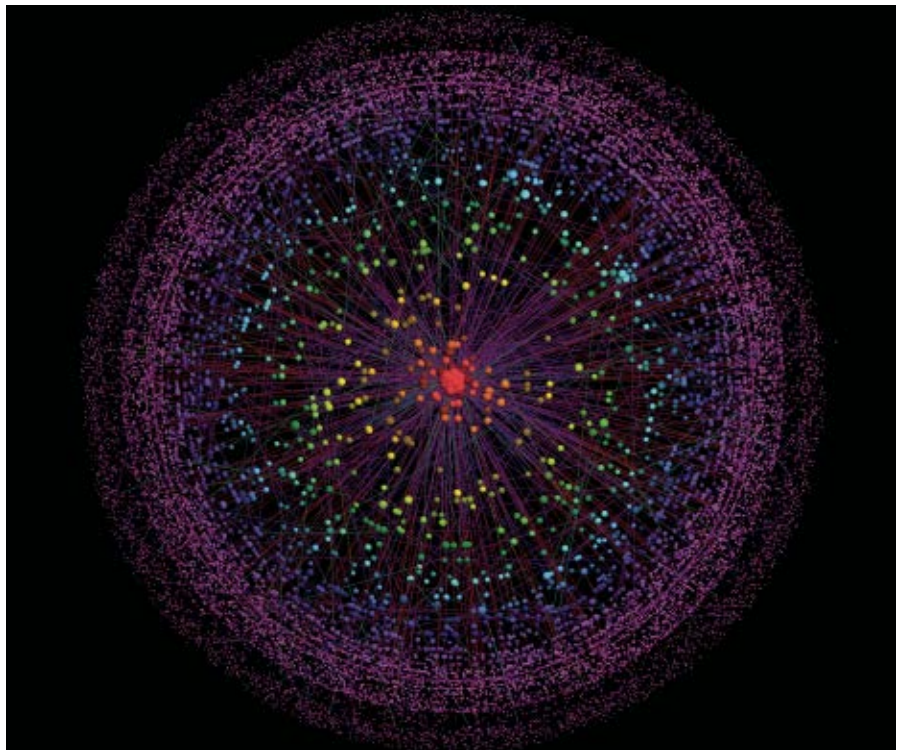
Because the Internet has grown hap-

hazardly, its structure has been mysterious. It began when universities, government agencies, and a few companies linked their internal computer networks to share information. New groups have kept joining ever since, with no central authority organizing the process. An e-mail sent today may pass through as many as 30 subnetworks before reaching its destination.

To map the physical structure of the Internet, researchers send packets of information as probes to various target locations. The probes report back on the subnetworks they pass through. Until now, most such probes have been limited by being launched from a small number of sites, usually universities in the United States. Data from the probes emphasize links close to the starting sites and miss links between remote sites. The resulting distortion was so great that "there was a growing opinion before [the new] study that you really couldn't measure the Internet," says Scott Kirkpatrick of the Hebrew University in Jerusalem.

To overcome the bias in the older studies, Kirkpatrick and his colleagues recruited volunteers to install software that would send out probes from more than 12,000 computers worldwide.

The researchers describe the Internet as being like a jellyfish because they found that it has three layers. Forming the core are the 100 or so most tightly connected subnetworks, including groups such as Google and AT&T Worldnet. The rest of the jellyfish's body consists of a much larger group of subnetworks that are highly connected to one another and to the core. The remaining sub-



CHARTING A COURSE A new map of the Internet shows a core containing the most tightly connected subnetworks (red), while the least-connected subnetworks lie at the edge (purple).

networks, about 20 percent of the total, can communicate with the outside world only by passing information through the core. They form the jellyfish's tentacles. The findings appear online and in an upcoming *Proceedings of the National Academy of Sciences*.

Previous maps had suggested a somewhat similar structure but had sliced the Internet differently, identifying the most important links in the network as those that connect to the greatest number of subnetworks.

The new effort instead ranked each subnetwork by counting the number of routes connecting it to the core of the Internet. The resulting map has a larger number of subnetworks, especially non-U.S. sites, in its core. It also shows that 80 percent of subnetworks can communicate with each other through links that don't pass through the core, suggesting that the Internet is less vulnerable to outages or attacks than researchers had previously thought.

The new method may hint at properties fundamental to many different kinds of networks, says Alessandro Vespignani of Indiana University in Bloomington. Preliminary work shows that networks as diverse as interacting proteins and airline traffic have similar structures under this analysis. "You see a universality that is puzzling and also exciting," he says. —J. REHMEYER

Warning Sign

River blindness parasite shows resistance

The worm that causes river blindness appears to be developing resistance to the sole drug that's effective against it, a study in West Africa shows. The finding is bad news in the fight against this parasite, *Onchocerca volvulus*, which infects roughly 37 million people worldwide.

The river blindness parasite spreads among people bitten by certain black flies that live near fast-flowing water. The worms can survive inside a person for 15 years. The female worms produce larvae that cause itchy skin and scarring of the cornea, which leads to blindness.

Since 1987, widespread use of the drug ivermectin has stalled river blindness in many countries. The once-a-year tablet doesn't kill adult worms living in a human host, but it wipes out larvae and hampers the females' ability to reproduce.

In Burkina Faso, whole villages had moved

from fertile river valleys to avoid the scourge, says parasitologist Roger K. Prichard of McGill University in Montreal. Since the introduction of ivermectin, many villagers have been able to move back, he says.

People in nearby northern Ghana have also benefited from the drug, but Prichard and his colleagues in Canada and Ghana have now found evidence of ivermectin resistance. The drug's effects are waning markedly in several Ghanaian villages that have received ivermectin treatment for 10 to 17 years, the researchers report in the June 16 *Lancet*.

To gauge whether ivermectin is working, the researchers obtained tiny skin samples from infected people after their annual treatment. In most of the 20 communities sampled in Ghana, these tests showed little sign of *O. volvulus* larvae.

In four villages, however, many skin samples contained significant numbers of larvae 90 days after ivermectin treatment, and the parasite's presence increased over the ensuing months.

Scientists had seen hints of ivermectin resistance, "but it's always been from anecdotal reports," says immunologist Eric Pearlman of Case Western Reserve University in Cleveland. "This is the first solid documentation."

Despite the evidence, there remains a chance that the parasites may not be devel-

oping resistance, says immunologist Thomas B. Nutman of the National Institute of Allergy and Infectious Diseases in Bethesda, Md. Rather, it's possible that some people don't absorb enough of the drug to fully fend off the parasite, he says.

In either case, he says, "there needs to be an additional hit, whether it's a second drug or a vaccine. This study makes the case [for] having an additional weapon."

Certain antibiotics can kill a microbe inside the worm that contributes to eye damage and keeps the worm fertile. Combining an antibiotic with ivermectin may be a useful strategy (*SN: 6/17/00, p. 389*). Unfortunately, the best available antibiotic is doxycycline, which patients must take daily for 4 to 6 weeks. Mass compliance with such a regimen would be poor, says Prichard. —N. SEPPA

Needling Cells

Stem cells could take their cues from silicon nanowires

The ability to make new heart muscle from a patient's own stem cells is a dream for many cardiologists. By growing stem cells on a bed of silicon needles, researchers may



Winged dragon

A quarry on the Virginia–North Carolina border has yielded fossils of an unusual, gliding reptile that lived in the region about 220 million years ago. Depicted here, *Mecistotrachelos apeoros*, which in Greek means "soaring and long necked," presumably spread a long, membrane-covered set of ribs to glide from tree to tree, says Nick C. Fraser, a paleontologist at the Virginia Museum of Natural History in Martinsville. The resulting aerodynamic surfaces gave the 25-centimeter-long reptile the 30-cm wingspan of a modern-day cardinal. Remains of the creature were encased in rock so hard that the bones couldn't be extracted without damaging them, says Fraser. He and his colleagues revealed the fossils by doing computerized tomography scans of the rocks surrounding the bones, the scientists report in the June *Journal of Vertebrate Paleontology*. —S. PERKINS

K. CARR

have found a way to give the cells a push in the right direction.

Peidong Yang of the University of California, Berkeley and Bruce Conklin of the Gladstone Institute of Cardiovascular Disease in San Francisco have succeeded in growing mouse and human stem cells that are pierced by silicon nanowires—conducting structures that could give the cells an electrical nudge to spur their development.

Researchers suspect that stem cells require a series of biochemical, mechanical, or electrical signals to form different types of tissue (*SN*: 3/6/04, p. 155). It's unclear, however, what mix of cues is necessary to produce any given outcome.

Since heart-muscle cells are electrically active, Yang and Conklin wanted to develop a technique that might enable them to electrically stimulate individual stem cells to become cardiac cells.

Yang's group used chemical-vapor deposition to create an array of vertically aligned silicon nanowires, tipped with gold, on a silicon surface. Each wire measured, on average, 90 nanometers wide and 6 microns high.

Next, the team deposited embryonic stem cells from mice onto the bed of nanowires. The wires penetrated the cells without any prompting by the researchers. "Embryonic stem cells are very sensitive to their environment," says Conklin. "The main purpose of the experiment was to see if the cells would remain alive."

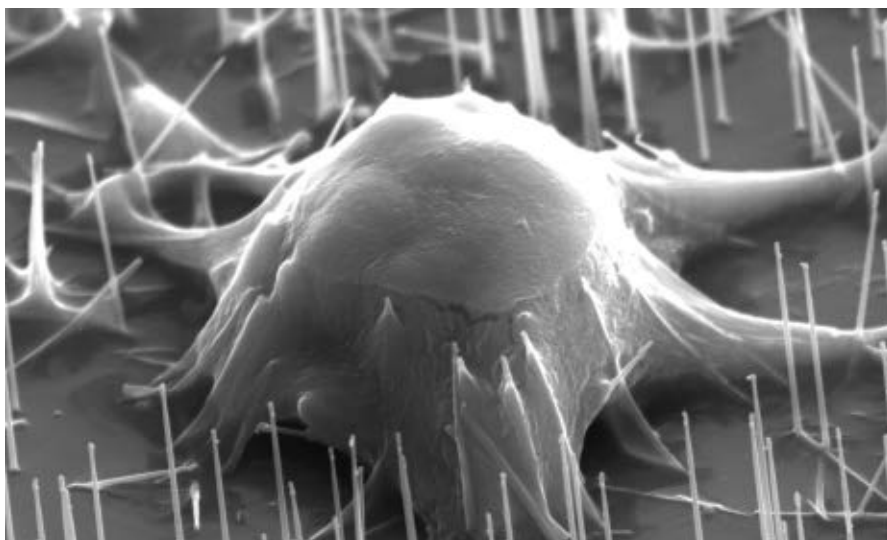
Indeed they did. When the researchers placed mouse embryonic cells that had already begun to differentiate into heart muscle cells onto the bed of needles, the cells continued to develop normally. In fact, they grew on the surface and continued to beat for up to a month, Yang and Conklin report in the June 13 *Journal of the American Chemical Society*.

The technology "has exciting potential," says Timothy McKnight, a bioengineer at Oak Ridge (Tenn.) National Laboratory. Researchers could insert biomolecules—genes and proteins—inside the cells by tethering the molecules to the wires, he adds.

As a proof of concept, Yang and Conklin showed that they could introduce bits of DNA into human embryonic kidney cells. Unfortunately, most of the DNA molecules stayed on the wires. Changing the method of binding DNA to the wires could fix that, the researchers say.

"Nanowire arrays are not ... representative of anything that really happens in nature," says Conklin. "But they might allow us to push the cells in new directions."

The next step will be to use the conducting nanowires to monitor the electrical activity of stem cells and to attempt to control their differentiation into cardiac cells. There are half a dozen different types of heart-muscle cells, each with its own spontaneous beating rate, says Oscar Abilez of Stanford University School of Medicine. He



ACCURATE PUNCTURE A mouse embryonic stem cell stays alive while pierced by silicon nanowires that could carry electrical pulses that prod the cell's development.

is also growing stem cells on nanowire arrays but has not yet published his findings. Turning stem cells into various types of heart muscle might require using different electrical signals, he suggests. —A. GOHO

Beyond Ethanol

Synthetic fuel offers promising alternative

DMF may not yet be a household name, but thanks to newly improved production processes, this biofuel may some day prove even better than ethanol as a sustainable alternative to gasoline.

Plant-derived biofuels such as ethanol offer renewable-energy alternatives to fossil fuels. Their use could help reduce carbon emissions and greenhouse-gas generation.

Currently, the global leader in biofuel production is Brazil, which focuses on converting energy-rich sugarcane into ethanol. Meanwhile, corn-to-ethanol plants, which are less efficient, are popping up across the midwestern United States.

Even ethanol from sugarcane, however, is far from ideal. A gallon of ethanol yields less energy than a gallon of gasoline, resulting in lower automobile mileage. Moreover, producing ethanol from sugar is slow and inefficient. As in wine and beer making, ethanol plants use yeast fermentation to brew the fuel from sugary liquids. Unfortunately, this process can take several days.

Chemists have long known about a synthetic alternative fuel called 2,5-dimethylfuran, or DMF. Like ethanol, DMF can be derived from sugars, but it has a 40 percent higher energy density, says James Dumesic, a chemical engineer at the University of Wisconsin–Madison. That means

cars could get at least as many miles per gallon of DMF as they get from gasoline.

Until now, DMF production has largely been confined to the lab. Typically, acidic catalysts are used to strip oxygen off either of two types of sugar, glucose or fructose, producing an intermediate compound known as 5-hydroxymethylfurfural (HMF). Extracting the HMF has been cumbersome, however. "If you leave it in water, it tends to react with the sugar that's still there," Dumesic says.

Now, Dumesic and his colleagues have developed a technology that could extract HMF efficiently enough to make DMF an attractive alternative to ethanol.

The team describes its two-step process in the June 21 *Nature*. First, the researchers added salt along with the acidic catalyst to a solution of sugars in water. They then exposed the watery mix to a second fluid, a hydrocarbon. The HMF quickly transferred into the hydrocarbon, in which it dissolved more readily than in water. Crucially, the presence of salt sped up the process by making the water more hostile to the HMF.

In the second step, the scientists mixed HMF with hydrogen and a copper-ruthenium-based catalyst. The hydrogen stripped two more oxygen atoms off HMF, producing water and DMF.

It should be relatively easy to apply the new technique on an industrial scale, says Dumesic. Before DMF can be mass-produced, however, further research is needed to explore its toxicity and potential environmental impact, he adds.

The new process is an "interesting piece of technology," says Lanny Schmidt of the University of Minnesota in Minneapolis. Using catalysts rather than fermentation could dramatically speed and simplify the conversion process, resulting in lower costs, he notes. Conrad Zhang of the Pacific Northwest National Laboratory in Rich-

land, Wash., calls the technique “an important step toward a usable, liquid transportation fuel.” —D. CASTELVECCHI

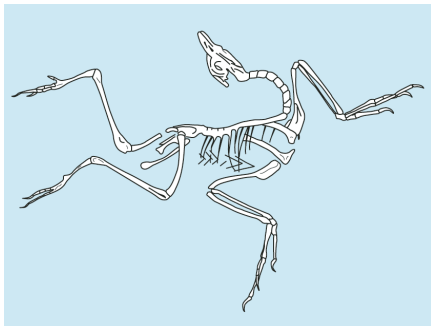
Jurassic CSI

Fossils indicate central nervous system damage

Many animal fossils appear in a head-thrown-back position called the “dead-bird” pose, which paleontologists traditionally attribute to rigor mortis, desiccation of the carcass, or the shifting of bones by water currents. Now, scientists report that the posture probably came about because dinosaurs or other animals died of central nervous system damage. Fossils of nearly all birdlike *Archaeopteryx*, as well as some *Tyrannosaurus rex* and other ancient creatures, exhibit the curious pose.

Study coauthor Cynthia Marshall Faux, a paleontologist at the Museum of the Rockies in Bozeman, Mont., who is also a veterinarian, has seen the same pose in many modern animals with central nervous system damage. She says that the posture, called opisthotonus, is common in animals suffering from brain injury or from oxygen deprivation, known as hypoxia. Bacterial infections such as meningitis and toxins from certain algal blooms (*SN*: 5/4/02, p. 275) can also send animals into opisthotonus.

“The pattern we see here with dinosaurs, pterosaurs, and mammals, is consistent with the problem of hypoxia causing trauma to the nervous system,” says study coauthor Kevin Padian, curator of the Museum of Paleontology at the University of California, Berkeley.



CAN'T ... BREATHE Fossils of *Archaeopteryx*, such as the specimen sketched here, are typically found in the “dead-bird” pose, which indicates death from central nervous system damage.

Faux and Padian argue that in a skeleton moved by water currents, limbs should lie in the same direction as the head and tail. To test whether rigor mortis could have deformed ancient remains, the researchers examined the movement of large, dying birds at a raptor-care center. The birds exhibited no change in position as the post-mortem muscle and skeletal changes set in.

Contortion of the skeleton from muscles and tendons drying and pulling at the joints also failed to explain the pose. The carcasses of red-tailed hawks left to dry in Styrofoam “peanuts” showed no movement after 3 months. Beef tendons pinned to a piece of Styrofoam didn’t shrink enough to dislodge the pins.

“The same principles applied back then as they do now,” Faux says. Since desiccation couldn’t produce the same posture in modern animals, she notes, “it didn’t seem to fit the scenario for drying out a *T. rex*.”

The researchers argue instead that animals found in the dead-bird pose died that way and were buried rapidly, so the posture remained undisturbed.

Scientists use the position of fossilized bones to infer the environment in which the animal perished. The new findings, which appear in the spring *Paleobiology*, give paleontologists a snapshot of the creatures’ last moments.

“What’s useful about this particular study is they’ve countered [traditional explanations] with real information, not just arguments,” says Matthew Carrano, curator of dinosauria at the Smithsonian Institution’s National Museum of Natural History in Washington, D.C. “It allows us more of a window into understanding how the dinosaurs died.” —C. BARRY

Profiles in Courtship

Flirting male fish show their best sides

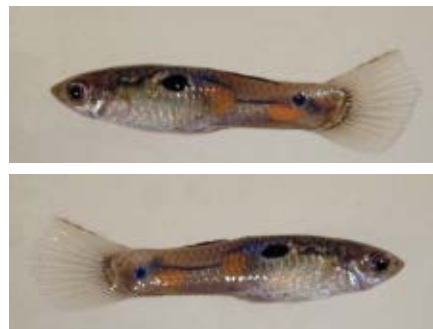
Male guppies sporting a tad more orange on one side of their bodies than on the other tend to flash that better side at females.

That’s the conclusion of a new study of asymmetric male guppies flirting with females in adjoining tanks, says Mart R. Gross of the University of Toronto. In reaction to a dead female suspended in a tank, males in a neighboring tank still courted but didn’t favor their good sides.

There’s something about a live female’s response that encourages a male to show the most orange, Gross and his colleagues report online in the *Proceedings of the Royal Society B*.

Gross says that the test’s emphasis on behavior is unusual for an experiment con-

cerning what biologists call fluctuating asymmetry. Such studies generally explore minor differences between the two sides of an organism that show up in all but Hollywood-perfect individuals. A 1992 test involving barn swallows suggested that females prefer males with the most-symmetric tails. Although evidence since then has been mixed, some theorists have proposed that high levels of symmetry indicate a prime physical specimen in many animal species.



BOTH SIDES NOW A male guppy shows slight differences between the alluring orange patches on either side of his body.

“Research has focused on preference for symmetry in the opposite sex but has ignored what individuals that are asymmetric actually do about it,” says Gross.

To check for effects of asymmetry, he and his colleagues worked with lab guppies descended from fish collected in Trinidad. The researchers observed courting fish for periods of 10 minutes, noting whether a female showed interest by crowding close to the side near a male’s tank. Every 15 seconds, the researchers noted which side of his body the male was displaying.

The researchers photographed their 53 males and analyzed the digital images. Males received a score for their total amount of orange on each side and how symmetrical their coloring was.

“The females were not interested in symmetry,” concluded Gross. “They were looking at orange.” The more, the better.

This insight helped researchers make sense of male displays. The 26 males with more-than-average symmetry displayed their very slightly better sides only 49 percent of the time.

The 27 males with pronounced lopsidedness, however, showed their good sides 60 percent of the time.

Gross says that the study challenges the idea that an organism can’t respond to its own asymmetry. Evolutionary biologist Stefan Van Dongen of the University of Antwerp in Belgium says the possibility that animals can hide symmetry flaws “is something to take into account when designing experiments.” He adds, however, that he’d like to see a test of whether male guppies showing their better sides father more offspring. —S. MILIUS

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

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STORM CENTER

A detailed look inside the core of a hurricane

BY SID PERKINS

Flying an aircraft through a hurricane is risky business, even if the plane is specially equipped for the job. In the hurricane's eye, skies are clear and calm prevails, but in the ring of intense storms surrounding the eye—the eyewall—rain falls in thick sheets and winds gust to 300 kilometers per hour.

In 2005, despite those perils, the pilots of three “hurricane-hunter” planes flew repeated missions into the cores of the monster storms Katrina and Rita as well as the much tamer Ophelia. During the missions—collectively dubbed the Rainband and Intensity Change Experiment, or RAINEX—scientists on board the instrument-laden aircraft collected unprecedented data on the structure, configuration, and interaction of clouds within the massive hurricanes. Probes dropped from the planes garnered additional information.

In one case, the aircraft were the first ever to encounter and directly observe a ring of intense thunderstorms just outside the storm's eyewall. Such secondary eyewalls, which appear to have significant effects on hurricanes' strengths, had often been detected by satellites and radar but had never been seen in the fine detail achieved during RAINEX.

Analyses of data from that encounter may enable researchers to identify the features within a hurricane that most affect the storm's intensity. With that information in hand, meteorologists could do a far better job of forecasting wind speed and ocean surge as a storm approached land. Also, scientists say, the new techniques that RAINEX researchers employed on shore to coordinate hurricane hunters' flights could transform how such missions are flown.

INQUIRING MINDS Whenever meteorologists announce a new tropical storm or hurricane, two questions immediately arise: Where's the storm headed? and How strong will it be when it gets there?

“The first question is by far the easier of the two,” says Hugh E. Willoughby, an atmospheric scientist at Florida International University in Miami. The path that a hurricane takes depends largely on prevailing weather patterns throughout the surrounding region, including factors such as the strength, configuration, and movement of high- and low-pressure areas. Recent improvements in forecasting hurricane paths stem primarily from enhancements in

the computer models used to predict weather in general, he says.

Meteorologists gauge the accuracy of path predictions by their “track error”—a measure of how far off its predicted line a hurricane's eye wanders, explains James Franklin, a forecaster at the National Hurricane Center in Miami. In the 1970s, the average track error in the 3-day forecasts for hurricanes and tropical storms was 700 km. So far this decade, 3-day forecasts have missed the mark only by 300 km on average, he notes.

Predictions of hurricane intensity haven't improved nearly as much. In the past 2 decades, errors in the National Hurricane Center's 2- and 3-day forecasts for wind speeds within hurricanes and tropical storms have dropped only a couple of kilometers per hour. That's because computer models that aim to represent hurricanes must pack data points close together to accurately simulate the

small-scale, rapidly evolving features that swirl around the core of a storm. If a computer model has weather-data points spaced no closer than 5 km apart, for example, the theoretical storms it portrays turn out to be “larger, weaker cartoons of their counterparts in nature,” says Willoughby.

“It's critical for forecasters to get a hurricane's track right, but it's an even bigger challenge to predict the strength of its winds,” says Bradley F. Smull, a research meteorologist at the University of Washington in Seattle.

Accurate wind forecasts are vital for several reasons. As well as directly affecting how much damage

a storm inflicts on structures, wind speed dramatically influences the height of a hurricane's storm surge, the mound of water its winds push ashore. However, hurricanes are notorious for their sudden, and sometimes severe, variations in intensity.

Some of the factors behind such changes are well understood, says Willoughby. For instance, three of the four hurricanes that struck the Gulf Coast in 2005—Dennis, Katrina, and Rita—intensified as they passed over the Gulf of Mexico's Loop Current, whose warm waters provided a ready source of energy for the storms. Rita strengthened from category-1 status (wind speeds between 121 and 153 km/hr) to category-5 (sustained winds exceeding 250 km/hr) in less than a day.

Then there are murkier influences on storm intensity, such as the interactions between thunderstorms immediately surrounding a hurricane's eye and those arranged in bands that, seen from space, lend hurricanes a pinwheel appearance. The dearth of information about such interactions led researchers to propose the 2005 RAINEX missions, which ended up differing from previous hurricane-hunter flights in several ways, says Robert A. Houze Jr., an atmospheric scientist at the University of Washington in Seattle.



REGAINING STRENGTH — Rita (seen here on Sept. 23, 2005) suddenly lost intensity when bands of thunderstorms coalesced to form a secondary eyewall, but winds intensified again before the hurricane struck land on Sept. 24.

First, one of the three aircraft deployed during each RAINEX mission was equipped with a type of Doppler radar that hadn't been used before inside hurricanes. The system has two antennas that look in slightly different directions and take measurements at a faster rate than normal Doppler radar does. The result is a high-definition look at clouds.

Second, information from the three aircraft was transmitted during the mission to earthbound scientists, who combined it with data from satellite images and ground-based radar to create a composite map of the storm.

Third, the ground team ran high-resolution computer simulations of the hurricane, which the scientists then used to direct the pilots toward parts of the storm where interesting features were present or likely to appear. "Using this technique, the pilots aren't flying blind," says Houze. He, Smull, and their colleagues described the experiments and their findings in the March 2 *Science*.

DESTRUCTIVE TRIO The RAINEX missions targeted hurricanes Katrina, Ophelia, and Rita, a trio of storms that certainly offered the scientists variety.

Katrina, which reached peak strength while over the Gulf of Mexico on Aug. 28, 2005, was a category-5 storm and the fourth strongest on record for the North Atlantic basin. After Katrina's eye moved off the Loop Current and over cooler waters, the hurricane weakened to category-4 status. Sustained winds at landfall measured about 200 km/hr.

Ophelia, which formed just east of Florida in early September, alternated several times between tropical storm and hurricane status as it wobbled its way slowly up the Atlantic Coast. With top winds of 140 km/hr, the hurricane never exceeded category-1 status.

Rita, one of the storms that strengthened to exceed Katrina, put on the best show for researchers in late September. Immediately after a single-day growth spurt to category-5 level, the hurricane underwent a strength-sapping process called eyewall replacement. That's just the kind of sudden intensity variation that RAINEX scientists were hoping to observe at close range, says Houze.

Meteorologists know in general terms how hurricanes typically evolve. The thunderstorms that ring a hurricane's eye are usually more intense than storms elsewhere in the system. The warm, humid winds that fuel these thunderstorms spiral toward the center of the hurricane at low altitude, says Willoughby. When that soggy air reaches the eyewall, it rises and some of its moisture condenses out as rain. The energy released during that process heats the air further and causes it to rise even faster. By the time the air has risen to the tops of the eyewall clouds, where air temperatures are normally 100°C cooler than they are at the ocean's surface, condensation has wrung all of the moisture out of the air.

But sometimes this circulation is interrupted, as it was inside Rita while it was still far out over the Gulf of Mexico. In that hurricane, thick bands of thunderstorms sweeping toward the eye coalesced to form a ring of storms about 20 km outside the eyewall. "The processes that occur during the formation of such a secondary eyewall aren't well understood, but their effects are clear," says Houze.

First, the thunderstorms in a secondary eyewall grab much of the humid air that's headed eyeward. That robs the inner eyewall

of fuel, which causes the thunderstorms there to weaken overall. Instruments dropped into the region between Rita's inner and outer eyewalls revealed that the air there was warmer and much less humid than expected, says Houze. That meant less condensation of moisture in the clouds of the inner eyewall, further stifling precipitation in the thunderstorms there.

Eventually, as Rita approached the western portions of the Gulf Coast, the inner eyewall collapsed completely. "In 12 to 24 hours, it was gone," says Houze.

Before the secondary eyewall formed, Rita's top winds raged at about 275 km/hr. After the thunderstorms in the inner eyewall had subsided, wind speeds in the secondary eyewall measured only 180 km/hr or so. Soon, however, the eye began to contract, and wind speeds picked up again. This process—in which an inner eyewall breaks up and an outer eyewall then draws inward to take its place—is what meteorologists call eyewall replacement.

Guided by ground-control personnel, the pilot of a RAINEX aircraft equipped with the high-definition Doppler radar flew through the moat between Rita's inner and outer eyewalls. During that 3-hour mission, the aircraft made at least one complete circuit of the moat, says Houze. The researchers discovered that the doughnut-shaped region wasn't simply a void where nothing was happening. Instead, the air everywhere inside the moat was moving downward. "It's not just a passive region that's stuck between two eyewalls," he notes.

The high-resolution data gathered during the RAINEX missions could improve scientists' simulations of hurricanes, says Willoughby. For example, meteorologists might be able to better estimate how external influences, such as ocean temperatures, and internal influences, such as cloud interactions, affect a storm's strength.

TIMING IS EVERYTHING

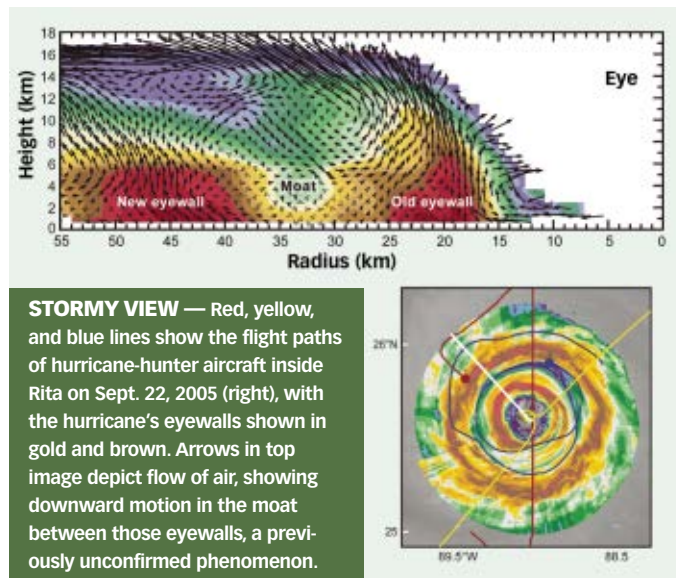
The unpredictability of a hurricane's hour-to-hour strength—especially as affected by still poorly understood phenomena such as development of a secondary eyewall—hobbles forecasters. Incorrect estimates of the timing and magnitude of such changes can result in inadequate storm warnings that can cost lives. The trick is in knowing what a hurricane's strength will be at or near its landfall.

Many storms suddenly intensify just before they strike land. Notable examples include Hugo, which slammed into South Carolina in 1989, and Charley, which raked across Florida in 2004.

In 1992, Andrew completed an eyewall replacement shortly before it struck Florida's Miami-Dade County as a category-5 storm. In contrast, other storms have unexpectedly weakened just prior to landfall—1999's Floyd, for example. Over the course of several days, a couple of eyewall replacements shrank the hurricane from near-category-5 status, transforming Floyd into a category-2 hurricane that caused more flooding than wind damage.

The RAINEX missions of 2005 may serve as a model for future hurricane-hunter flights, says Houze. "Focusing future aircraft observations in the same way should make it possible to identify small-scale areas in a storm where the processes that affect intensity are occurring," he notes.

Willoughby agrees, noting that the data gathered in such targeted missions could yield new insights into hurricane behavior. "We haven't solved all of the problems [of hurricane forecasting] in the past few years, but we've made a lot of progress," he notes. ■



STORMY VIEW — Red, yellow, and blue lines show the flight paths of hurricane-hunter aircraft inside Rita on Sept. 22, 2005 (right), with the hurricane's eyewalls shown in gold and brown. Arrows in top image depict flow of air, showing downward motion in the moat between those eyewalls, a previously unconfirmed phenomenon.

STENTS STUMBLE

Enthusiasm wanes for drug-coated artery tubes

BY BRIAN VASTAG

At a cardiology meeting in Stockholm 6 years ago, attendees witnessed what seemed to be the birth of a new era in treating heart disease. In the first large study of drug-coated stents—tiny mesh tubes that prop open clogged arteries—all the implanted arteries stayed open. The data were so stunning that after French researcher Marie-Claude Morice presented the study results, audience members stood and applauded.

“I remember it well,” says Robert Harrington of Duke University Medical Center in Durham, N.C. “You don’t see people get a standing ovation at a scientific meeting. There was this tremendous hope that we had finally beat it.”

The “it” was restenosis, the re-narrowing of arteries propped open by stents. Caused by tissue growing on the stent like moss invading a hollow tree trunk, restenosis is the main drawback of non-drug-coated, or bare-metal, stents. It leads to repeat procedures in about 30 percent of patients with those devices.

The dramatic data that Morice, of the Institut Cardiovasculaire Paris Sud, presented in Stockholm showed that 6 months after implantation of stents coated with drugs that inhibit tissue growth, an astonishing zero percent of arteries had reclosed. “We are probably witnessing a new revolution in the treatment of coronary disease,” Morice announced to the packed hall.

After the drug-coated stents gained regulatory approval in Europe in 2002 and in the United States in 2003, cardiologists eagerly adopted them. Soon, 90 percent or more of all implanted stents were of the drug-coated variety. Today, some 4 million to 6 million people worldwide carry them.

But now, interventional cardiologists are sitting on their hands.

A series of setbacks has thrown the field into turmoil. In 2004, researchers first reported seeing potentially deadly blood clots in patients who had undergone stent insertion a year or more earlier. Large studies later confirmed that finding. This April, another study showed that oral drug therapy may be just as good as stent implantation in treating mild artery blockage. Also in April, researchers reported that in patients with severe arterial disease, drug-coated stents offered no benefit over heart-bypass surgery.

A growing chorus of cardiologists and other observers now complains that hype outstripped evidence for drug-coated stents. They

say that the devices were too often used on high-risk patients with severe coronary artery problems who should have undergone heart-bypass surgery instead.

The Food and Drug Administration stepped in last December, calling a special meeting to consider safety issues. The agency is now working with the makers of the two approved drug-coated stents to strengthen packaging language—the FDA’s equivalent of handing out a speeding ticket.

Says Mark Eisenberg, a cardiologist at the Jewish General Hospital in Montreal: “I think the interventional [cardiology] community is completely confused at this point.”

DELAYED CLOTS In patients with coronary artery disease, the leading cause of death in the United States, fats and other detritus stick to the lining of the blood vessels supplying the heart. The disease first manifests as chest pain, but if the arterial plaques break free and block the vessel, a heart attack can follow.

Cardiologists often treat blockages that don’t critically limit blood flow with drugs that reduce cholesterol and prevent blood clots. In severe cases, they generally recommend bypass surgery to reroute the blood supply around the blocked vessels. In the 1990s, they began implanting bare-metal stents in arteries to keep them open.

After the restenosis problem became apparent, stent makers struck on a novel approach—coating the stents with drugs to prevent the tissue growth that causes restenosis. The two drug-coated stents on the market use cancer drugs—paclitaxel in one, sirolimus in the other—that kill fast-growing cells.

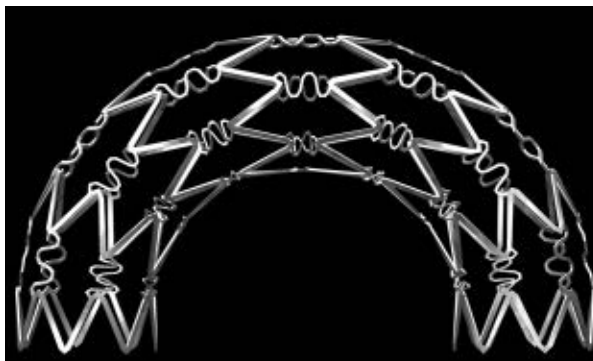
The first signs of trouble appeared in fall 2004, when a study in the

Lancet reported that four patients had life-threatening blood clots 11 months or more after receiving drug-coated stents. The report worried cardiologists because while blood clots sometimes appear in the first few days after implanting a stent, late blood clots in patients with bare-metal stents were virtually unheard of.

“There were increasing numbers of case reports of this, and it was a new phenomenon,” says Eisenberg. Research teams began monitoring stent patients over the long term. “We identified that, yes, in fact, this is a real issue [that] affects just the drug-eluting stents” and not the bare-metal stents, Eisenberg says.

This year in the Feb. 24 *Lancet*, a European team reported that blood clots continue to occur in patients up to 3 years after insertion of drug-coated stents. The study followed 8,146 patients and found that about 0.6 percent per year suffered life-threatening blood clots.

While the percentage of problems reported is small, the sheer vol-



BENT STENT — Mesh tubes coated with drugs to keep clogged arteries from reclosing are falling out of favor after they rocketed to popularity.

ume of people receiving the stents means that thousands of patients each year suffer blood clots that can lead to heart attacks and death.

Neal Kleiman, a cardiologist at the Methodist Hospital in Houston, says that he tries to keep the issue in perspective. "I think [concern] has been a little overblown.... I don't think [blood clots are] the principle risk in these people's lives."

The reports of late blood clots ignited a debate over how long to maintain patients on aspirin and clopidogrel (Plavix), both of which prevent clotting. The FDA-approved packaging for the stents calls for 3 to 6 months of anticlotting drugs, but many cardiologists are now keeping patients on the drugs for 12 months or more.

After the December meeting, the FDA acknowledged an acute need for more data but issued a statement maintaining that "concerns about thrombosis do not outweigh the benefits" of drug-coated stents when the stents are used for "approved indications."

And there's the rub. The agency approved the stents for only a specific group of low-risk patients—those with one small blockage in one artery. But according to two studies in the May 9 *Journal of the American Medical Association (JAMA)*, about half of patients who receive drug-coated stents do not fall in that category.

STENT WHO? Off-label use is common in medicine. Makers of a drug or device seek FDA approval for a specific condition, but once approval is granted, physicians are free to use the therapy however they see fit.

For drug-coated stents, "there was off-label use like you've never seen," says Michael J. Mack, director of the Cardiopulmonary Research Science and Technology Institute in Dallas. "I think this was mainly due to the marketing hype."

As soon as the stents were approved, cardiologists ventured into unknown territory, implanting stents in patients with serious disease even though physicians had no information on the suitability of the devices for those conditions. They stuck two stents end to end to treat long blockages; they stented V-shaped blockages at the juncture of two arteries; they restented arteries that had collapsed after earlier procedures; and they stented the large left-main artery, which supplies 75 percent of the heart's blood. They even triple-stented patients with three blocked vessels, a deadly serious condition formerly treated only by surgery.

"What surgeons have heartburn about in all this is that the increase in off-label use came at the expense of coronary-bypass surgery," says Mack, a surgeon. "It's all gone to drug-eluting stents without good evidence."

Not surprisingly, patients who receive stents for the more complicated off-label conditions fare worse than do their lower-risk peers, according to the two *JAMA* reports. The first report described a study of 6,993 patients. After a year, 4.3 percent of those receiving stents for the serious off-label conditions had died, whereas 2.6 percent of the on-label group had died. In the off-label group, the rate of blood clots at 1 year was twice as high, and about twice as many patients returned to the hospital for an additional stent or surgery compared with the results in patients with on-label conditions.

Despite this, report coauthor Charles Davidson, a cardiologist at the Northwestern University Feinberg School of Medicine in Chicago, says that "absolute rates of adverse events are low" and "the safety profile appears excellent" for all patients receiving drug-coated stents.

The second *JAMA* study, though, came to a more troubling conclusion. Drawing from a different database of 3,323 patients, the study found that within a year, 18 percent of patients with the most serious, off-label diseases had died, had a heart attack, or needed an additional stent or surgery. The figure for patients with on-label conditions was about 9 percent.

Kleiman, who coauthored the report, says, "Something is going on, and it may just be that these [off-label] folks are sicker. It may be that the drug-eluting stents carry more of a risk with them. Or it may be both."

WHO PAYS? As for why the second study reported a higher rate of bad outcomes than the first, Duke University's Harrington invokes sponsor bias. The first study, in which the authors conclude that the overall rate of negative events was low, was sponsored by Cordis, the division of Johnson & Johnson that makes drug-coated stents. Millennium Pharmaceuticals and Schering Plough Inc., makers of anticlotting drugs, paid for the second study, which found much higher rates of poor outcomes.

"If you're an [anticlotting-drug] manufacturer, it's in your best interest to demonstrate that the risk of these procedures is high, because you have a therapy that might lower that risk," Harrington says. "If you're a drug-eluting-stent manufacturer, it's in your best interest to show the procedures are very safe."

Whatever the true rate of poor outcomes in the on- and off-label groups, the use of drug-coated stents is down sharply this spring. Harrington says that at Duke, about 50 percent of implanted stents are now drug coated, down from about 90 percent last fall. Information from 400 hospitals across the United States shows that, in March, drug coated stents accounted for 73 percent of all stents implanted, down from about 90 percent last fall. "I think it's almost exclusively the late [blood-clot] issue," says Harrington.

But other stent skeptics cite an additional factor. A study in the April 12 *New England Journal of Medicine (NEJM)* showed that

patients with mild arterial disease fared just as well without stents as they did with them, as long as they took standard medication, including blood thinners and beta blockers. After almost 5 years, about 19 percent had died among patients who got stents and medication and among those who got medication alone.

Judith Hochman of the New York University School of Medicine says in an accompanying *NEJM* editorial that the study should be a clear signal to doctors to reduce stent implantation in patients whose arterial plaques aren't immediately life threatening. About 85

percent of stents are implanted in such patients.

Also in April, researchers at an American Heart Association meeting in Chicago reported that, in high-risk patients, drug-eluting stents offered no advantage over heart-bypass surgery. The study found similar rates of severe complications, such as heart attacks, in the first month after treatment. Death rates after 3 years were similar. Study leader James Wilson of the Texas Heart Institute in Houston says that the findings from the study, the first head-to-head comparison of bypass surgery and drug-coated stents, were "a bit of a surprise." Cardiologists had expected fewer complications from stents.

Adding to the glum news for cardiologists, this spring Johnson & Johnson halted a clinical trial of its next-generation drug-coated stent. Early data showed that the new stent didn't help patients any more than existing devices did, says the company.

However, a glimmer of hope appeared in the June 2 *Lancet*, where researchers report favorable early results for a new, biodegradable stent (*SN: 6/9/07, p. 356*). This stent disappears after a few months, and, though results are preliminary, cardiologists hope that the threat of late blood clots will vanish with it.

Every expert interviewed for this article expects the FDA to tighten monitoring of stents and to ask manufacturers of new devices to provide more data on a wider range of patients, such as those with more complex disease. Stent manufacturers have vowed to keep a closer eye on the safety of their products.

Observers predict a continuing decline in the use of drug-coated stents. Says Eisenberg: "This is one of those situations where we thought there was no downside. But now that there is a serious downside, even if the risk is tiny, most of us are very risk averse. So I need to be convinced now by hard data that a drug-coated stent is the right way to go." ■

"I think the interventional [cardiology] community is completely confused . . ."

— MARK EISENBERG,
JEWISH GENERAL
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BIOMEDICINE

Diabetes drug might hike heart risk

A popular prescription drug for type 2, or adult-onset, diabetes increases a person's risk of heart attack, an analysis of 42 clinical trials suggests.

The drug, called rosiglitazone or Avandia, is taken to lower blood sugar. The Food and Drug Administration approved the drug in 1999, and more than 11 million prescriptions were filled for it last year in the United States.

In the new analysis, researchers tabulated heart attacks among 15,560 people with diabetes who got rosiglitazone in various trials and 12,283 people who also had diabetes but didn't receive the drug.

There were 86 heart attacks in the rosiglitazone group and 72 in the control group. After statistical adjustment, that yields a 43 percent higher risk of heart attack among rosiglitazone users, says study coauthor Steven E. Nissen, a cardiologist at the Cleveland Clinic. He and his colleague Kathy Wolzki report the findings online and in the June 14 *New England Journal of Medicine*.

Philadelphia-based GlaxoSmithKline makes rosiglitazone. The company's chief medical officer, Ronald L. Krall, responded online in *Lancet* that the data show only rare heart attacks in the large patient populations analyzed. He argues that a close analysis of past and ongoing trials of rosiglitazone will acquit the drug.

The FDA has assigned a panel to reconsider the drug's approval. —N.S.

ARCHAEOLOGY

Ancient beads found in northern Africa

Excavations in eastern Morocco have yielded 13 perforated, pigment-stained shells that were probably strung together as some type of body ornament about 82,000 years ago, according to a new report.

The ancient finds, referred to as shell beads by Abdeljalil Bouzouggar of the National Institute of Archaeological and Historical Sciences in Rabat, Morocco, and his coworkers, come from snails of the same genus as do 75,000-year-old perforated shells previously discovered in South Africa. Similar shell

ornaments, not yet firmly dated, also come from sites in Algeria and Israel.

Bouzouggar's team found the Moroccan shell beads in 2002 in a cave called Grotte des Pigeons. Measurements of radiation in sediment and burned stone artifacts at the site produced the age estimate.

People either deliberately created holes in the shells or combed beaches for shells that already had large, circular gaps, the researchers say. Such shell openings rarely occur naturally, they note. Microscopic wear on the inside edges of the shell perforations indicate that the items were held on a cord of some kind. Red pigment on the shell beads apparently resulted from rubbing against pigment-coated hide, skin, or thread.

These discoveries suggest that people in Africa and southwestern Asia made beads long before their European counterparts started to do so, about 40,000 years ago, Bouzouggar and his colleagues argue. Even 80,000 years ago or more, shell beads carried some sort of symbolic meaning as well as aesthetic appeal for their makers, the scientists propose in the June 12 *Proceedings of the National Academy of Sciences*. —B.B.

ZOOLOGY

Moths mimic 'Don't eat me' sounds

Some moths defend themselves from hungry bats by mimicking the sounds of other, bad-tasting moths, according to new tests. This trick represents the first confirmed acoustic example of classic defensive mimicry.

The study's unpalatable moths, members of the tiger moth family, pick up noxious chemicals from plants that they feed on as caterpillars. A bat unwise enough to catch one of these moths typically spits it out fast.

When a bat swoops near, tiger moths make bursts of "click-click-click" sounds. A young bat hearing clicks and then snagging a vile mouthful learns to avoid the moths, according to earlier work by William E. Conner at Wake Forest University in Winston-Salem, N.C.

To see whether other moths could protect themselves by mimicking those clicks, Jesse Barber, also at Wake Forest, raised bats

from babyhood in large, netted enclosures where he could control when they first encountered various prey.

At some point, he included clicking, unpalatable tiger moths among the nightly flying snacks. After 5 nights, all the bats had learned to avoid that species. Then Barber substituted a different tiger moth species. A few bats sampled the newcomers before avoiding them, but the majority avoided them from the outset.

In another experiment, Barber offered milkweed tussock moths to 10 bats. These moths click, but they're palatable. Three bats discovered that the new moths were edible, but the other seven didn't catch on.

That means clicking works both as Müllerian mimicry (two unpalatable species benefiting by making similar sounds that predators can

learn by catching either one) and Batesian mimicry (edible prey borrowing an "unpalatable" signal), says Barber. The work appears in the May 29 *Proceedings of the National Academy of Sciences*. —S.M.

EARTH SCIENCE

Tree rings tell tale of megadroughts

Analysis of tree rings in timber from the Colorado Plateau indicates that the region experienced a 60-year drought in the 12th century, a dry spell that eclipses any deficiencies in rainfall the area has suffered in the past century.

Previous reconstructions of the region's climate using tree rings stretched back only to 1490, says Connie A. Woodhouse, a climatologist at the University of Arizona in Tucson. Those studies used data gathered from living trees, but she and her colleagues have extended that time line back to A.D. 762 by matching up the ring patterns in ancient tree trunks found throughout the upper reaches of the Colorado River. "It's so arid that wood can remain on the landscape for hundreds of years" without rotting, she notes.

Two prolonged droughts are prominent in the new record, the researchers report in the May 28 *Geophysical Research Letters*. The team estimates that midway through the deeper drought, which stretched from 1118 to 1179, the flow vol-



HOLE IN ONE An 82,000-year-old shell, one of 13 found in a Moroccan cave, contains an opening that allowed it to be suspended, perhaps as part of a necklace.

ume in the Colorado River ran below average for 13 consecutive years. In comparison, droughts in this region during the past century have resulted in lower-than-average river flows for no more than 5 years in a row, says Woodhouse. —S.P.

MATERIALS SCIENCE

Heal thyself—again and again

A new material can repair repeated damage at the same spot without assistance from external factors such as heat or pressure, a team of chemists and engineers reports.

The team had previously created self-healing materials by encapsulating a healing agent in pockets set just below their surfaces. A crack in the material would rupture some of the pockets, allowing the healing agent to flow into the fissure. There, the agent would encounter an embedded catalyst that would cause it to harden and repair the breach (*SN*: 2/17/01, p. 101).

In such a material, however, “if the dam-

age [repeatedly] occurs in the exact same location, you only have a finite volume of healing agent,” says Nancy Sottos of the University of Illinois in Urbana-Champaign.

In the new material made by Sottos and her colleagues, a three-dimensional network of microscopic capillaries replaces the pockets. The capillaries can bring additional healing agent to a location where repeated damage has drained the initial supply, Sottos says. The team’s work will appear in an upcoming *Nature Materials*.

For now, the material can repair itself only seven times at the same location before the catalyst is either deactivated or buried in the “scar tissue” of previous healing cycles. Sottos and her colleagues are already testing a more advanced system in which two capillary networks separately deliver healing and hardening agents into a crack. —S.W.

ZOOLOGY

Clownfish noisemaker is new to science

Researchers have figured out how clownfish make “pop-pop-pop” noises at each other. The secret turns out to be an unusual tooth-clacking mechanism that scientists had never before documented.

Plenty of fishes make noises, explains Eric Parmentier of the University of Liège in Belgium. Most species either scrape bones together or vibrate air-filled swim bladders.

Those mechanisms don’t generate sound with the right frequencies or other qualities to explain the noises of the clownfish *Amphiprion clarkii*, says Parmentier. These striped reef fish chirp or pop during courtship or daily life around the reef, or when an intruder looms.

To study the sounds in that last scenario, Parmentier and his colleagues worked with Michael Fine of Virginia Commonwealth University in Richmond. The lab team combined a high-speed video camera with X-ray equipment and recorded the fish’s bone movements at 500 frames per second, 20 times the speed of a typical movie.

When a male clownfish sees an intruder, he opens his jaws and then lifts his head, causing unusual ligaments to snap the jaws shut. The popping sound comes from the front teeth smacking together. The researchers tested the idea by sabotaging the ligament. When its jaw couldn’t snap shut, the fish was mute, they report in the May 18 *Science*.

Fish have evolved diverse ways of making sound, says Parmentier, and he predicts that the cichlids that he’s studying now use yet another mechanism. —S.M.

MEETINGS

American Society of Clinical Oncology
June 1 – 5
Chicago, Ill.

GENETICS

New player in cancer risk

A newly discovered category of RNA could play an important role in cancer, researchers announced.

This new RNA type is distinct from microRNAs, snippets of genetic material that are also known to influence a person’s risk of developing tumors. The discovery presents an unexplored form of genetic involvement in cancer that could lead researchers to a better understanding of the disease, says George Calin of the M.D. Anderson Cancer Center in Houston. The new, as-yet-unnamed RNAs “are involved in cancer to the same degree as microRNAs,” he says.

The conventional role of RNA is to translate the code in DNA into proteins, which in turn do most of the work in a cell. Like microRNAs, this new class of RNA is not involved in manufacturing proteins, but instead influences the activity of other genes.

Calin and his colleagues found that about 10 percent of patients with colo-

rectal cancer or leukemia had mutations in one of the new RNAs. Among people without cancer, none had the same mutations, showing a strong link between the mutations and cancer risk. “These are another class of noncoding RNAs that could be involved in cancer predisposition,” Calin says. “This, I think, is an important idea for understanding the genetic basis of familial cancers.” —P.B.

IMAGING

Fluorine highlights early tumors

A new technique utilizing microscopic, fluorine-packed particles can vividly show small, cancerous growths that don’t appear in standard medical imaging. Finding cancer early can improve a patient’s chances for survival, but small tumors can be difficult to see with scanning techniques such as magnetic resonance imaging (MRI).

For the new tagging procedure, scientists first wrap droplets of fluorine-containing liquids in a layer of fat molecules. These nanoparticles, as the researchers call them, are about 200 nanometers across, roughly one-thirtieth the size of a red blood cell. The particles include surface molecules engineered to bind only with cancer cells. Injected into cancer-bearing mice, the particles selectively cluster onto tumors.

In an MRI machine, fluorine emits a strong signal with a characteristic frequency. Tuning the MRI equipment to that frequency creates a clear image of the tumor without showing surrounding tissues.

“So now we’re not imaging the protons or water in your body [as MRI customarily does], we’re imaging the fluorine that’s in this nanoparticle. And that’s important because it’s a unique signature with no background,” says Samuel A. Wickline of the team that created the technique at the Siteman Center of Cancer Nanotechnology Excellence in St. Louis. Scientists had used fluorine-based MRI to track drugs in the body, but no one had ever used fluorine and targeted particles to image cancer, he adds. —P.B.

Books

A selection of new and notable books of scientific interest

DO DOLPHINS EVER SLEEP? 211 Questions and Answers about Ships, the Sky and the Sea

PIERRE-YVES BELY AND SALLY BELY

Pierre-Yves Bely has taken many trips across the Atlantic and Pacific Oceans. Along the way, the engineer had plenty of time to ponder the ocean surrounding him. This book compiles answers to 211 intriguing questions about the ocean. They include, "How does the wind create waves?" "Why are sunsets usually more colorful than sunrises?" "Why are cold seas green and warm seas blue?" and "Why do some people get seasick?" The selection introduces readers to ocean-related phenomena that they may not have been aware of, including the fact that thunderstorms rarely form over seas. Sally Bely, Pierre-Yves' wife, translated this edition from French. *Sheridan House, 2007, 294 p., color images, paperback, \$19.95.*

THE PLANT FINDER: The Right Plants for Every Garden

TONY RODD AND GEOFF BRYANT

With small print and hefty size, this book carries a wealth of information on more than 5,000 plants that are suitable for gardens. Rodd, a horticultural botanist, and Bryant, a New Zealand-based horticultural writer and photographer, provide 10 chapters of comprehensive information on trees and shrubs, annuals and perennials, bulbs, corms and tubers, grasses, sedges and bamboos, fruit trees, nut trees, other fruits, vegetables and herbs, climbers and creepers, cacti and succulents, orchids, ferns, palms, and cycads. Each chapter opens with at-a-glance listings of information, such as climate, the presence of showy foliage or scented flowers, and other attributes for each species to be described. Each plant is then profiled regarding the amount of sunlight needed for optimal growth, frost tolerance, and physical features. Each genus description also provides tips for cultivation and blooming periods. *Firefly, 2007, 992 p., color images, hardcover, \$49.95.*

THE ECONOMIC NATURALIST: In Search of Explanations for Everyday Enigmas

ROBERT H. FRANK

Many principles of economics, like those of other social sciences, are best understood in terms of familiar scenarios, not equations or formal theories. Frank, a professor of economics at Cornell University, explains how many real-world conundrums, such as why drive-up ATM machines have braille dots, can be explained by economics. (The answer is that it's cheaper to make the same machine for both walk-up and drive-through ATMs). Frank addresses a different category of such quirks of modern life in each chapter. Topics include the eco-

nomics of product design, such as why milk is sold in rectangular containers while soft drinks come in cylindrical ones. The author enlists the concept of supply and demand to explain why dry cleaners charge more for women's shirts than for men's. Other topics include the divergence between individual and group interests, the costs and benefits of property rights, the psychology of economics, and economic logic in personal relationships. *Basic, 2007, 226 p., b&w images, hardcover, \$26.00.*

THE CLOUDSPOTTER'S GUIDE

GAVIN PRETOR-PINNEY

Most people don't think about clouds, except to curse them for blocking the sun. Pretor-Pinney, however, celebrates the fluffy white forms and even the dark gray ones. Founder of the Cloud Appreciation Society, Pretor-Pinney provides the tools that every fledgling cloud spotter needs to identify the 10 main cloud varieties. Each chapter is devoted to a particular type of cloud and includes a "How to Spot" chart. Divided into sections devoted to low, middle, and high clouds, this field guide to the sky includes such details as that cumulonimbus clouds are ferocious storm producers, that altocumulus lenticularis clouds look like UFOs, and that cirrostratus clouds have a tendency for form halos. Finally, the author describes his voyage to Australia to view the cloud spotter's ultimate goal, a cloud known as the morning glory, which can stretch as far as 600 miles across the sky. *Penguin, 2006, 320 p., b&w images & color plates, paperback, \$19.95.*

THE LAST HUMAN: A Guide to Twenty-Two Species of Extinct Humans

G.J. SAWYER, VIKTOR DEAK, ET AL.

We take for granted that we are the only human species on Earth and that the same would have been true for our ancestors. But over the past 6 million years, 22 other hominid species have stridden the planet upright, and some of them lived at the same time. This book is the result of collaboration among physical anthropologist Sawyer, paleoartist Deak, and six other anthropologists and technicians. The result offers a glimpse of what most, if not all, human ancestors may have looked like. With the help of modern imaging technology and the latest paleontological research, the authors re-created muscle, glands, skin, and hair over casts of fossils and then placed the reproductions in mock environments. The fossil evidence for the work is mainly from skulls discovered at archaeological sites around the world. The text accompanying these images describes what scientists hypothesize would have been a day in the life of each species, emphasizing similarities to conditions of modern-day humans. The book also explains how skull fragments and teeth suggest other skeletal features as well as what these creatures ate, how they walked and stood, where they lived, and how they behaved. *Yale, 2007, 256 p., color images, hardcover, \$45.00.*

LETTERS

Bad start

In "Violent Justice: Adult system fails young offenders" (*SN: 4/21/07, p. 243*), an association is found between young offenders being tried as adults and increased criminal offenses later. The implication is made that one thing causes the other. Perhaps a better interpretation of the data would be that, because not every young offender is treated as an adult, the system is good at picking the ones that need it the most. Not every association tells you that one thing causes the other.

STEPHEN WOOD, ORLANDO, FLA.

When making a decision as to whether a minor should be tried as an adult or a juvenile, the seriousness and nature of the crime should be the overwhelming consideration. Murder or violent crimes are properly tried in adult courts, but there's a gray area for robberies. I am sure that if the statistics for future criminal activity for those minors convicted in adult or juvenile courts are analyzed, the lesser the crime the greater the likelihood that the juvenile offender will be hurt by being in the adult system.

NELSON MARANS, SILVER SPRING, MD.

The researchers report that juvenile offenders remanded to the adult justice system were 34 percent more likely to be arrested for a subsequent charge than those who were kept within the juvenile justice system. How did the researchers control for the tendency to reserve adult-court referral for the worst offenders?

PAUL BADE, MANKATO, MINN.

While I claim no expertise in the area, I have long held the belief that sending juveniles to adult prisons only allows their further education in criminal activity. However, the study as you presented it has a major flaw. Judges and courts in general do not allow the designation of juveniles as adults without strong evidence that they are likely unrecoverable. Thus, the rate of recidivism would be expected to be higher than for youths who committed similar crimes but were not sentenced to adult prisons.

BOB PRATT, FORT DAVIS, TEXAS

The studies used statistical controls for criminal history and other factors that influence decisions to transfer juvenile offenders to the adult system. —B. BOWER

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