SCIENCE NEWS of the week

Drug Wards Off Sickle-Cell Attacks

Federal officials announced this week the first drug therapy that prevents the painful attacks of sickle-cell anemia, an inherited blood disorder that in the United States afflicts mostly blacks of African descent.

Claude Lenfant, director of the National Heart, Lung, and Blood Institute (NHLBI) in Bethesda, Md., called it "the first effective treatment for this serious illness."

The huzzahs for the drug, hydroxyurea, stem from data collected in an NHLBI-sponsored, multicenter test of its effectiveness. Although scheduled to continue until May 1995, the drug trial was called off on Jan. 14, after a group of independent scientists determined that interim results offered compelling evidence of the drug's value. NHLBI's decision to halt the study means that physicians can now offer all patients the option of hydroxyurea treatment.

Investigators at 21 medical centers across the United States began the trial by recruiting 299 people with moderate to severe sickle-cell disease. All the volunteers were age 18 or older and had experienced at least three sickle-cell crises in the year prior to enrollment. Half the recruits received hydroxyurea; half got an inactive substance, or placebo.

The interim results revealed a dramatic benefit from drug therapy. Daily treatment with hydroxyurea reduced by half the number of sickle-cell episodes.

People with this disorder suffer periodic attacks in which their red blood cells form a characteristic crescent shape. An abnormal hemoglobin, or pigment, in these cells lies at the root of the problem. After releasing the oxygen they carry, hemoglobin molecules are supposed to remain separate. But in sickle-cell anemia, they form rigid rods that prevent the red blood cell from remaining pliable.

These sickle-shaped cells then clog the body's small blood vessels and block the distribution of life-giving oxygen, an exceedingly painful event that can cause organ damage.

Until now, doctors had to rely on palliatives such as painkillers and blood transfusions to treat symptoms of the disease. But these measures didn't attack the underlying problem.

"The patients treated with hydroxyurea also required about 50 percent fewer blood transfusions during the study," noted study chairman Samuel Charache of the Johns Hopkins University School of Medicine in Baltimore. In addition, the drug significantly reduced a complication of the disease in which patients develop severe chest pain and fever, he said.

Researchers don't fully understand why hydroxyurea works. But they suspect it boosts the body's supply of fetal hemoglobin, a type of hemoglobin produced by fetuses and newborns that does not form stiff rods inside red blood cells. Normally, adults make only tiny amounts of this variation of hemoglobin.

The Food and Drug Administration has already approved the drug as a treatment for polycythemia vera, a disease in which the body makes too many red blood cells. Thus doctors can now prescribe hydroxyurea for their patients even though the compound has yet to pass FDA muster specifically as a treatment for sickle-cell disease.

However, researchers offered patients a warning. "Hydroxyurea is not a cure," Charache says. "It has beneficial effects, but they last only as long as the patient continues to take the prescribed dose."

They also caution that not every sickle-cell patient should get the drug, which can cause serious side effects.

"Hydroxyurea is a cytotoxic agent," Charache says, noting that it has been linked with leukemia in some polycythemia vera patients. In addition, the trial collected data only on adult patients. For now, scientists advise against giving the powerful medication to children. — *K. Fackelmann*

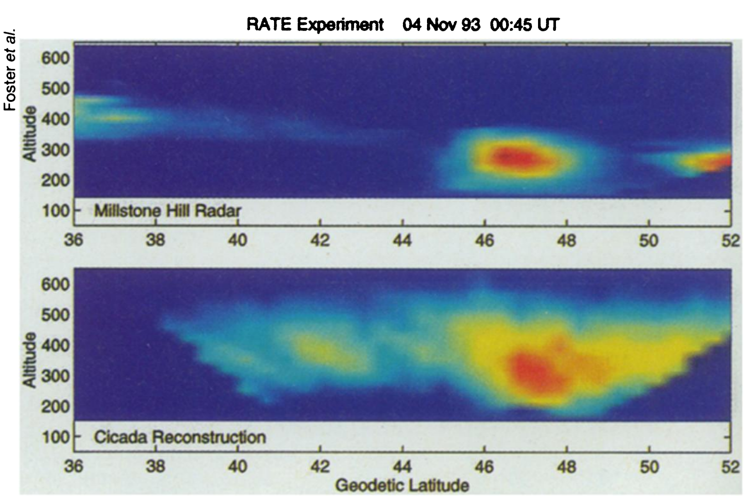
Mapping stormy weather in the ionosphere

Solar outbursts can roil Earth's ionosphere, rapidly changing the distribution of electric charge at high altitudes. In turn, these disturbances can damage orbiting satellites, disrupt radio communications, and cause harmful surges in electric power lines.

Although researchers have long used radar to study storms and other features of the ionosphere, they have lacked the tools needed to monitor and map it on a regular basis. A recent experiment has now furnished important data that will help scientists develop and refine a novel technique for producing global "weather" maps of the ionosphere.

Known as radio tomography, the technique involves the reconstruction of the three-dimensional distribution of ionospheric electric charge from its effect on radio signals sent from orbiting navigation satellites to ground-based receivers. It requires the same kind of mathematics used in medical tomography to construct three-dimensional X-ray images of biological tissue.

"Radar systems are too costly to build and run to do long-term, global monitoring of the upper atmosphere," says John C. Foster of the MIT Haystack Observatory in Westford, Mass. Radio tomography offers a relatively inexpensive way of achieving such coverage.



Both radar observations (top) and a Russian tomographic reconstruction based on radio signals from a Cicada satellite (bottom) delineate key features of dramatic fluctuations in the concentration of charged particles in the ionosphere.

To test the validity of ionospheric radio tomography, Foster, Vyatcheslav E. Kunitsyn of Moscow State University, Evgeny D. Tereshchenko of the Polar Geophysical Institute in Murmansk, Russia, and their coworkers set up a joint experiment to see how well tomographic reconstructions stack up against radar measurements. The project, called the Russian-American Tomography Experiment (RATE), also allowed them to compare rival mathematical schemes for constructing the images.

Over a 10-day period beginning Oct. 29, 1993, the researchers used pairs of portable radio receivers at various locations in North America to monitor signals from radio beacons aboard the Russian Cicada and U.S. Transit satellites. This period coincided with a severe ionospheric storm caused by a "solar bullet" of charged particles emitted by the sun.

"We predicted this event 3 or 4 months before it took place, so we scheduled our experiment to bracket it," Foster says. "We needed ionospheric structure — a real storm — to really test the method, and we got it."

Using computers, researchers created tomographic images of the ionosphere, which they compared with radar measurements made at the same time as the radio observations (see illustration). In general, the best mathematical algorithms presently available picked up the same ionospheric features seen in the radar data, though not the details.

"The tomographic algorithms developed by Kunitsyn and the Moscow group are the most sophisticated and most accurate I've seen," Foster contends. He and his colleagues describe the RATE project in the recently released Summer 1994 INTERNATIONAL JOURNAL OF IMAGING SYSTEMS AND TECHNOLOGY.

Several groups in the United States and elsewhere are working to develop computerized radio tomography into a viable method of mapping the ionosphere. At the same time, scientists studying the ionosphere have an unusually well documented storm to ponder.

— I. Peterson

New mixture takes the ache out of aspirin

Researchers may have found a new way to prevent the stomach pain many people get from aspirin — and to make the drug work better as well. Their solution, tested in rats, is not for the squeamish, however: They used aspirin mixed with a component of intestinal mucus.

Aspirin falls into a class of pain relievers called nonsteroidal anti-inflammatory drugs (NSAIDs). All tend to irritate the stomach or intestine, says physiologist Lenard M. Lichtenberger of the University of Texas Medical School at Houston. Buffered or coated tablets go down more easily, but they don't work as well.

Lichtenberger found in earlier work that NSAIDs seem to affect the slippery coating that protects the gastrointestinal tract lining from gastric acid. The coating, secreted by mucous cells, is topped off with a detergentlike molecule called a phospholipid.

In the February NATURE MEDICINE, Lichtenberger and his colleagues report that in the test tube, NSAIDs combine with this phospholipid. In the body, that could make the intestinal coating less resistant to water and acid.

To prevent this action, the researchers tried mixing the phospholipid and aspirin *before* they reach the stomach. Compared to rats given plain aspirin, rats fed this complex experienced much less gastrointestinal bleeding. The complex also proved "significantly more effective" at reducing fever and inflammation in the rats, the group reports.

Tests with other NSAIDs yielded similar results. "The activity of these complexes was at least as good as, and in almost all cases better than, the NSAID alone," Lichtenberger says. "The reason, we feel, is that the complexed NSAID is more lipid-soluble, so it can get across the [cell] membrane faster."

The phospholipid produced naturally in the body isn't cheap. But the Texas group got the same effect with a less expensive — and less revolting — phospholipid: soy lecithin, commonly sold in health food stores. Adding lecithin to aspirin "wouldn't prohibitively increase" its cost, Lichtenberger says.

Gastroenterologist Dennis McCarthy of the University of New Mexico School of Medicine calls the study "quite an important paper scientifically." But he cautions that the question remains whether the new preparation inhibits blood platelet clotting, a widespread use of aspirin.

Lichtenberger's group has already begun platelet clotting tests in rats. Next, they hope to try their tamed-down aspirin in humans.

— J. Kaiser

Deep-sea sponge reaches out, devours

Most people think sponges spend their days quietly sucking in and spitting out water, hoping to trap a few bacteria or some organic matter in their filters for dinner. A newly identified sponge may send this picture of passivity down the drain.

Jean Vacelet and Nicole Boury-Esnault of the Université d' Aix-Marseille II in Marseille, France, discovered a sponge that has evolved some, shall we say, unique characteristics in response to the scarcity of food in the relatively still waters of the deep sea, they report in the Jan. 26 NATURE.

"This remarkable sponge is effectively a carnivore," Michelle Kelly-Borges of the Natural History Museum in London notes in an accompanying editorial.

The sponge has developed filaments to capture small crustaceans. Minute, hook-shaped, pointy structures called spicules cover the moveable filaments and provide "a Velcro-like adhesiveness," the authors say.

Crustaceans, usually less than 1 millimeter wide, get trapped on the spicules. They struggle for hours to free themselves. Then new filaments grow over the prey, covering it completely in a day. Within a few days, the sponge digests its catch.

Most of this food is broken down within the sponge's body, but the filaments can digest little nibbles, Vacelet explains.

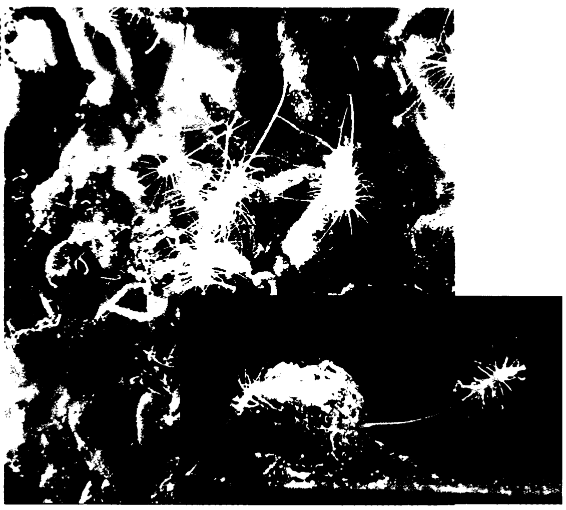
The as-yet-unnamed sponge belongs to the genus *Asbestopluma,* which normally resides in the North Pacific and North Atlantic at least 100 meters below sea level. Indeed, members of this genus live as far down as 8,840 meters. However, Vacelet and Boury-Esnault found their specimen a mere 17 meters below sea level, in a Mediterranean cave.

No one knows for certain how the sponge got there. Perhaps strong currents carried it from a deep-sea canyon. In any case, the cave had all the attributes of the deep sea: cold water, limited nutrients, and darkness, Kelly-Borges notes.

Researchers had suspected that deep-sea and shallow-water sponges had different systems for capturing their dinner. Scientists had even seen sponges with spicules. However, they knew little about the deep-sea dwellers or what the spicules did.

The cave discovery "made it possible to observe for the first time how sponges feed in such extreme environments," the French scientists report.

Vacelet



A carnivorous sponge in a cave in the Mediterranean Sea and (inset) in an aquarium engulfing crustaceans.

Normal sponges "are filter feeders *par excellence.* Their entire body is organized for filtering water, which is moved inside an aquiferous system by choanocytes," or pumping cells.

The new sponge has neither choanocytes nor a system for filtering water. "The definition of the phylum, based on the aquiferous system and . . . choanocytes, is now inadequate," Vacelet says.

— T. Adler