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SCIENCE NEWS

THE WEEKLY MAGAZINE OF SCIENCE

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losing game

CONCERNS ABOUT A BRAIN DISEASE

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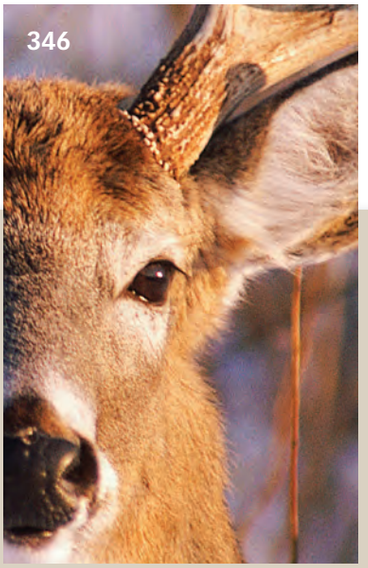

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Cover Chronic wasting disease, a fatal, once-obscure brain disease of wildlife, has turned up and made headlines in additional parts of the United States this year. Page 346

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Cosmic Couple

One galaxy, two gravitational beasts

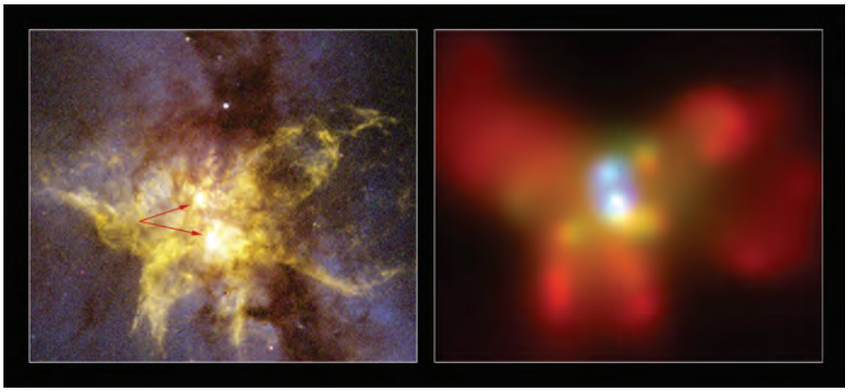
In a single galaxy, two massive black holes are spiraling toward each other in a gravitational dance that will end in a few hundred million years, when the black holes merge, astronomers report.

They had good reason to suspect there'd be such pairs. Accumulating evidence has revealed black holes in galactic centers and mergers of galaxies. So, it follows that some galaxies ought to have two black holes. "It was starting to become a little embarrassing that there was actually so little evidence of any [such] galaxies," says Roeland van der Marel of the Space Telescope Science Institute in Baltimore.

The new finding comes from NGC 6240, an extraordinarily bright galaxy only 400 million light-years from Earth. This galaxy is the product of an ongoing merger of two galaxies, a process characterized by distorted shapes and flailing loops and tails. The galaxy's relative proximity made it easy for the Chandra X-Ray Observatory, which has been orbiting Earth since 1999, to discern the two black holes in its center.

"It was a surprise," says Stefanie Komossa of the Max Planck Institute for Extraterrestrial Physics in Garching, Germany. She and her colleagues were drawn to NGC 6240 by its unusual properties, including its infrared brightness, strong X-ray emissions, huge concentrations of gas, and fast-moving stars. They conjectured that a single black hole could partially explain such characteristics.

However, studying NGC 6240 has been tricky. "It's very difficult to actually look at the very center of this galaxy because it is strongly obscured by clouds of gas and dust," says Komossa. Images obtained by the Hubble Space Telescope show two distinct bright spots, hinting at a binary black hole system. But it isn't possible from these visible-light images to tell whether the spots arise from the center or surface of the galaxy.



OPTICAL: VAN DER MAREL AND J. GERSSEN /NASA AND STSCI.; X-RAY: KOMOSSA ET AL./NASA, CXC, AND MPE

DOUBLE TROUBLE Hubble telescope optical image (left) shows two points of light (arrows) in galaxy NGC 6240. Chandra's X-ray image (right) indicates that each is a supermassive black hole.

With its X-ray vision penetrating the galaxy's center, Chandra has settled that issue. "X rays allowed [us] for the first time to zoom into the center of this galaxy," says Komossa. "These two very massive black holes emerged."

The finding, to be reported in an upcoming *Astrophysical Journal Letters*, supports the view that just as galaxies can grow by merging, so can black holes.

The X-ray emissions also indicate that the black holes are actively devouring interstellar matter around them. "Most galaxies have black holes that are inconspicuous," says van der Marel, who took the Hubble images of NGC 6240. He says that Komossa's team was fortunate to find a galaxy in which two massive black holes are both radiating large amounts of X rays.

As the two giant black holes in NGC 6240 bridge their 3,000–light-year gap and merge over millions of years, they will release intense radiation. They'll also emit powerful gravitational waves. These waves produce ripples in space and cause distances between points to fluctuate. After the Laser Interferometer Space Antenna, or LISA, is launched in 2008, it should detect these types of waves from black holes already merging.

Meanwhile, Komossa says her team will "look much deeper" into NGC 6240 and also search for binary black holes in similar galaxies. —C. MARZUOLA

Loony Tunes

Bugs blare in software set to music

Imagine a band playing "Here Comes the Bride" in the middle of a funeral dirge. It would be jarring, to say the least.

Now, British researchers are exploiting the attention-getting effect of musical flubs to highlight errors, or bugs, in computer programs. In a test of a new software-to-music scheme, student programmers found bugs more easily when they listened to melodies representing computer programs than when they used only conventional debugging techniques.

Software bugs cost some $60 billion annually in the United States alone (*SN: 7/20/02, p. 45*). One way to reduce that impact is to convert computer programs into music, propose James L. Alty of Loughborough University in Leicestershire and Paul Vickers of Northumbria University in Newcastle-upon-Tyne.

"We took a deliberate, structured musical approach," Vickers says. The goal was to convert software into familiar musical forms, such as classical or rock, that listeners would find easy to recognize and follow.

That's in contrast to previous attempts at software-to-music conversion in which researchers arbitrarily assigned musical notes to program instructions, he says. Those approaches resulted in unfamiliar, atonal forms of music.

In their work, Vickers and Alty composed brief melodies representing various commands in the Pascal programming language, though the technique could be applied to other languages, too. For the test, the British team translated only instructions that involve making a decision about which path the program will take.

To indicate the outcomes of decision commands, Alty and Vickers relied on standard features of conventional music. For instance, to represent two different processing paths, the researchers offered similar melodies in a major key for one path and in a minor key for the other. Samples can be heard online at http://computing.unn.ac.uk/staff/cgpv1/caitlin/phd1.htm.

To a programmer familiar with these motifs, a program becomes a musical score, Vickers explains. The programmer then detects bugs by noticing when the performance doesn't follow the expected musical flow.

"I consider it a good step forward for that general application," comments Gregory Kramer of Portland, Ore., a pioneer

and consultant in converting nonauditory information into sound.

However, Eric Somers of Dutchess Community College in Poughkeepsie, N.Y., questions how well the scheme would work for debugging even medium-size programs with thousands of lines of code. Vickers agrees it would be tedious. However, he expects programmers to use other techniques first to narrow the bug search to certain stretches of code.

In their test, Alty and Vickers gave eight programs to a group of computer science undergraduates and asked them to search for bugs, half the time with music and half the time without. With the musical assistance, students found about 20 percent more of the programs' bugs than they did using only conventional techniques. The researchers report their results in the December *Interacting with Computers*. —P. WEISS

Outside-In

Clearing up how cloud droplets freeze

A fresh look at old experimental data is threatening to overturn a longstanding theory about how water droplets freeze within clouds.

Suspended water droplets can remain liquid even when they and the air that surrounds them have temperatures far below the normal freezing point, says Azadeh Tabazadeh, an atmospheric chemist at NASA's Ames Research Center in Mountain View, Calif. Data collected in recent years show that clouds as cold as –37.5°C can still contain many supercooled droplets. Such droplets freeze solid almost instantly if they bump into each other or are otherwise disturbed.

Familiar as clouds are, the behavior of their constituent droplets remains only partly understood. This conceptual fog is particularly thick for conditions in which there aren't many particles in the air, says Tabazadeh.

Most scientists have long assumed that a tiny globule of pure, supercooled water, when disturbed, begins to freeze around an icy seed that suddenly forms inside it. According to this scenario, the time needed to freeze a given volume of water—say, 1 liter dispersed into a fine mist—is independent of the size of the individual droplets because the formation of a seed particle is a chance event.

SKY LIGHTS The ratio of ice particles to liquid droplets in a cloud affects how often the cloud spawns lightning and how much precipitation the cloud yields.

But the results of recent laboratory experiments, when combined with information garnered from tests conducted as many as 30 years ago, don't back up that scenario. Together, the data indicate that the time needed to freeze a given volume of supercooled water varies drastically—by a factor of up to 100,000—according to droplet size, says Tabazadeh. She and her colleagues report their analysis in an upcoming *Proceedings of the National Academy of Sciences*.

This extreme variation makes sense if freezing begins at the surface of the drops, not at the cores. Dividing a given volume of water into a large number of small droplets yields more total surface area than if the volume is split into a small number of large drops, Tabazadeh explains. The freezing rate would then depend on the surface area.

The laws of thermodynamics also argue against ice nuclei forming inside supercooled droplets, says Howard Reiss, a physical chemist at the University of California, Los Angeles and a coauthor of the new report.

When water molecules begin to assemble into ice crystals, they release large amounts of latent heat. If that process occurred in the center of a supercooled droplet, the heat would remain trapped within the globule, slowing the freezing process. But if crystallization begins at the droplet's surface, latent heat can more easily transfer to the surrounding air. In this case, the droplets are so cold that heat released internally as the crystallization proceeds probably wouldn't melt the developing ice, says Tabazadeh.

Lightning, rainfall, and other meteorological phenomena vary with the ratio of water droplets and ice particles in clouds, says Lawrence Hipps, a meteorologist at Utah State University in Logan. Linking freezing rates of clouds to those atmospheric and other climate processes is one of the most unreliable areas in current climate simulations, Hipps adds. "It's important to understand how clouds operate if we ever expect to model them," he says. —S. PERKINS

Lost That Smoking Feeling

Emotions sputter as cigarette motivator

Cigarette smokers have reported on many questionnaires that sadness, nervousness, and other unpleasant feelings prompt their tobacco intake. Many researchers have inhaled those accounts and argued that people continue to smoke cigarettes to quell nasty moods triggered by the first pangs of nicotine withdrawal.

It may be time for researchers to kick that habit. The first detailed effort to monitor the reactions of cigarette smokers as they carry out their daily activities finds that they light up at times when they feel neither better nor worse than at times when they don't begin smoking.

"I was very surprised at this finding," says psychologist Saul Shiffman of the University of Pittsburgh, who directed the new investigation. "It demonstrates the danger of relying only on people's beliefs about their past emotional reactions rather than tracking emotions from moment to moment."

Cigarette smoking showed a modest relationship to the presence of other cigarette smokers, a sense of restlessness, participation in leisure activities, and consumption of alcohol, food, and coffee, Shiffman and his coworkers report in the November *Journal of Abnormal Psychology*.

People were most likely to reach for a smoke when they reported a low-to-moderate rise in their subjective urge to smoke. The findings are consistent with past suggestions that cigarette smokers anticipate their nicotine urges and light up quickly enough to stay within a personal comfort zone, Shiffman says.

The research team monitored 304 cigarette smokers who had enrolled in but not yet started a smoking-cessation program. Volunteers, who ranged in age from 34 to 54, had smoked an average of 28 cigarettes daily for between 13 and 32 years. Nearly all were white and high school graduates, and most were female.

For 1 week, each participant pressed a key on a handheld computer to record every cigarette that he or she smoked. Each day on four or five occasions when volunteers were about to smoke, they responded to computer prompts by pressing keys to note their current emotional state, smoking urge, location, and activities.

The computer asked for the same information at four or five randomly selected times each day when the volunteers weren't lighting up.

Smoking restrictions in public places led to a decline but not an absence of cigarette use, Shiffman says. For 22 percent of all cigarettes consumed during the study, participants reported smoking in areas where smoking was either forbidden or discouraged.

Analyses of smoking and nonsmoking occasions in cigarette-tolerant settings yielded no evidence of a link between cigarette use and either negative or positive emotions.

These findings need to be confirmed among people who smoke fewer cigarettes per day and who don't want to stop smoking, Shiffman notes.

Scientists who study nicotine dependence are nonetheless intrigued by the implication that emotional responses exert little control over cigarette use by regular smokers. "I would have predicted exactly the opposite," says psychologist John R. Hughes of the University of Vermont in Burlington.

Still, Hughes adds, emotional reactions in particular social settings influence decisions both to start and to stop cigarette use.

Shiffman's results "are striking and deserve a lot of attention," remarks psychologist Timothy B. Baker of the University of Wisconsin–Madison. Smokers may respond unconsciously to subtle internal and environmental cues that prompt their lighting up, Baker suggests. In this way, they may avoid unpleasant feelings triggered by nicotine withdrawal. —B. BOWER

Worm Attacks

Invading earthworms threaten rare U.S. fern

In the ecological equivalent of the dreaded Klez Worm burrowing into computers around the world, European earthworms are eating enough leaf litter in North American forests to put a rare fern at risk of extinction.

An unusual study reports that the goblin fern (*Botrychium mormo*), an elusive species that pokes up from thick leaf litter on a forest floor, has disappeared from 9 out of 28 patches surveyed in Minnesota's Chippewa National Forest. Michael J. Gundale, now at the University of Montana in Missoula, also found that the normal forest carpet of fallen leaves was thin in all nine spots, and in eight of them, the forest floor was wriggling with the earthworm *Lumbricus rubellus*. In a lab test, these 3-to-4-centimeter-long worms proved capable of reducing a forest carpet to a balding remnant, Gundale reports in the December *Conservation Biology*.

S. MORTENSEN

ELUSIVE GOBLIN A rare fern in northern forests may be succumbing to invasions of alien earthworms.

"This is the first paper that looks at the response of a native plant to exotic, invasive earthworms," says Gundale.

Another chronicler of earthworm invasions, Patrick Bohlen of Archbold Biological Station in Lake Placid, Fla., welcomes the study. Although he and other scientists have studied what earthworms do to soil, "very little research has focused on the effects on plants," he notes.

North America north of a line from Massachusetts to Iowa has no native earthworms, Bohlen explains. Scientists presume that the last big glaciers creeping down from Canada wiped out any wormy ancestors, and southern species haven't advanced far into the territory.

When European settlers colonized the New World, earthworms came, too. Worms could have hitchhiked in soil used for ship ballast or in the root balls of plants. Even today, commercial bait worms escape their fate and take up residence around resorts.

Farmers have traditionally regarded earthworms as their friends because these burrowers aerate soil and can speed the release of nutrients as they eat fallen leaves. Bohlen says that his research shows that worms' effects on soil nutrients can get complicated.

Gundale suspected that earthworms could be quite a shock to a forest that hadn't hosted any for thousands of years. To see how forest plants might react, Gundale revisited sites where surveyors had found goblin ferns during the past 6 years. He found no significant link between disappearances of goblin ferns and the presence of a small exotic earthworm, *Dendrobaena octaedra*. However, the bigger *L. rubellus* was indeed associated with the disappearances. In places with this worm, the leaf litter was about half the thickness of the cushion in forest spots with no earthworms. In only 3 of the 11 sites with *L. rubellus* did the fern persist.

To determine whether worms could actually cause the thinning—instead of just moving into low-litter spots—Gundale raised worm colonies in buckets of leaves and soil in his lab. The earthworms did indeed consume the upper layer of litter and reduce it to castings that mixed in with the soil below.

These observations support the hypothesis that the ferns are dependent on a leafy cushion on the forest floor and "that the removal of this [layer] by exotic earthworms may lead to the extinction of this species," warns Gundale. —S. MILIUS

Predisposed to Trouble

Gene variants implicated in stomach cancer

Over the past 20 years, as scientists have established that the bacterium *Helicobacter pylori* causes ulcers, they've also linked the microbe to stomach cancer. A new study suggests that a person's risk of this malignancy can depend on the genetics of both the individual and the bacterium.

Scientists in Portugal report that among people with an *H. pylori* infection, those who carry certain variants of genes in the microbe and in their own cells face a substantially higher risk of stomach cancer

than do people without these variants. The study appears in the Nov. 22 *Journal of the National Cancer Institute.*

The human and microbial variants occur in genes known to orchestrate inflammation, says Martin J. Blaser of the New York University School of Medicine. The Portuguese findings "suggest that inflammation is really driving this [cancer] process," he says. Although the new study needs to be confirmed by larger trials and studies of other gene variants, he says, the work points to a synergy between microbial and human genetic variants.

The researchers analyzed genes found in *H. pylori* and blood samples taken from 221 people who had chronic stomach inflammation and 222 others who had undergone surgery for stomach cancer. The scientists examined variations in two *H. pylori* genes that influence inflammation—*vacA* and *cagA*. People carrying microbes with certain variant forms of at least one of these genes had a cancer risk up to 17 times as great as that of people without those variant forms.

The scientists then looked for variants in human genes dubbed *Il-1B* and *Il-1RN*. A person with both a high-risk microbial variant and one of certain human-gene variants was 7 to 87 times as likely to have stomach cancer as was someone without any of these variants, says study coauthor Céu Figueiredo of the University of Porto.

Earlier studies had identified high-risk *H. pylori* and human gene variants. The new study is the first to measure stomach cancer risk in light of both, Figueiredo says.

An infection with *H. pylori* often goes unnoticed. Some scientists estimate that this microbe lives in the stomachs of up to half the world's people, though no country does widespread screening for the infection. Doctors test for the microbe mainly in people who complain of ulcer symptoms.

People infected with *H. pylori* have a lifetime risk of stomach cancer three to six times that of uninfected people (*SN: 10/9/99, p. 234*). However, diet, chemical exposure, and other microbes probably also contribute to stomach cancer.

"If *H. pylori* eradication could be targeted to individuals who are infected by a more virulent *H. pylori* strain . . . such treatment could result in substantially reduced gastric cancer risk," says study coauthor José Carlos Machado, also of the University of Porto.

The work represents "a good first step" toward finding human gene variations that predispose people to stomach cancer, says Karen M. Ottemann of the University of California, Santa Cruz. Further research could eventually lead to procedures with which doctors could screen people to judge this cancer risk, she says. —N. SEPPA

Martian Radiation

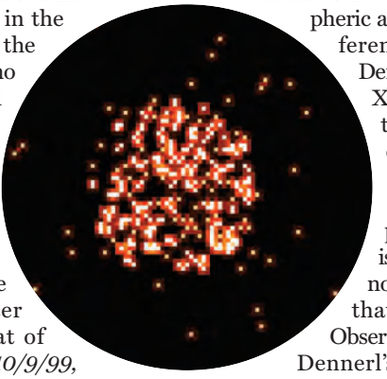
Giving off a faint X-ray glow

X rays from the Red Planet! That may sound like the title of a low-budget sci-fi flick, but it could actually be the label for a documentary. Using an Earth-orbiting telescope to record what Mars would look like if our eyes were sensitive to high-energy radiation, researchers have for the first time detected X-ray emissions from the planet.

Mars requires a partner to generate these rays. X rays from the sun induce the emissions when they interact with atoms in Mars' upper atmosphere. The atoms absorb the radiation and reemit it at a lower X-ray energy, a process known as fluorescent scattering.

The X rays come primarily from a region 90 to 160 kilometers above the Martian surface, reports Konrad Dennerl of the Max Planck Institute for Extraterrestrial Physics in Garching, Germany. He reports the findings in a mid-November issue of *Astronomy & Astrophysics*.

"With X rays, we have direct observational access to the upper Martian atmosphere, which is difficult to study by other means," he notes. Because each type of atmospheric atom fluoresces at a different X-ray wavelength, Dennerl says, "the Martian X rays contain information about the chemical composition of its upper atmosphere."



MARS IN A NEW LIGHT X-ray image of the red planet.

DENNERL/CHANDRA/ASTRONOMY & ASTROPHYSICS

Merely detecting the planet's faint X-ray glow is an accomplishment, he notes. During the 9 hours that the Chandra X-ray Observatory stared at Mars in Dennerl's study, the satellite recorded only about 300 X-ray photons. These Martian X rays show features similar to those that Chandra recorded from Venus' atmosphere (*SN: 12/8/01, p. 357*).

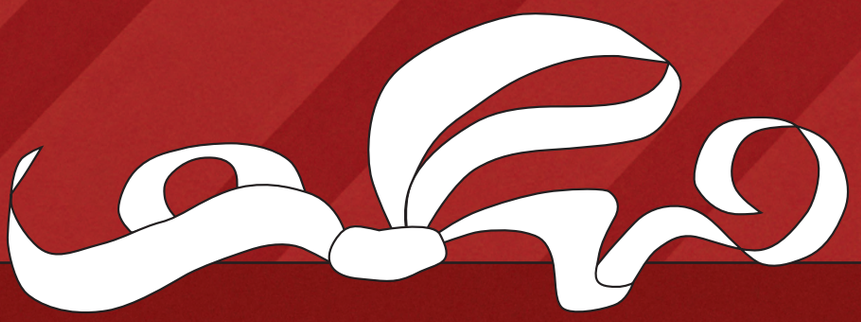
But 10 percent of the Martian X-ray photons form a dim halo, which suggests an additional X-ray source. That source is the solar wind—the stream of charged particles blowing out from the sun, Dennerl says. The wind carries highly ionized particles into the Martian atmosphere. When they strike neutral atoms there, the particles snatch and energize the atoms' electrons. As the captured electrons shed their sudden windfall of energy, they emit X rays.

Solar wind also prompts comets to emit X rays (*SN: 6/7/97, p. 352*). A comet's expansive shroud, or coma, of gas and dust provides a large target for particles, says Dennerl. Solar X rays don't generate comet X rays because the density of atoms in the coma is too low.

In planetary atmospheres, in contrast, the smaller, denser volume of material makes the scattering of incoming solar X rays dominate over interactions with the solar wind, says Dennerl.

The findings suggest that the solar system's edge, where the solar wind meets neutral atoms from interstellar space, could be a prime place to look for X-ray emissions, says Carey M. Lisse of the University of Maryland in College Park. Such emissions might reveal the chemical composition of this uncharted region.

Just like the sun, other stars could trigger X-ray emissions on planets and comets they possess, Lisse adds. —R. COWEN



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TAMING TOXIC TIDES

Can we slay poisonous algal blooms with clay?

BY JANET RALOFF

Marine scientists have been documenting a disquieting trend in the past few decades—increasing blooms of poisonous algae. Outbreaks in Chinese coastal waters, for example, increased 10-fold between 1975 and 1995. Many species tint the water a deep hue, from red or blue-green to dirty brown. Others proliferate more stealthily. Recognition of their intoxicating presence generally dawns only when wildlife or people sicken.

Scientists have logged some 50 different species of toxic algae. The microbes' targets and modi operandi can vary dramatically. At least one *Pfiesteria* species appears to kill by swarming all over a fish and secreting factors that eat away the unwitting host's skin (*SN: 8/10/02, p. 84*). Several secrete poisons that cause acute, gut-wrenching disease in people, while toxins of others paralyze, induce permanent amnesia, or trigger respiratory problems that are sometimes severe.

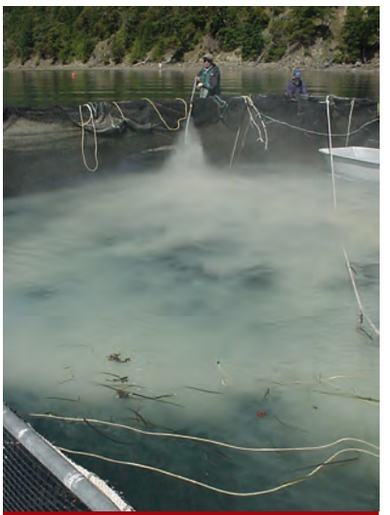
Harmless concentrations of these microscopic poison factories can be isolated from coastal waters at any time. However, those diffuse populations periodically—and unpredictably—mushroom almost overnight into vast blooms that can blanket hundreds of square miles of open water (*SN: 9/27/97, p. 202*).

Known as algal tides, these profusions of algae can float atop the water or reside throughout it, creating a toxic soup that extends to the seafloor. There's been no stopping a red tide or any other algal bloom as it's buffeted by winds and shuttled by currents. So, at the first signs of one's emergence, fishing fleets, recreational boaters, and beach bathers disappear—temporarily devastating the economy of coastal communities.

But help may be on the way. A growing international cadre of scientists has begun exploring a remarkably simple control strategy. The researchers fling dirt into the water to sweep away harmful algae.

Not just any dirt. The particles must be mined from fine, silty clay. And not just any clay. Depending on its mineral composition, one clay might wipe out a bloom, while another just irritates the algae.

So far, only Asian researchers have wrangled permission to test this clay therapy in open waters—and then almost exclusively to protect pens of high-value farmed fish. But if some of their U.S. counterparts get their way, experimental sprays of wet clay could be coming to an algally challenged bay in as few as 3 years.



BLOOM FIGHTER — In Puget Sound, algal blooms periodically devastate fish farms. Don Anderson sprays a phosphatic-clay solution into an enclosed salmon pen there. The test probed impacts on water quality, plankton, and seafloor animals.

WOODS HOLE OCEANOGRAPHIC INSTITUTION

AN ASIAN RECIPE Japanese scientists originated the clay therapy. The idea behind it: Find something heavy that sticks to the algae and weighs them down like microanchors.

In 1989, several Japanese publications described shipboard dispersal of wet clays onto blooms of algae threatening pens of fish. "Though the reports were all favorable," says Mario R. Sengco of the Woods Hole (Mass.) Oceanographic Institution, the Asian researchers shelved the concept, citing prohibitive costs.

Then, in 1995, a major bloom of *Cochlodinium polydrikoides* algae devastated Korea's marine aquaculture industry. It killed fish worth some $100 million. Overnight, interest in the clay defense system soared.

Korean scientists immediately ramped up a research program to field-test techniques for spraying clay onto affected waters. Those nationwide trials during the next year cost an estimated $1 million but held Korea's aquaculture losses to just $5 million. "The Koreans have been using clay ever since," says Sengco.

This year alone, Korean researchers have dispersed roughly 140,000 tons of yellow clay in treatments that typically remove 90 percent of the algae, according to Sam-geun Lee of Korea's Harmful Algal Blooms Research Department in Pusan. Although environmental assessments of this technique are still under way, Lee told *Science News* that his group has not yet found any negative impact.

Buoyed by such reports, U.S. scientists launched their own investigations in the 1990s. The bottom line, Sengco now reports, is that though clay indeed can sequester toxic algae into the sediment, "one size doesn't fit all." Users have to select a clay to target a specific microbe and, in some cases, employ chemical boosters, he notes.

FLUFFY IS BEST Clay is dirt made from especially small mineral particles. Anticipating that not all minerals would exhibit equal affinity for sticking to algal cells, Sengco and his colleagues tested 25 U.S. clays and Korea's yellow clay against the Florida red-tide organism, now called *Karenia brevis*, and a New York brown-tide alga, *Aureococcus anophagefferens*.

In mineral composition, six of the U.S. clays were bentonites, two were montmorillonites, and one was a phosphatic clay—a scrap residue of Florida's phosphate-mining industry. In test-tube experiments, these nine clays each trapped about 80 percent of the red-tide algal cells when applied at a dose of at least 0.25 gram per liter of treated water. That's equivalent to adding a few pinches of powder to a gallon of liquid.

In contrast, clays with mineral characteristics like those of the Korean yellow clay achieved the best removal of the brown-tide

cells. But the concentrations required were at least 16 times as high as those needed for the best red-tide control agents to be effective.

Sengco's team reported its findings in the Jan. 26, 2001 *Marine Ecology Progress Series*.

Since the phosphatic clay performed so well against the red tide alga and was literally free for anyone willing to cart it away, Sengco and his Woods Hole colleagues are working out the best ways to use it in trials in Florida and the Pacific Northwest.

Clay clears algae from water by two means. First, organic materials on the surface of algae are sticky, so the microbes bond to clay particles and sink. Second, some clays swell in seawater and coagulate into fluff, or what Sengco describes as "marine snow." As these flakes sink, they rake down additional algal cells.

Whether a particular clay forms marine snow depends on its crystalline structure. Bentonites, for instance, consist of sandwiched layers of tetrahedral silicon-based units and an octahedral aluminum-based compound, Sengco says. Water molecules can slide between the layers, swelling a particle to perhaps double its dry size. A similar swelling occurs with moistened montmorillonite but not with some other clays, Sengco explains.

To further enhance the fluffiness of wet clays, his group has added a chemical booster called polyaluminum chloride, or PAC. Water treatment plants often rely on this commercial coagulant to gather small pollutant particles into big flocs that settle out for collection. The Woods Hole scientists find that with PAC, clay forms stickier, more voluminous sieves for filtering algal cells out of the water.

Toxic cells dragged to the seafloor by clay can survive for at least a couple hours, Sengco's studies show. He observes that if not firmly pinned down—by more clay, for instance—the algae can wriggle out "and swim to the surface to reestablish their vegetative growth."

TOXIC SOUP — Fish carcasses float in water rust-colored by a brown algal bloom.

ALL CHOKED UP? The Woods Hole research team is coordinating efforts by several U.S. research groups to determine just how much extra clay an environment's residents can tolerate. In Puget Sound, consulting biologist Jack Rensel of Arlington, Wash., has been dumping clay onto pens of juvenile Atlantic and Chinook salmon. His initial 5-hour trial in open-bottom cages simulated what might happen if fish farmers were to treat algae that infiltrated aquaculture pens at sea.

The 10-pound salmon clearly found the clay irritating, Rensel observes, and "did what fish do in response to a lot of things that interfere with their gills: They coughed." Later examination of their gills turned up no permanent damage, however.

Anticipating environmental restrictions, the Woods Hole scientists and their collaborators typically have applied clays at about one-fortieth the dose that Korean investigators used on open waters. However, Sandra Shumway of the University of Connecticut in Groton has tailored her studies to match Asian application rates.

She administered clay to water over filter-feeding bivalves—scallops, limpets, hard clams, and other crustaceans that sieve their meals of tiny organisms from water pumped through their body cavities. In October at the International Conference on Harmful Algae in St. Pete Beach, Fla., Shumway reported "significant negative impacts of clay on filtration" in all species.

These animals extract oxygen from the water, so any drop in their filtration rate can be serious, she says. For bay scallops, adding just 10 milligrams of clay per liter of water halved the filtration rate. In two species of oysters, 100 mg/l clay applications cut filtration by 50 percent, and at 1,000 mg/l, the animals' filtration "almost shut down," Shumway says.

The filtration effects may explain other findings reported at the same conference by Monica Bricelj of Canada's National Research Council in Halifax. She and her colleagues simulated an algae-control program by applying phosphatic clay to water flowing over juvenile hard clams. When flow rates were slow enough for the clay to settle out rapidly, the clams fared fine. But when there was enough turbidity for clay to remain suspended for 2 weeks—a worst-case scenario—the clams' growth rate dropped by 90 percent.

SACRIFICIAL CLAMS Florida scientists have applied low concentrations of clay—with and without PAC—to laboratory tanks containing a bottom-dwelling estuarine fish and tiny burrowing crustaceans known as amphipods.

By itself, algae-free clay floc that settled on the tank bottoms didn't harm the critters, says ecotoxicologist Michael A. Lewis of the Environmental Protection Agency's laboratory in Gulf Breeze, Fla. However, the red-tide algae wiped them out—even when a clay floc with PAC had been used. In fact, he says, flocculation may largely transfer the algae's poisons from the water to sediment.

To Shumway, these preliminary findings suggest that clay treatment "has to be approached with great caution because, while it may appear to be a quick fix for the aquaculture people with fish pens, over the long term, it may actually do more harm than we currently appreciate." Indeed, she concludes, "scientists and managers have to consider the possibility that no intervention is the best policy."

However, Richard H. Pierce, director of ecotoxicology at the Mote Marine Laboratory in Sarasota, Fla., counters with another view. He argues that a clay treatment might be considered beneficial if it limits losses to just the sediment communities.

A toxic tide can leave in its wake a dead zone that includes seafloor communities. In an estuary, for example, an algal bloom "pretty well wipes out everything," Pierce explains. Not only does Florida's red tide produce at least nine neurotoxins, he says, but the bloom's high nighttime respiration can also suck much of the oxygen from the water.

NO SHOW STOPPERS Currently, clay has great promise for taming a host of toxic algae, says Donald M. Anderson, who heads Woods Hole's clay investigations. However, in North America, unlike Korea, getting a go-ahead to use clay will take a long time, he adds, "because we're going to have to do a lot more to prove to everybody that it's safe."

Toward that end, Anderson's team has just secured a 3-year federal grant to coordinate a new round of clay investigations at several laboratories. Many of the experiments will be conducted in large, closed pens in open bodies of water.

Yet even if the tests establish that clay is largely benign, economic hurdles may still limit its deployment. Although some clays are virtually free for the taking, there would be major costs for transporting them to bloom-threatened areas and financing crews to spray slurries. Fish farmers may be willing to spend a few thousand dollars to safeguard their pens, but would cities spend millions to head off blooms threatening their beaches?

Future tests may further define the economics of clay therapy, but the tests are, in part, at the mercy of nature, Anderson notes.

Indeed, Rensel relates, "we had been experiencing blooms at [Puget Sound] fish-farm sites every single year from 1989 to 1999." Then he received a grant to study the fish-killing *Heterosigma* algae around aquaculture pens, and suddenly, the red tides were nowhere to be found.

"The fish farmers think it's because I'm studying [the blooms]," he jokes. "So, I've been offered a retainer to study them for the rest of my life." ■

WOODS HOLE OCEANOGRAPHIC INSTITUTION

MAD DEER DISEASE?

Researchers puzzle over brain illness in North American wildlife

BY SUSAN MILIUS

This autumn, the nation's big-game hunters are lifting their guns and bows in the service of science. They're collecting the biggest sample ever of deer and elk brains—predicted to total 200,000—to test for a once-obscure wildlife disease that's become the stuff of headlines and headaches coast-to-coast. So-called chronic wasting disease strikes mule deer, white-tailed deer, and elk. It riddles the brain with tiny holes as the victim slowly withers and dies. Once found in the wild only in an area intersecting Colorado, Wyoming, and Nebraska, the disease appears to be spreading. This year, it turned up in wild herds in South Dakota, New Mexico, and Canada and jumped all the way to Wisconsin and Illinois.

This disease belongs to the same class of maladies as mad cow disease, which appeared in Britain in 1986 and about a decade later, showed up in people who had eaten tainted meat.

Last year, some 11 million people hunted deer and elk in the United States, and many more helped them eat their prizes. So far, the news for hunters looks reassuring. Several weighty groups, including a panel from the World Health Organization, have concluded that there's no evidence so far that people can catch chronic wasting disease.

These reassurances come with plenty of caveats, since scientists know relatively little about transmission of the disease and its relatives. The recent alarm over sick deer and elk has shaken loose new funding for research. Scientists are experimenting with laboratory rodents, setting up controlled experiments in livestock, and scrutinizing cases of brain disease in people.

DRESSED FOR TESTS — Hunters in Wisconsin in October turned in deer heads to be tested for chronic wasting disease, part of a nationwide effort that could test 200,000 tissue samples this hunting season.

B. QUEEN/WISCONSIN DEPARTMENT OF NATURAL RESOURCES

OUT OF OBSCURITY Elizabeth Williams, the veterinarian who in 1978 discovered the critical brain degeneration in chronic wasting disease, recalls her breakthrough research as "nothing fancy." She's now a wildlife pathologist at the University of Wyoming in Laramie, but she made her discovery when she was still a graduate student in Colorado.

Wildlife-pathology students traditionally dissect animals that perished from various ailments, and one day Williams set about analyzing a mule deer that had died at a research station. With an emaciated frame, the animal seemed to have suffered a mysterious nutritional ailment that had been killing animals there since 1967. To be thorough about her job, Williams examined slices of brain under a microscope. Myriad tiny holes dotted the tissue, a discovery that at the time seemed interesting but not earthshaking.

"I didn't go, 'Eureka,'" she says. "I went, 'Oh, maybe it's scrapie.'"

Several phenomena can punch an animal brain full of holes, and one of the most widespread is the sheep disease called scrapie. Shepherds and pathologists have recognized it since the 18th century. Afflicted animals twitch, lose weight, and finally die of paralysis. Williams wondered if some relative of scrapie might be savaging the brains of the mule deer.

Because sheep haven't been known to transmit their brain disease to people despite centuries of opportunity, in the late 1970s and early 1980s—well before mad cow disease—"there wasn't a lot of concern about scrapie," Williams remembers. So, her new mule deer disease didn't spark much alarm.

Scavenging a few thousand dollars here and there for research, she and some interested colleagues established that chronic wasting disease attacks elk and white-tailed deer as well as mule deer. At first, the researchers knew the disease only from captive animals at two western research stations. In the mid-1980s, though, surveys discovered chronic wasting disease in wild herds in northeastern Colorado and southeastern Wyoming. Later, pathologists detected the disease in an adjacent area of Nebraska. Today, the brain malady strikes perhaps 6 percent of deer and less than one percent of elk in this endemic area.

Nobody knows how the disease first arose. The western deer and elk may have somehow caught sheep scrapie, Williams speculates. Or perhaps the brain malfunction started spontaneously in one unlucky wild beast and has been passed around ever since. Also, the deer may have caught the disease from some source that pathologists haven't yet imagined.

"In the realm of wildlife diseases, there's a lot we don't know—believe me," Williams says.

Similar spongy-brain diseases have appeared in at least 10 animal species, so far. Farmed mink, domestic cats and some of their bigger relatives like cougars, and such hoofed stars of zoo displays as bison, kudu, and oryx succumb to this sort of brain disorder.

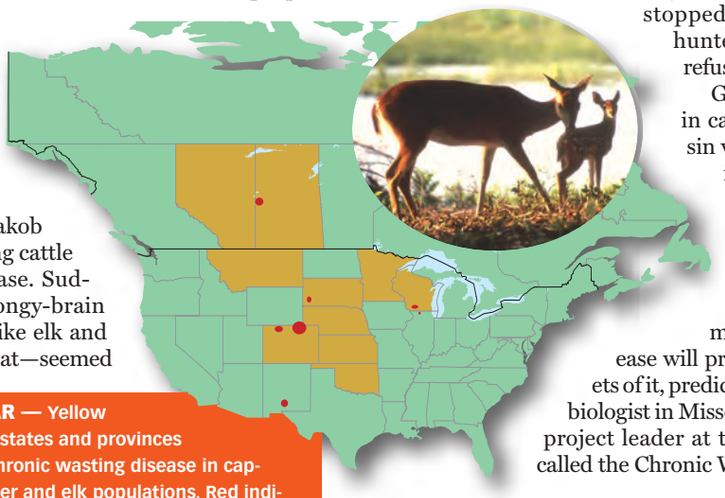
Williams' troubled wildlife attracted more attention after the

discovery of mad cow disease in Britain, and researchers are now exploring the idea that the diseases spread via misfolded proteins, or prions, instead of bacteria or viruses.

When mad cow disease first turned up, its similarities to scrapie made it seem unlikely to be a hazard for people. However, there is a human spongy-brain condition. Called Creutzfeldt-Jakob disease, it pops up randomly in about one in a million people, runs in families, or spreads via cannibalism. A victim can remain outwardly healthy for years then go into a rapid course of confusion, loss of memory, and death.

In 1996, the British government announced evidence that a new variant of Creutzfeldt-Jakob disease might come from eating cattle suffering from mad cow disease. Suddenly, other animals with spongy-brain diseases—especially animals like elk and deer that hunters butcher and eat—seemed threatening.

That same year, chronic wasting disease turned up in a new arena. Elk on a Saskatchewan game ranch became ill. Pathologists worried that other ranches might have instances of the disease, too. Animals carry it for years without showing symptoms, and ranchers sell and ship live elk and deer over great distances.



SO FAR — Yellow marks states and provinces with chronic wasting disease in captive deer and elk populations. Red indicates that the disease is in wild herds. Illinois joined the latter group Nov. 1.

USGS; USDA

Since 1996, the disease has struck at least 20 commercial U.S. herds, mostly of elk. Contaminated animals shipped from North America to South Korea spread the disease to game farms there.

This year brought more worrisome news. In February, Wisconsin game managers announced that a routine exam they'd been doing for several years on animals shot by hunters had turned up three white-tailed deer with chronic wasting disease. By the end of the summer, the managers found 40 sick deer, all in an area west of Madison. State wildlife officials declared a special hunting season during the summer to try to eradicate the deer—and stamp out the disease—in the two counties where it had been found.

"Now, we're scaring the stuffing out of hunters," says Scott Wright, branch chief at the U.S. Geological Survey's National Wildlife Disease Center in Madison. The sale of hunting licenses is sagging this season, he says. Some meat processors have stopped carving up venison for hunters, and certain landfills refuse deer carcasses.

Galvanized by the outbreaks in captive herds and Wisconsin wildlings, game managers in other states are encouraging, or even ordering, hunters to submit the heads of killed deer and elk for disease testing.

Looking so much more intensively for the disease will probably reveal more pockets of it, predicts Gary J. Wolfe, a wildlife biologist in Missoula, Mont., who serves as project leader at the sportsman's coalition called the Chronic Wasting Disease Alliance.

RISKY QUESTIONS In all the furor, what people most want to know is whether the disease can cross from meat to meat eater or handler. Patrick Bosque, a neurologist and prion researcher at the Denver Health Medical Center says that he doesn't yet know of a reliable experiment to see if a prion disease of animals will infect people. New molecular evidence convinces him that scientists don't yet fully understand the basics of prion transmission (*see box below*).

Yet, other scientists have plunged into experiments looking for animal-to-animal transmission of chronic wasting disease. Tests with such a worrisome disease require keeping animals inside secure facilities where workers take showers and change clothes each time they leave the animals. Workers also heat-treat the waste from all their test animals.

When Proteins Go Bad

How does a mysterious agent cause chronic wasting disease?

The basic infectious entity causing mad cow disease, chronic wasting disease, and related brain destruction has puzzled scientists for decades. Researchers couldn't pin the disease on a bacterium or virus. The disease-causing agent didn't even seem to have genetic material of any sort. Stanley Prusiner of the University of California, San Francisco proposed an entirely different villain—a misfolded protein. First met with incredulity, his idea won him a 1998 Nobel prize.

Misfolded forms of normal brain proteins, or prions, trigger the brain-eating diseases, contends Prusiner, a biochemist and neurologist. Warped prions corrupt normal ones into going haywire, too, and folding into the wrong shape. Thus, the disease spreads without any virus or other DNA-bearing pathogen.

Once scientists began to look for misbehaving proteins that could spoil others of their kind, a similar phenomenon even turned up in yeast. Mercifully, there's no indication that anyone has to worry about mad beer disease.

As researchers venture into the world of prions, the territory gets stranger and stranger. For example, there's evidence that a prion can have strains, says Patrick Bosque of the Denver Health Medical Center. Because all the prion proteins made by one host animal have the same sequence of amino acids, scientists had expected these prions to show the same behavior. Yet in various experiments, Bosque says, prions from the same animal appear to misfold in several ways, sometimes creating different effects.

Also, Bosque notes, some species survive as apparently unfazed carriers of prions that kill another species. Prions from a diseased hamster, for example, didn't make a mouse sick during a 2-year experiment. However, an inoculate of brain tissue taken from mice at the end of the experiment induced fatal prion disease in hamsters. The original prions probably didn't last 2 years, so the mouse must have created the agent that was transferred to the hamsters. "The hamster is more sensitive to the mouse prions than the mouse is," Bosque marvels. —S.M.

At the National Animal Disease Center in Ames, Iowa, researchers have taken liquefied brain tissue from diseased mule deer and injected it into the brains of raccoons, sheep, and cattle. Amir N. Hamir reports that so far, 4 of 13 cattle and 1 of 4 sheep of a type prone to scrapie have developed the prion disease. The raccoons, and scrapie-resistant sheep have shown no sign of prion disease, now some 3 years after exposure. Hamir plans to continue the cattle-and-sheep experiment for another 5 years.

Williams, however, is exploring more realistic scenarios. She fed cattle one dose of liquefied tissue from a diseased mule deer. After 2 years, she sees no signs of disease. Also, she's monitoring cattle penned in a paddock with sick deer. Here, too, she reports no signs of transmission after 3 years.

Both Hamir and Williams warn that prion brain diseases can take many years to show up. Good news so far from their experiments means no more than that there's no bad news yet.

"There's no strong evidence" that any person has contracted chronic wasting disease, says Ermias Belay of the Centers for Disease Control and Prevention in Atlanta. He and others are examining any suspicious cases of Creutzfeldt-Jakob disease that turn up.

Chronic wasting disease has afflicted wildlife in Colorado and Wyoming for at least 20 years and probably longer. So far, neither federal nor state health officials have found more-frequent prion-related deaths of people in areas known to host the wildlife disease than in areas untouched by chronic wasting disease.

ILL ELK — A female elk at a research station in Wyoming shows the skinny body, tatty coat, and drooping ears typical of an animal succumbing to chronic wasting disease. Tiny cavities in brain tissue (inset) indicate the diagnosis of a class of fatal ailments including mad cow disease and chronic wasting disease.

WYOMING GAME AND FISH DEPARTMENT'S SYBILLE WILDLIFE RESEARCH UNIT

Of course, the records may have missed prion deaths. Conservative voices also debate whether the numbers of people exposed so far are great enough to detect a disease that affects people infrequently.

Three provocative cases turned up during the late 1990s, Belay says. Two 28-year-olds and a 30-year-old who had eaten venison or elk meat died after rapid mental deterioration.

Belay and his colleagues researched these peoples' lives, reviewed their medical records, and examined what tissue samples remained. However, no link showed up between eating game meat and the disease, the researchers reported. The "most important evidence," according to Belay, was that he couldn't find any indication that the game meat had come from areas where chronic wasting disease occurred.

Scrutiny of brain-disease cases continues, Belay says.

All the uncertainty though, isn't going to stop Wolfe from hunting elk, he says. He's even traveling from Montana to the corner of Wyoming with endemic disease. "I hope people are going to put this in perspective," he says. "I figure my greatest risk is driving to get there." ■

OF NOTE

PALEONTOLOGY

Forged fossil is a fish-eating fowl

A fossil creature once thought to be a missing link between dinosaurs and birds actually derives mostly from an ancient fish-eating bird, researchers have found.

Dubbed *Archaeoraptor*, the purported find was unveiled by the National Geographic Society in October 1999. At that time, some paleontologists proposed that the fossil's odd mix of features—the tail of a meat-eating dinosaur with the feathers and wing structure of a bird—would have placed the species between dinosaurs and birds on life's family tree (*SN: 11/20/99, p. 328*).

Other scientists were wary. Further studies determined the odd specimen was a forgery, smuggled from China and sold at a gem and mineral show in Tucson for $80,000. The chimera was cobbled together from the remains of up to six different species (*SN: 1/15/00, p. 38*), including the tail of a small theropod dubbed *Microraptor* (*SN: 4/21/01, p. 253*).

The latest research, published in the Nov. 21 *Nature*, focuses on *Archaeoraptor*'s skull, body, wings, and hind limbs. Results strongly suggest that those bones come from *Yanornis martini*, a bird that lived between 110 million and 120 million years ago in what is now northeastern China, say the researchers.

Those body parts are shedding new light on the *Yanornis* species, says Julia A. Clarke, a paleontologist at the American Museum of Natural History in New York and a coauthor of the new study. That's because some intact features of the forgery's skeleton weren't preserved in the first *Yanornis* fossil to be described, she notes.

The stomach contents of a third known *Yanornis* fossil confirm that the ancient bird ate fish, according to the new report. —S.P.

EARTH SCIENCE

El Niños came more often in Middle Ages

Analyses of sediments from a South American lake suggest that the worldwide weather effects of El Niños occurred more frequently about 1,200 years ago, when Europeans were entering the Middle Ages, than they do today. El Niños are periodic, sustained warmings of the ocean in the equatorial Pacific.

Two 8-meter-long cores of layered mud from Laguna Pallcacocha, a lake 4,200 m high in the Andes, chronicle southern Ecuador's climate for the past 12,000 years. But, those sediments probably don't record all El Niños, says geologist Geoffrey O. Seltzer of Syracuse University in New York. That's because weak El Niños probably wouldn't send precipitation high enough in the Andes to wash thick layers of silt—an El Niño signature—into the lake.

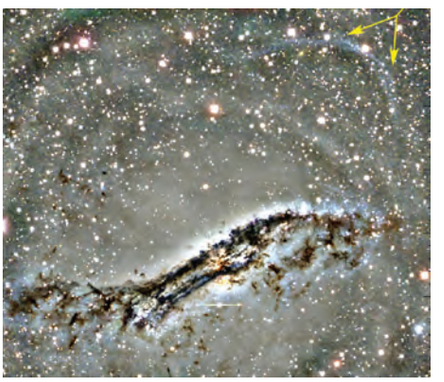
The sediments suggest that between 12,000 and 7,000 years ago, no more than five strong El Niños occurred each century. Their frequency then increased, peaking in the 9th century A.D., when they occurred every 3 years or so. Seltzer and his colleagues report their findings in the Nov. 14 *Nature*.

Today, El Niños occur once every 2 to 8 years, says Seltzer. However, El Niños strong enough to be recorded in Laguna Pallcacocha's sediments probably occur now only once every decade or so. —S.P.

ASTRONOMY

Galactic cannibalism strikes again

An arc of blue stars that stretches for thousands of light-years sits just above the nearby galaxy Centaurus A. Astronomers analyzing the arc have discovered that it's the stellar remains of a tiny galaxy that was swallowed by Centaurus A only a few hundred million years ago. In the December *Astronomical Journal*, the scientists report that this relatively recent example of galactic cannibalism is another indication that material ripped from smaller galaxies is a key contributor to the formation of halos—the tenuous outer perimeters of galaxies.



PENG/JHU/NOAO/AURA

GALACTIC REMAINS Arc of stars (arrows) sits above the galaxy Centaurus A.

"This adds a nice example in the local universe to the growing evidence that galactic halos are built up from the accretion of dwarf satellite galaxies," says study coauthor Eric Peng of the Johns Hopkins University in Baltimore. Halos are intriguing, he adds, because their ancient stellar denizens provide data about galaxies as they were when they were forming billions of years ago.

Other astronomers had detected the arc but didn't recognize it as the remnant of a galactic merger. Using a new wide-field camera attached to a 4-meter telescope at the Cerro Tololo Inter-American Observatory near La Serena, Chile, Peng's team viewed Centaurus A through several color filters. Those images revealed the predominance of young stars in the arc, which probably were born following a recent merger with Centaurus A.

Peng says he would now like to measure the velocities of star clusters in the arc and map their course. That would enable his team to better determine how long ago the galactic merger occurred and what was the motion of the galaxy as it was swallowed. —R.C.

IMMUNOLOGY

Study exonerates childhood vaccine

A nationwide study in Denmark provides strong evidence that a childhood vaccine once blamed for some cases of autism plays no role in the development of that neurological disorder.

Researchers used data on all children born alive in Denmark between 1991 and 1998 to see whether being vaccinated against measles, mumps, and rubella (MMR) could be a factor in whether a child subsequently develops autism. Of 537,303 children in the study, 82 percent received the three-in-one MMR vaccine. The rates of autism among vaccinated and unvaccinated children—both less than 0.6 case per 1,000—were statistically equivalent, Kreesten Meldgaard Madsen of the Danish Epidemiology Science Center in Århus and her colleagues report in the Nov. 7 *New England Journal of Medicine*.

That finding, which backs up smaller recent studies, may allay lingering concerns about the safety of the MMR vaccine (*SN: 8/18/01, p. 110*). Measles alone

OF NOTE

kills nearly 1 million people each year in countries where the MMR vaccine isn't widely used. —B.H.

TECHNOLOGY

Resistancefree wire takes long jump

Researchers worldwide are racing to develop low-cost wire with no electric resistance. Making it in practical lengths has been a tough challenge. A wire-making company has now demonstrated a process that yields potentially inexpensive, high-current wires about 10 times longer than previous prototypes.

For the past few years, electric utilities have been field-testing power cables and other equipment containing wires of so-called high-temperature superconductors (*SN: 11/18/00, p. 330*). Those materials lose all electric resistance at temperatures that are extremely cold yet much higher than the operating temperatures of ordinary superconductors.

Because the field-tested wires include silver, they're pricey. As an alternative, researchers have been developing a ribbonlike wire of cheap nickel alloy coated with a veneer of high-temperature superconductor. Yet until recently, the developers couldn't make such ribbons both longer than a meter and able to carry high currents.

Last month, American Superconductor of Westborough, Mass., with help from Oak Ridge (Tenn.) National Laboratory, produced the first 10-meter-long ribbons that can superconduct electricity at 100 amperes per centimeter of ribbon width.

Scientists achieved that sudden leap by fine-tuning chemical reactions in a prototype production line, says company president Gregory J. Yurek. The researchers still need to figure out how to make kilometer lengths of such ribbons that carry even higher currents, he says. —P.W.

ZOOLOGY

Hawkmoths can still see colors at night

For the first time, scientists have detailed evidence that an animal can see color by starlight. People lose color discrimination in such dimness, but hawkmoths aced tests of color recognition at night.

Some older studies suggested that goldfish and a different moth see colors in dim light, but Almut Kelber of Lund University in Sweden and his colleagues focused on the *Deilephila elpenor* hawkmoth, which collects nectar during the darkest hours of the night in Europe.

The researchers trained moths to associate sugar-water with either yellow or blue artificial flowers. When offered an array of colored and gray choices, moths settled on the color they'd been trained to seek. Even as the researchers dimmed the light from dusk to starlight, moths still picked the right color most of the time, the investigators report in the Oct. 31 *Nature*.

To see whether the moths had managed their feat just by exquisite sensitivity to shades of darkness and lightness, the researchers offered a wider selection of flowers, including a darker and a lighter version of the target color. The moths rarely investigated flowers in the completely wrong hue—a sign of recognition of the hue itself—but did show interest in the alternative versions of their treat-associated color.

Moths even can compensate for shifts in the color of illumination, the researchers say. Moths trained to select green artificial flowers managed to alight on them even when yellow light made a turquoise decoy appear, at least to a human eye, to be green, as well. —S.M.

MEETINGS

American Public Health Association
Philadelphia, Pa.
Nov. 9 – 13

ENVIRONMENT

Child-care sites, health threats

Federal agencies have completed the first national study of lead, pesticides, and allergens in U.S. child-care facilities.

Joey Y. Zhou of the Department of Housing and Urban Development (HUD) and his colleagues sampled dust, play-yard soil, and residues on windowsills and other surfaces at 168 sites that make up a representative sample of the nearly 100,000 licensed child-care centers in the United States.

One in every six sites had detectable amounts of a common allergen produced by cockroaches, and about one in four had one or both of the dust-mite allergens the researchers looked for. Nearly half the sites at which 15 percent or more of the children suffer from allergies had detectable amounts of the cockroach allergen.

Environmental lead measurements exceeded EPA standards at 14 percent of the sites. While that seems high, it is "quite a bit better" than the 27 percent rate for hazardous lead concentrations found in an earlier survey of U.S. housing, said Peter Ashley of HUD, who presented the new study's preliminary findings.

The pesticide data are taking longer to analyze and quantify, but Ashley reported that tests identified at least 24 pesticides at the sites the team sampled. —B.H.

DENTAL HEALTH

Natural fluoride isn't quite enough

The reunification of East and West Germany in 1990 has had some consequences for dental health, researchers have found.

Decades ago, health officials in many countries, including East Germany, added fluoride to public water sources to reduce tooth decay. After Germany reunified in 1990, however, the country's eastern states suspended fluoridation, which hadn't caught on with their western counterparts.

To test how natural variations in the amount of fluoride in water influenced dental health in their country, Gudrun Beyer and Joachim Kugler of Dresden Medical School analyzed the frequencies of common dental problems in 46,875 school children in the eastern German state of Saxony. They also determined the average background fluoride concentration in drinking water in each of the state's 29 districts. For most districts, the natural fluoride concentration was between 0.1 and 0.4 milligram per liter, well below the 1 mg/l concentration mandated by these districts before reunification.

The researchers found that differences in fluoride concentrations among the districts explained 24 percent of the variation they found in the children's dental health, including the number of cavities, pulled teeth, and fillings. That finding is consistent with observations from the days before artificial fluoridation: Communities' dental health correlated with the background concentration of fluoride in their water. Those observations led health officials to fluoridate water supplies in the first place, says John P. Brown of the University of Texas Health Science Center in San Antonio.

The new study underscores the lesson that sufficient amounts of fluoride in drinking water are important for public health, says Brown. Germany's lack of a fluoridation policy suggests "some people need to relearn that lesson," he says. —B.H.

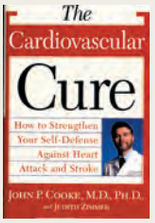
Books

A selection of new and notable books of scientific interest

THE CARDIOVASCULAR CURE: How to Strengthen Your Self-Defense Against Heart Attack and Stroke

JOHN P. COOKE AND JUDITH ZIMMER

In 1998, a trio of scientists received a Nobel prize for their discovery that nitric oxide is critical in maintaining the health of the inner lining of blood vessels. Cooke, a researcher who is the director of vascular medicine at Stanford University Medical School, has built on this discovery to suggest the ways in which nitric-oxide production in the body can naturally prevent and even reverse heart disease. Even though we produce nitric oxide naturally, a poor diet, smoking, and a sedentary lifestyle inhibit the chemical's production. Divided into three sections, this book outlines Cooke's approach to preventing heart disease and stroke. Section one details the science behind this approach and gives the basics of vascular medicine. Next, Cooke outlines a Mediterranean diet that is optimal for producing nitric oxide. He includes 2 weeks of menus and recipes, as well as an exercise regime. Finally, he helps readers assess their vascular health and offers guidelines for using nutritional supplements. ***Broadway, 2002, 310 p., hardcover, $25.00.***



THE CARTOON HISTORY OF THE UNIVERSE III

LARRY GONICK

From the rise of Arabia and the Byzantine Empire to the Italian Renaissance, Gonick imparts history of these times through serious scholarship and clever illustrations. In this long-awaited volume, Gonick details the clashes of religion and culture in the Middle East, Europe's struggle through the Dark Ages, the Crusades, and even the attack of the Black Death in cartoons that are humane, irreverent, and at times laugh-out-loud funny. ***Norton, 2002, 311 p., b&w illus., hardcover, $35.00.***

CORPSE: Nature, Forensics, and the Struggle to Pinpoint Time of Death

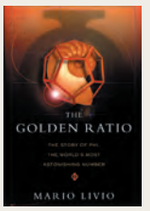
JESSICA SNYDER SACHS

A lynchpin in the prosecution of any murder case is time of death. Without it, all suspects' alibis become more plausible. For 2,000 years, people have been trying to make this determination accurately. Many factors skew results, however. Body size, manner of death, and climate all alter postmortem conditions. Sachs introduces readers to the pursuit of forensic ecology, which relies on the insects that populate a corpse and the soil and plants surrounding the body to indicate not only the time but also the circumstances of death. Sachs recounts the work of 12 forensic entomologists. He shows, for example, how the life cycles of blowflies and maggots have become important elements of modern crime solving. Dirt under a corpse, rife with fluids of human decay, is also a useful tool. Readers tour the crime scenes of a host of bizarre cases and other chilling places, such as the "body farm" in Knoxville, Tenn., where scientists study decaying corpses. From the street to the courtroom, Sachs details the history of this field and its challenges. Originally published in hardcover in 2001. ***Perseus Pubng, 2002, 270 p., paperback, $15.00.***

THE GOLDEN RATIO: The Story of Phi, the World's Most Astonishing Number

MARIO LIVIO

More than 2,000 years ago, Euclid defined the number phi—1.6180339887—and linked it to the construction of the pentagram. Since then, this never-ending, never-repeating, irrational number has been called the Golden Number or the Golden Ratio and linked to patterns ranging from the petal arrangement of roses to the composition of the "Mona Lisa." Astrophysicist Livio takes an invigorating look at this ubiquitous number by examining the mathematical, aesthetic, and metaphysical qualities attributed to phi over the centuries. He also profiles the scientists and artists who have harnessed phi for a variety of purposes. He gives special attention to phi's appearance in natural patterns in the world. ***Broadway, 2002, 294 p., hardcover, $24.95.***



STONE BY STONE: The Magnificent History in New England's Stone Walls

ROBERT M. THORSON

Stone walls are ubiquitous in New England. At one time, these walls could have encircled the globe 10 times. The mass of stone used is greater than that from all the remaining ancient monuments in the world. Thorson, a professor of geophysics and geology, relays a scientific as well as a sociological history of the walls—a "geoarchaeology." He proposes that these walls are not merely architectural ornaments, but amount to landforms much like the coral reefs of Florida or the caves of Kentucky. Beginning with the Ice Age formation of the stones, Thorson explains that by clearing away old growth forests, colonial farmers enabled the stones to emerge from the ground. These and later farmers had to clear the stones away. They found that they could do this efficiently by stacking the stones into low-rising walls. Thorson examines the environmental impact of this practice, as well as the construction, function, and structure of the different types of walls that were built. Finally, he examines the demise of stone walls and the structures that replace them today. ***Walker, 2002, 287 p., b&w photos/illus., hardcover, $26.00.***

LETTERS

Space issue

Advocates of a "space elevator" ("Ribbon to the Stars," *SN: 10/5/02, p. 218*) seem to have forgotten about angular momentum. When an elevator ascends the ribbon, it must be accelerated eastward because the Earth's rotation represents a larger eastward velocity the higher you go. The required eastward force on the ascending elevator would have to be provided by a corresponding westward force on the ribbon. Does Bradley Edwards have an answer to this?

ROBERT H. BEEMAN, CORAL SPRINGS, FLA.

Bradley C. Edwards of the space-elevator design company Eureka Scientific in Berkeley, Calif., replies: "If you go through the math quantitatively, the angular momentum for the climbers requires a pound or so of force over the one-week travel time, and we do that easily with our many tons of material in the anchor and the counterweight."

The greatest concern for the space elevator appears to be impacts. Has someone forgotten that each and every satellite in Earth orbit (except for those in an exact geosynchronous orbit) crosses the equator twice during each and every orbit? Unless that elevator is really good at dodging, one of these satellites is going to run into it.

DAN PANKRATZ, HUNTINGTON BEACH, CALIF.

Edwards replies: "We are good at dodging, and we will avoid the satellites. We are tracking them and will have days to weeks warning. We will move the anchor about a kilometer each day to avoid the debris."

The last space shuttle–tether experiment, which unspooled about 12 miles of cable, generated thousands of volts of electrical potential and kilowatts of power, burned through the insulation of the cable, and generated a tremendous explosive arc of electricity, that snapped the tether. Now imagine a 60,000-mile-long cable and its electrical-generating capacity and you begin to see the disastrous potential.

JEFFREY WILSON, DEXTER, MICH.

According to Edwards, the voltage builds up on tethers in space because they are traveling 11,000 mph relative to Earth's magnetic field. The space ribbon would be stationary relative to Earth's magnetic field and thus the voltage produced is essentially zero. —R. COWEN

For more letters on "Ribbon to the Stars" go to http://www.sciencenews.org/20021005/bob9.asp.

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