SCIENCE NEWS
THE WEEKLY NEWSMAGAZINE OF SCIENCE

NOVEMBER 18, 2006 PAGES 321-336 VOL. 170, NO. 21

evolutionary *flo*
speedier spill cleanup
netting neandertal dna
muscular dystrophy slowed

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incoming!

ROGUE WAVES BATTER SHIPS

THE WEEKLY NEWSMAGAZINE OF SCIENCE

SCIENCE NEWS

NOVEMBER 18, 2006 VOL. 170, NO. 21

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This Week

Of Note

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Cover New mathematical analyses, backed up by satellite data, hint that dangerous rogue waves are more common than scientists previously recognized. In this archive photo from the National Weather Service, a merchant ship encounters a rogue in the Bay of Biscay west of France. (National Oceanic and Atmospheric Administration) Page 328

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SCIENCE NEWS
This Week

Ancient Gene Yield

New methods retrieve Neandertals' DNA

Welcome to the era of Neandertal genetics. Researchers announced this week that they have retrieved and analyzed a huge chunk of Neandertal DNA, covering more than 1 million of the roughly 3 million paired chemical constituents of an individual's genetic makeup.

Until now, scientists had extracted small DNA segments from Neandertal bones, mainly from mitochondria outside cell nuclei (*SN: 4/1/00, p. 213*). Two new techniques have now recovered large amounts of genetic material from nuclei. One also permits tagging of ancient DNA sequences that correspond to modern human genes.

A team led by Svante Pääbo of the Max Planck Institute for Evolutionary Anthropology in Leipzig, Germany, presents results from the first new technique in the Nov. 16 *Nature*. A group directed by Edward M. Rubin of the U.S. Department of Energy Joint Genome Institute in Walnut Creek, Calif., describes results from the second technique in the Nov. 17 *Science*.

These new studies "foreshadow an exciting development—the recovery of the complete Neandertal genome," comment David M. Lambert of Massey University in Auckland, New Zealand, and Craig D. Millar of the University of Auckland, in an editorial published with the *Nature* report. Pääbo and his colleagues expect to complete the genome within 2 years.

Pääbo's team extracted DNA from a 38,000-year-old Neandertal fossil previously discovered in Croatia. Because of the conditions in the cave where the fossil was interred, it retained much DNA that could be analyzed.

In this new approach, unlike in traditional methods, DNA is sequenced directly from fragments. About 6 percent of sequences identified in this way were uncontaminated and presumed to be Neandertal DNA.

The scientists sorted the genetic material into appropriate chromosome locations by matching each fragment to similar sequences in human DNA.

The result indicates that humans diverged from Neandertals about 516,000 years ago. The investigators say that it will take additional sequencing of Neandertal DNA to determine whether that species interbred with Stone Age people.

Rubin's group sequenced DNA from the same Croatian fossil using a method that makes many copies of DNA fragments by putting them into bacteria. The authors then used DNA sequences from people to identify corresponding Neandertal-DNA strands.

With this technique, the scientists identified 29 of 35 genes that they had targeted for recovery. Rubin and his coworkers place the evolutionary split of modern humans and Neandertals at around 370,000 years ago.

STATS

1 million

Neandertal-DNA components that have been sequenced

Another new genetic study, slated to appear in the *Proceedings of the National Academy of Sciences*, suggests that modern humans and a closely related species, possibly Neandertals, occasionally interbred. Those contacts led to the spread in human populations of a particular gene that regulates brain size, contends a team led by geneticist Bruce T. Lahn of the University of Chicago.

Lahn's team reported last year that this gene originated in people 37,000 years ago and now appears in 70 percent of the world's population (*SN: 9/24/05, p. 206*). The new analysis indicates that Neandertals or some other now-extinct *Homo* lineage first possessed the gene about 1 million years ago and eventually passed it to Stone Age people.

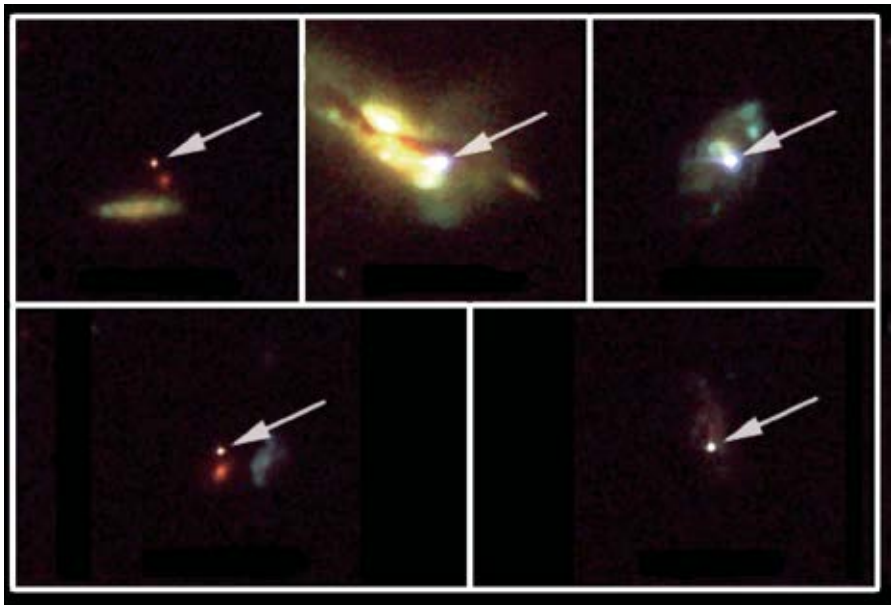
Although the specific function of this gene remains unclear, it adds to growing genetic evidence of interbreeding among various lines of human ancestors within and outside Africa, remarks geneticist Michael F. Hammer of the University of Arizona in Tucson. —B. BOWER

Dark Fingerprints

Hubble sheds light on cosmic expansion

The mysterious cosmic push that's tearing apart the universe began revving up about 5 billion years ago. But a new study reveals that several billion years earlier, the bizarre, elastic substance that fuels this push was lurking in the shadows and already beginning to fight gravity's tendency to pull things together.

The new report, based on 24 distant stellar explosions recorded by the Hubble Space Telescope, indicates that the substance, dark energy, was present in the universe 9 billion years ago. The observations also hint that dark energy, which pervades all space, might emanate from the cosmic vacuum and have a constant density. If so, dark energy would resemble the cosmological constant, which



RIESS ET AL., NASA, ESA

SUPER SHOTS Distant type 1a supernovas (indicated by arrows) examined by the Hubble Space Telescope are revealing the nature of dark energy billions of years ago.

Albert Einstein conceived shortly after he developed his theory of gravitation more than 90 years ago.

At press time, Adam Riess of the Space Telescope Science Institute in Baltimore and his colleagues were scheduled to hold a Nov. 16 briefing to unveil the new results, which document dark energy farther back in time than ever before.

Deciphering the nature of dark energy, which turns gravity from attractive to repulsive, is the most elemental riddle in all of physics and cosmology, many researchers say. The new study, "is a very significant first step" in examining the early history of dark energy and its effect on the universe, says theorist Andy Albrecht of the University of California, Davis.

"These new results help extend our map of the cosmic expansion farther into the past," adds Eric Linder of the Lawrence Berkeley (Calif.) National Laboratory.

Astronomers first discovered the handiwork of dark energy in 1998. That's when studies of exploding stars called type 1a supernovas revealed that despite the mutual gravitational tug of all the matter in the universe, the cosmos is expanding faster and faster (*SN: 1/21/06, p. 35*). The finding indicated that some 70 percent of all the energy and mass in the universe is made of dark energy.

Because all type 1a supernovas have about the same intrinsic brightness, their appearance in the sky indicates how far away they lie. These distances, combined with measurements of how rapidly each supernova's home galaxy is receding from Earth, enable researchers to measure past rates of cosmic expansion.

Previous Hubble studies had found that dark energy 5 billion years ago won the cosmic tug of war, turning the overall gravitational force from a pull to a push and revving up the universe's expansion. The new Hubble observations, which reveal dark energy when gravity's tug still dominated, could begin to constrain theories about the origin of this mysterious substance, says Riess.

The researchers also found hints that type 1a supernovas haven't changed over time. Those observations boost scientists' confidence that the explosions can be used to study cosmic expansion, says Riess.

It will be fascinating to compare Riess' supernova findings with other Hubble data now being analyzed, which were recorded from equally distant supernovas, notes Linder. The latter supernovas originate in regions that contain little dust, so the data aren't confounded by dust's dimming effects. —R. COWEN

Unstoppable Bot

Armed with self-scrutiny, a mangled robot moves on

Severe maulings hardly slowed down the robotic assassins in the *Terminator* science fiction movies. Now, roboticists have made a real machine that carries on despite serious damage.

The crucial factor in that feat, the robot's developers say, was to program the device's computer to create and update a representation of the machine's physical structure. That way, when the robot broke, the device recognized its changed condition and found new ways to reach its goals.

In the Nov. 17 *Science*, computer scientist Josh Bongard of the University of Vermont in Burlington and his colleagues describe a starfishlike, ambulatory machine that they created. They report detaching a portion of one of the four legs and that, in response to the insult, the device changed its gait.

Under similar circumstances, most conventional robots would stop functioning, notes Christoph Adami of the Keck Graduate Institute of Applied Life Sciences in Claremont, Calif., commenting in the same issue of *Science*.

The self-adjusting machine could adapt because its computer software includes a novel algorithm, explains mechanical engineer and team leader Hod Lipson of Cornell University. In that algorithm, the machine uses electrical readings from its two tilt sensors and eight motors to determine its structure.

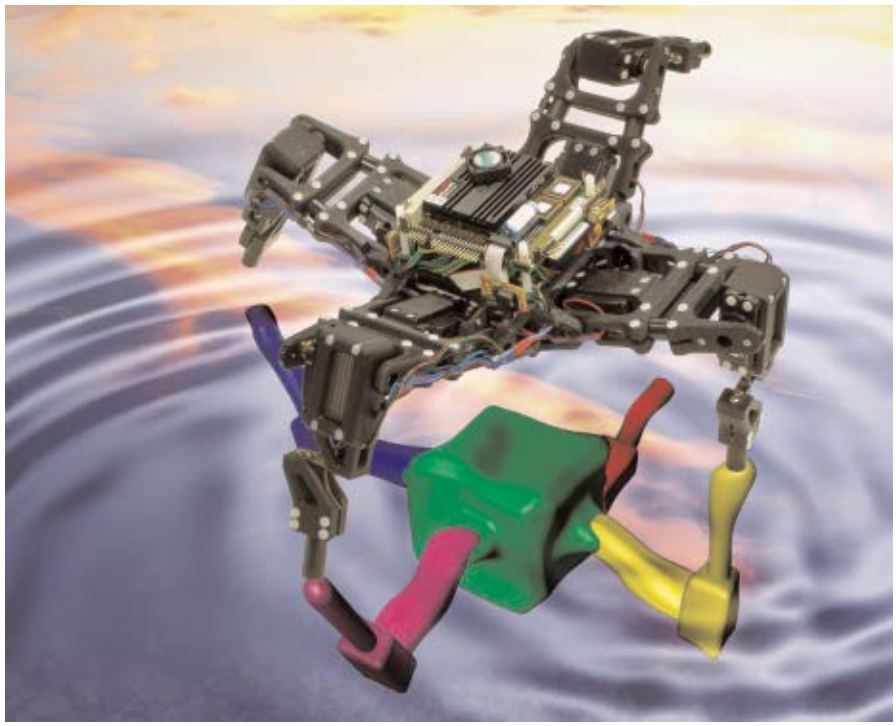
In an iterative process, the computer figures out which of about 100,000 possible arrangements of the machine's parts is generating those readings, Bongard says.

Once the computer comes up with a plausible structure, it hypothesizes many series of component movements and calculates how far the robot could move as a result of each series, Lipson adds. Finally, the robot implements the motions that it predicts will maximize the distance traveled—the goal specified for it by its designers.

The new work is "a major advance in autonomous robotics," says roboticist Dario Floreano of the Swiss Federal Institute of Technology in Lausanne. "The algorithm … is very efficient and applicable to a wide range of robots."

Typically, when creating a robot, developers face two daunting tasks, says Cornell mechanical engineer Victor Zykov, a codesigner of the new machine. The scientists must devise a detailed, mathematical model of the device and also create a related control mechanism that operates the robot under various conditions.

In the new experiment, neither step was necessary. "This achievement could be expanded to other machines that are difficult to control," Zykov adds. Those could include



BONGARD ET AL./SCIENCE

I FEEL PRETTY In this fanciful image, a newly developed robot stands over water in which the machine is mirrored as a colorful block figure. By conjuring and using such a simple model of itself, the device can adapt to damage more readily than ordinary robots do.

the remarkably agile prosthetic limbs currently under development, Lipson says.

"Designing robots that can adapt to changing environments and can compensate for damage has been a difficult problem," comments neuroscientist Olaf Sporns of Indiana University in Bloomington. "This work provides a new way toward solving this important problem."

Sporns uses robots to study how body structure influences the data that a machine or organism gathers about its environment. With the new self-modeling robot, cognitive scientists might investigate whether people and other animals employ abstract representations of their bodies and environments, Lipson says. —P. WEISS

More Evidence of Protection

Circumcision reduces STD risk in men

Circumcised men are less likely to get sexually transmitted diseases than uncircumcised men are, a long-term study finds.

Circumcision—the surgical removal of the foreskin on the penis, usually soon after birth—is rarely considered a medical necessity and carries a risk of surgical complication. But a spate of reports in recent years has suggested that this ancient but controversial practice confers benefits, including a reduced risk of acquiring HIV, the AIDS virus (*SN: 10/29/05, p. 275*).

To determine whether circumcision protects against other sexually transmitted diseases (STDs), researchers in New Zealand analyzed information from 510 men born in 1977 who had been monitored as part of a 25-year health study. In that group, 154 of the men had been circumcised by age 15 and 356 had not.

By age 21, 1.3 percent of the circumcised men had contracted an STD, compared with 3.5 percent of the uncircumcised men. By age 25, those numbers had increased to 3.4 percent and 8.5 percent, respectively. After accounting for differences in the number of sexual partners and the frequency of sex without a condom, the researchers calculated that circumcision decreased a man's risk of getting an STD to less than one-third the risk in uncircumcised men.

"There is clear evidence to suggest that routine neonatal circumcision may reduce rates of STDs quite dramatically," says David M. Fergusson, a psychologist at the Christchurch School of Medicine and Health Sciences in New Zealand.

More than half of the STD cases were chlamydia. Genital warts, genital herpes, urinary tract infections, and gonorrhea also turned up. No one in either group acquired HIV or syphilis, Fergusson and his colleagues report in the November *Pediatrics*.

Roughly four-fifths of boys born in the United States are circumcised. The main risk—surgical complication—occurs in less than 1 percent of patients. Nevertheless, when the American Academy of Pediatrics last reviewed the pros and cons of newborn-male circumcision in 1999, it stated that "the potential medical benefits ... are not sufficient to recommend routine neonatal circumcision."

Not everyone agrees with that assessment. The pediatrics academy "overestimates the risk of the surgery and underestimates the potential benefits of it," says epidemiologist Helen A. Weiss of the London School of Hygiene and Tropical Medicine.

Earlier work showed that during the first year of life, uncircumcised boys have 10 to 20 times as many urinary tract infections as circumcised boys do. Two other studies demonstrated that uncircumcised men are nearly three times as likely to get human papillomavirus and more than twice as prone to acquire HIV, as compared with circumcised men. This year, Weiss and her colleagues found that uncircumcised men are also more likely to acquire syphilis and chancroid, a genital lesion.

"My sense is that the evidence is moving in favor of circumcision, while public and clinical opinion is hardening against it. It takes an awful lot of evidence to overturn well-entrenched positions," Fergusson says. —N. SEPPA

QUOTE

"It takes an awful lot of evidence to overturn well-entrenched positions."
DAVID M. FERGUSSON, Christchurch School of Medicine and Health Sciences

Cleanup Speedup

Device improves oil-spill recovery

By adding grooves to the surface of a common oil-skimming device, researchers recovered up to three times as much oil as they did with smooth-surfaced devices. The improvement could reduce the environmental and economical costs of oil spills.

The *Exxon Valdez* incident spewed nearly 11 million gallons of crude oil into Alaska's Prince William Sound in 1989. Although spills of that magnitude occur infrequently, smaller-scale spills are common. According to Jeff Brown of the National Response Center in Washington, D.C., nearly 100 spills of at least 1,000 gallons of oil and more than 10,000 smaller spills have been reported annually in U.S. waters in recent years.

When a grounded tanker or burst pipeline releases oil into the sea, response teams first attempt to contain the spill with a large loop of plastic tubing that surrounds the oil. In most situations, responders next place skimmers shaped like drums or disks into the water. These skimmers rotate and pick up oil on their surfaces. An attached scraper removes the oil, which is later pumped into a storage tank.

Although effective, the skimmers work slowly. Their recovery rates range from 50 cubic meters per hour for heavy crude oil to 0.2 cubic meter per hour for diesel oil, which is lighter, notes Arturo A. Keller, an environmental engineer at the University of California, Santa Barbara.

Victoria Broje, now a spill-response specialist with Shell Global Solutions in Houston, had joined Keller's lab with the goal of improving the efficiency of skimmer technology. She and Keller made several changes to a 25-centimeter-wide, drum-shaped skimmer. Their key innovation was V-shaped grooves, each 2.5 cm deep, on the aluminum drum, Keller says. The grooves increased the surface area of the drum and provided wells that collect oil.

The researchers tested their skimmer in pools of seawater under different temperatures, at different rotational speeds, and with oils of varying viscosities and in different oil slick thicknesses. The grooved drums skimmed up to three times as much oil as the smooth drums did, the researchers report online for an upcoming *Environmental Science & Technology*. Under most conditions, the grooved drums picked up twice as much oil as the smooth ones did.

"We knew it was going to be better, but we didn't think it would be that much better," says Keller. He adds that the technology has now been licensed to a company that manufactures oil-spill cleanup equipment.

It's been a decade since such a "big improvement" in skimming technology has occurred, says Joseph V. Mullin, who manages oil-spill–response research at the Minerals Management Service, the federal agency in Herndon, Va., that funded the new work. "We look forward to this research being transferred to real-world operations." —A. CUNNINGHAM

Chicken Speak

Birds pass test for fancy communication

A chicken going "tck, tck, tck" as it pecks is announcing the presence of food. That clucking makes the chicken the first animal other than primates that's been shown to make

sounds that, like words, represent something in the environment, researchers say.

Older studies have hinted at this chicken power, notes Chris Evans of Macquarie University in Sydney, Australia. For example, he and his colleagues have shown that the particular clucks that chickens give when they find food inspire other chickens to search for it.

The old tests, however, left a nagging possibility that the clucks just trigger a reflex to search for food, Evans says. Now, he and Linda Evans, also of Macquarie University, have used a different approach that's "given us confidence," he says, to label the chicken clucks as representational signals.

Various researchers have linked various kinds of vocalizations to particular responses. The Evans lab, for example, found that chickens give different alarm calls depending on whether a scary intruder flies in or approaches along the ground. Other chickens look in the appropriate direction after each of those calls.

For the new tests, the Evanses went back to food calls. For example, males go "tck, tck, tck" upon discovering anything edible (*hear audio at www.sciencenews.org/20061118/foodcall.aif*). Hens then stalk over to investigate. They take a tidbit from a male's beak or stare intently at the ground. "They look like people who've lost their glasses," says Chris Evans.

In half the tests, the researchers scattered a few kernels of corn onto the floor. That's enough food for a hen to notice, but nowhere near enough to satisfy its craving. The hens ate the corn before hearing a male's clucks. In the other half of the tests, hens encountered no food.

After each hen heard a recording of a male's food call, those that had already received corn spent less than 3 seconds peering at the ground. But birds that hadn't been fed searched, on average, for 7.5 seconds.

The difference in response times reflected whether a bird already knew that food was available, so the call isn't an automatic trigger for some reflex to search the ground, the researchers argue. In contrast, a rooster's ground-intruder call didn't evoke different responses from the fed and unfed groups, the Evanses say in a paper available online and in an upcoming *Biology Letters*.

Primatologist Klaus Zuberbühler of the University of St. Andrews in Scotland compares the results to those from his own test with monkeys. Once those animals heard monkey calls indicating one kind of predator, they responded with less commotion to recordings of that predator than to recordings of a different attacker. So, Zuberbühler argues, these monkey alarm calls are likewise not just triggers of an automatic response.

Finding a similar effect in chickens' food calls is "wonderful," he says. —S. MILIUS

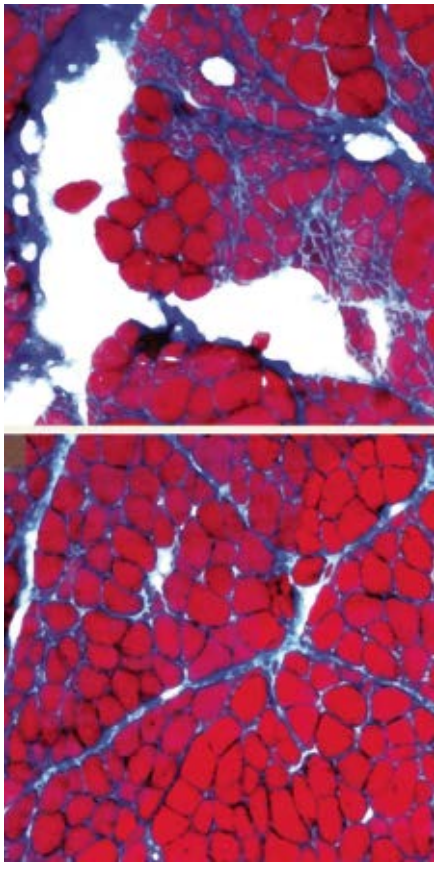
Derailing a Disease

Stem cells slow dogs' muscular dystrophy

Muscle-producing stem cells injected into dogs with the equivalent of Duchenne muscular dystrophy significantly slowed the disease's progression, researchers report.

In people who have the incurable disease, abbreviated as DMD, muscles rapidly degenerate, and patients typically die in their late teens or early adulthood. Although steroid injections and other therapies can ease some of the disease's symptoms, no treatment slows DMD's progression.

Ten years ago, Giulio Cossu of the San Raffaele Scientific Institute in Milan, Italy, and his colleagues discovered muscle-producing stem cells in the walls of blood vessels. When the researchers collected these cells from healthy mice and then injected the cells into mice carrying a genetic mutation that causes muscular dystrophy, disease progression slowed, as measured in several tests. But because mice don't show the same symptoms as people do, the scientists needed to use a different animal to test whether stem cells might be effective against DMD in people.



MUSCLE MASS **Muscle cells from an untreated dog with muscular dystrophy form thin, irregular bundles (top), but a dog treated with donor stem cells has thick, healthy cell bundles (bottom).**

M. SAMPAOLESI

In new work, Cossu's team studied golden retrievers that had a natural canine version of the DMD-causing mutation. These animals experience rapid muscular degeneration similar to that in people with the disease.

Six dogs received five monthly injections of stem cells from a healthy donor dog. The treatment started either at 1 month or 5 months of age, after symptoms had appeared. All these dogs received drugs to prevent tissue rejection.

Four other dogs had their stem cells removed and the disease-causing gene replaced with a healthy one. Each dog then received its own, altered cells in five monthly injections starting at 4 months of age. With this strategy, the dogs didn't need antirejection drugs.

Cossu and his colleagues compared three untreated dogs with the animals receiving each of the stem cell procedures. Though the disease affected each animal differently, by 8 months of age, untreated animals typically could no longer walk, and they all died a year or so after birth.

The dogs that received healthy dogs' stem cells did much better. One of the three dogs that received donor cells 1 month after birth could still walk well at 13 months. Two of the three dogs given donor cells later in their lives were more mobile at 10 months of age than they had been when treatment started.

Dogs that received their own cells with corrected genes also showed slower disease progression than did the untreated dogs but not as dramatic an improvement as did the dogs that received donor cells.

Cossu says that the difference might relate to the gene put into the stem cells. Because the DMD-related gene is so long that it's difficult to get into cells, the researchers worked with a shortened form of the healthy gene. This truncated version might not offer all the benefits of a gene from a healthy donor dog.

Cossu's team reports its results online for an upcoming issue of *Nature*.

Jeffrey Chamberlain of the University of Washington in Seattle, who studies various forms of muscular dystrophy, warns that the research has a long way to go before yielding a treatment for people with DMD. Nevertheless, he calls the findings "a significant breakthrough."

He says, "Any disease that involves significant muscle wasting could be a candidate for this approach." —C. BROWNLEE

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DASHING ROGUES

Freak ocean waves pose threat to ships, deep-sea oil platforms

BY SID PERKINS

In February 1933, the Navy tanker USS *Ramapo* was steaming its way from the Philippines to San Diego in the midst of an exceptionally strong storm. The 146-meter-long ship was buffeted by near-hurricane–force winds. Early on the morning of Feb. 7, a wave far larger than the others surrounding the ship overtook the *Ramapo* from behind.

As the stern of the ship dropped into the trough in front of the wave, an officer on the bridge noted that from his vantage point, the crest of the oncoming wave lined up with an observation platform on the ship's mast. Basic geometry puts the wave at more than 34 m tall, the highest ever observed.

Rogue waves like the one that struck the *Ramapo* occupy a special place in nautical lore. They've smashed into cruise ships, sunk oil-drilling platforms, and terrorized seafarers in fictional accounts for 2,000 years, from Virgil's *Aeneid* to this summer's film remake *Poseidon*.

WALL OF WATER— Rogue waves, such as this 20-meter-tall monster encountered in 1986 by the SS *Spray* in the Atlantic's Gulf Stream, can appear even in calm seas.

NOAA

Although rogue waves—also called freak waves or monster waves—are most often encountered during storms or bad weather, they can appear even in calm seas, and they almost always show up with little warning. Scientists once assumed that rogue waves strike any particular patch of ocean only once every several millennia, but oceanographic data now suggest that the waves are much more common.

New mathematical analyses indicate how rogue waves form in some instances and how long these monsters last before they blend back into the surrounding waves. These models suggest that rogue waves build up and dissipate more readily than lore and past research had indicated. The new analyses may enable scientists to better predict where rogue waves will strike—data well worth knowing for the captains of oceangoing vessels.

BIG & TALL "There's no clear definition of what a rogue wave is," says Paul C. Liu, an oceanographer with the National Oceanographic and Atmospheric Administration in Ann Arbor, Mich.

Scientists don't have many detailed shipboard measurements of rogue waves because they tend to appear without warning, and bobbing ships make poor observation platforms.

A wave typically achieves rogue status not by growing to a certain minimum size but by exceeding the surrounding waves by a certain proportion. The basis for comparison is an oceanographic parameter called significant wave height, which researchers typically calculate by taking the average of the tallest one-third of the waves in a particular patch of ocean. Many scientists define a wave as a rogue if it's 2.2 times as tall as the significant wave height.

Besides their size, rogue waves differ from their tamer kin in their shape. The peaks and troughs of ripples that spread from a gentle disturbance in the water have the approximate shape of a smoothly curving sine wave. But the larger an ocean wave is, the more its profile diverges from a sine wave.

"Real waves have higher crests and shallower troughs than sines," says Al R. Osborne, an oceanographer at the University of Turin in Italy. And rogue waves take these shape changes to the extreme. Their crests are often described as "mountains of water" and their troughs as "holes in the sea".

When a ship drops into the trough in front of a rogue wave, "it's like riding a down elevator," says C. Linwood Vincent, an oceanographer at the Office of Naval Research in Arlington, Va.

According to some scientists' models, any particular spot in the ocean should encounter a rogue wave every 10,000 years or so—about the time since the most recent ice age ended. However, data gathered by instruments on relatively stable platforms and on buoys hint that such big waves occur much more frequently than that.

Take, for instance, the data gathered by sensors mounted on a gas-drilling platform that stands in 100-m-deep water off the southern coast of South Africa. That spot, near the imaginary boundary between the Indian and Atlantic Oceans and on the edge of the Agulhas Current, lies within an ocean region well known among mariners for its abundance of rogue waves (*SN: 11/23/96, p. 325*).

Between 1998 and 2003, the platform's radar equipment measured wave heights twice each second for 20 minutes out of each hour. Of the more than 50,000 data sets gathered during those 6 years, almost 1,600 included at least one wave that measured more than twice that hour's significant wave height, Liu's threshold for rogue-wave status.

In other words, the chance of encountering a rogue wave during any hour spent at this spot was about 3.1 percent. Liu and his South African colleague Keith R. MacHutchon presented their findings in

June at the International Conference on Offshore Mechanics and Arctic Engineering in Hamburg, Germany.

Most of the South African rogues were between two and three times the size of their companions, says Liu. In rare cases, however, the rogue waves towered over their peers even more. Six waves measured between three and four times the size of surrounding waves, and another four were more than four times the size of their neighbors. One previous model had suggested that a quadruple-size rogue wave would appear only once every several million years.

In 2004, Liu and another group of colleagues analyzed data gathered by buoy-mounted equipment in the South Atlantic east of Rio de Janeiro between March 1991 and June 1995. Of the nearly 7,500 data sets that the researchers analyzed, 276 included a wave that measured at least twice the size of its companions. So, the chance of encountering a rogue wave during any hour spent at this spot was about 3.7 percent, slightly higher than that found at the site near South Africa.

OCEAN IN MOTION Despite similarities in the frequency of rogue waves at the two sites that Liu and his colleagues analyzed, the root causes of the waves are probably very different.

The seas off South Africa are geographically complicated and highly dynamic, says Liu. The Agulhas Current flows into the area from the northeast, while the prevailing winds in the region blow from the southwest. As a result of that opposition, the winds—which often have blown uninterrupted over long distances—strike the faces of tall, current-driven waves and cause them to stack up even higher. Also, the shape of the seafloor and the coastline steers the waves as they travel through the area, sometimes creating chaotic encounters between wave clusters traveling in different directions at various speeds.

"Surrounded by such a varied assortment of dynamic interactions, it should not be surprising that very large rogue waves could appear from time to time," Liu and his colleagues note.

The buoy data from near South America tell a different story, however. They suggest that rogue waves can occur in relatively calm seas as well as in rough weather, says Liu. The researchers found rogues during periods when significant wave height measured 12 m, but also when significant wave height was as low as 50 centimeters.

Should the smaller waves really be considered rogues? Yes, Liu argues, because they stand out from their peers.

The Office of Naval Research's Vincent agrees. "We're all interested in 100-foot waves," he adds, but a smaller rogue wave in relatively calm waters can pose a threat to fishing boats or pleasure craft.

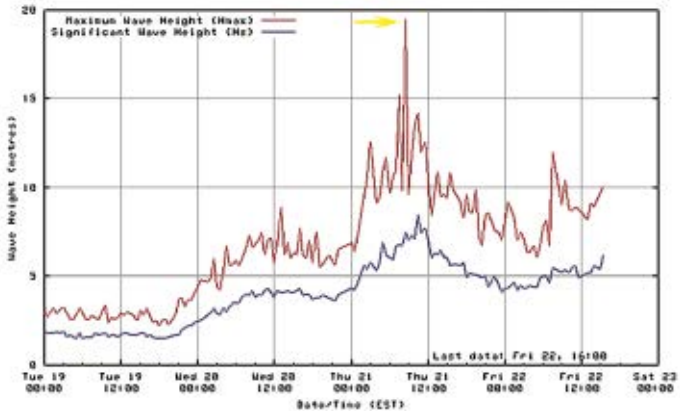
ADDING UP Scientists underestimated the frequency of rogue waves for many years because they presumed that real ocean waves behave as mathematically ideal waves do: When two theoretical 1-m-tall waves cross paths, they briefly form a wave that's 2 m tall. Physicists call this the principle of linear superposition.

But just as ocean waves don't maintain a perfect sine wave profile, they don't often follow the principle of linear superposition. Instead, they usually stack up to make a wave that's larger than the sum of its parts.

When large numbers of waves are generated by the same phenomenon—a strong storm, say, or an ocean current—they travel in groups called wave trains. Individual waves in a train can pass energy back and forth among themselves, for example when large waves overtake and briefly subsume smaller ones. Over the course of 5 or 10 minutes, relatively benign waves can become "much more exciting," says Osborne.

Moreover, the amplifying interactions between two wave trains traveling in different directions—a condition called crossing seas—can really pump up a wave, he and his colleagues report in the Jan. 13 *Physical Review Letters*. Not only do the rogue waves grow taller in crossing seas than they do within a single wave train, they're also more likely to form in the first place. Many ships lost in rough weather have gone down in crossing seas, the researchers note.

Computer simulations indicate that the rogues can form quickly in crossing seas, says Mattias Marklund of Umeå University in Sweden. For instance, when two trains of 3-m-tall waves intersect at an angle of about 22°, waves 10 m tall appear after just 11 minutes. Marklund and his colleagues report their findings in the Sept. 1 *Physical Review Letters*.



WAVY WEATHER— Data recorded by a buoy off the west coast of Tasmania feature a 19.5-meter-tall rogue wave (arrow), which towered above other large waves from a storm passing through the region in mid-September.

Similar analyses suggest that rogue waves can disappear almost as quickly as they form. During one computer simulation that featured several trains of 3-m waves, a 7-m rogue formed in a little over 7 minutes, says Victor P. Ruban of the Landau Institute for Theoretical Physics in Moscow. However, just 3 minutes later—after traveling only 1.2 kilometers—the wave had already dissipated its energy and shrunk back to the size of its peers.

With such mathematical techniques, scientists may predict the conditions that spawn rogue waves. Indeed, in addition to their weather projections, the European Centre for Medium-Range Weather Forecasts is now issuing rogue-wave forecasts on an experimental basis, says Peter Janssen of the centre in Reading, England.

Researchers there have divided the world's seas into 40-km-by-40-km areas, and they use data about ocean currents and the weather in those regions to estimate the distribution of wave sizes that mariners can expect. The forecasters issue a warning for an area when one wave out of every 3,000 there is likely to be a rogue.

The center has issued rogue-wave forecasts for about 3 years, but the slow trickle of reports from the open ocean has slowed the verification of the forecasts. Shipping companies don't like to share details about their routes and positions, but Janssen says that he occasionally hears from captains who have encountered a rogue wave that his center had predicted.

The forecasts are important for a variety of seafarers, including workers on oil platforms and on ships laying underwater cables and pipelines, says Vincent. Captains on oil tankers and cargo ships plying the open ocean—the nautical equivalent of long-haul truckers—often seek the shortest and most economical routes to their destinations, sometimes passing closer to a storm than is prudent.

An unexpectedly large wave could disrupt some naval operations at sea, including those in which ships have pulled alongside each other to transfer people, cargo, or fuel. Accurate forecasts of when and where rogue waves could strike will enable captains to steer clear of risky routes and reach distant duty stations as safely as possible, says Vincent.

Although menacing waves have different of causes, identifying the conditions under which some of these rogues form may cut the risk of ships being caught by surprise. ■

LIU

EVOLUTION'S MYSTERY WOMAN

Disagreements rage about tiny ancient islanders

BY BRUCE BOWER

All hail Flo, the diminutive belle of the evolutionary ball. She made a flashy entrance in 2004 using the species name *Homo floresiensis*, given to her by her discoverers. Flashbulbs popped when the scientists announced the results of their analysis of Flo's partial skeleton and the assorted bones of other individuals uncovered on the Indonesian island of Flores.

The shape and size of the fossils showed that they came from little cousins of humankind, the team concluded. The island individuals, who lived between 100,000 and 12,000 years ago, stood about 3 feet, 3 inches tall and possessed chimpanzee-size brains.

Flo's discoverers, led by anthropologist Peter Brown and archaeologist Michael J. Morwood, both of the University of New England in Armidale, Australia, described their fossil gal as being considerably shorter than members of modern pygmy groups, blessed with incredibly strong legs, and a member of a now-extinct *Homo* species that had spent tens of thousands of years developing its own toolmaking tradition on Flores (*SN: 10/30/04, p. 275*).

Anthropologists largely greeted Flo as a member of a new species of human ancestor. She seemingly provided the first evidence that, like many other animals, the *Homo* lineage had evolved small island-dwelling forms.

But after being welcomed to the scientists' evolutionary shindig, Flo continued to make a scene. The fossil islander triggered an unusually vitriolic scientific dispute within months of her discovery. Debate over whether she represents a previously unknown species reached a fever pitch with the publication of a new analysis of the Flores fossils in the Sept. 5 *Proceedings of the National Academy of Sciences*.

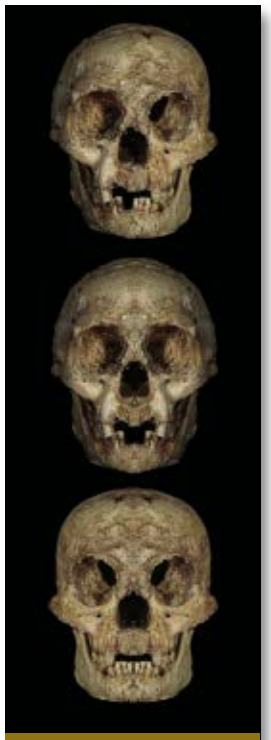
That report concludes that Flo was a pygmy *Homo sapiens* with a stature about 7 inches taller than previously estimated. What's more, Flo displays skull and limb abnormalities that resulted from a still-enigmatic, genetic growth disorder, say anthropologist Teuku Jacob of Gadjah Mada University Faculty of Medicine in Yogyakarta, Indonesia, and his coworkers.

These scientists hold that in her prime, Flo tottered on malformed legs or may even have been paralyzed. Some of her fellow Flores folk inherited the growth disorder, the scientists suggest. Still, physically capable members of Flo's kind fashioned stone tools that could have been made only by anatomically modern people, Jacob's team asserts.

With such arguments, Flo's evolutionary status has gotten fuzzier, remarks Susan C. Antón of New York University. It's tough to delineate precisely where one hominid fossil species ends and another begins, she notes. Longstanding debates over the number of species in the human evolutionary family attest to that difficulty.

"It's a bit like our Pluto," Antón says, referring to astronomers' dustup over how to define planets.

To make matters worse, the Flores finds so far include only one skull and two lower-jaw bones, along with scattered lower-body remains from a handful of individuals. That's precious little material with which to re-create an ancient population.



THREE-FACED — The actual skull of Flo (top) displays shape imbalances that show up in computer-generated composite images composed of the right side of the skull and its mirror image (center) or the left side and its mirror image (bottom).

E. INDRIATI, D. FRAYER

SPECIOUS SPECIES If you want to look up Flo's flesh-and-blood descendants while visiting Flores today, just look down, says anthropologist Robert B. Eckhardt of Pennsylvania State University in University Park, a coauthor of Jacob's new paper. According to Eckhardt, Flo's modern offspring, the Rampassasa pygmies, live close to Liang Bua Cave, the site of the *H. floresiensis* discoveries.

These small folk, ranging in height from 4 to 4.5 feet and having brains about standard size for modern humans, possess skeletal features originally described by Brown's team as unique to Flo's kind, Eckhardt asserts. For instance, many Rampassasa display receding chins and cheek teeth positioned at an unusual angle.

Overall, 140 skull and tooth features of the Flores fossils also appear in the Rampassasa and other native inhabitants of Australia and Melanesia, Eckhardt and his colleagues hold. They say that Brown's group erred by comparing their fossil finds mainly with European *H. sapiens* skeletons.

To compound this problem, Flo's discoverers used a mathematical formula for estimating stature that shortchanged her height, Eckhardt contends. Flo, also referred to as LB1, stood an inch or two shy of 4 feet, according to his team's adjusted calculations.

This revised height gives a brain-to-height-ratio that suggests that Flo suffered from an as-yet unspecified growth disorder that included microcephaly, a genetic condition that results in an unusually small head and brain.

Evidence of facial asymmetry strengthens the argument that Flo suffered from a growth disorder, Eckhardt adds. Composite photographs of her facial bones that combine an image of either the left or right side and its mirror image look much different than an unmanipulated photo does. These disparities reveal more pro-

nounced facial-feature imbalances than have been observed in typical modern people, his team reports.

Using a scanning device, Eckhardt and his coworkers found that Flo's limb bones, although large in diameter, contain unusually thin outer layers of bone, a sign of developmental trouble.

Another finding suggests that she had great difficulty in moving or that she suffered from paralysis, says study coauthor Maciej Henneberg of the University of Adelaide Medical School in Australia. Muscle-attachment sites on Flo's arm and leg bones show only faint marks, a sign of limited movement throughout her life, since these sites become more prominent with greater muscle use.

A limited ability to twist her upper arm, gleaned from the team's analysis of Flo's fossilized arms and shoulders, also underscores her movement difficulties.

Flo "is not a normal member of a new species, but an abnormal member of our own," Eckhardt says.

DEVELOPING DOUBTS Some anthropologists see the new report from Jacob's group as a confirmation of their suspicions—largely stimulated by the modern-looking stone tools found with the Flores fossil—that the bones come from Stone Age people, not a new species of human ancestors. "There is genuine cause for concern about the widely popularized scenario of *Homo floresiensis*," remarks Robert D. Martin of the Field Museum in Chicago. Jacob's investigation shows that some modern people in Indonesia possess Flo's supposedly unique skeletal features, Martin says.

Determining whether Flo had developmental abnormalities will require studies to identify similarities and differences between her limb and torso bones and those of modern adults with microcephaly. Nonetheless, Flo's brain case strongly resembles that of a short person with microcephaly, Martin and his colleagues conclude in the November *Anatomical Record*.

The team examined computer-generated reproductions based on measurements of the inner walls of braincases from Flo and two present-day adults with microcephaly, one from Africa and the other from India. The scientists then reconstructed the brain's surface for each specimen. The three individuals display similar neural contours, the researchers say.

Their report counters earlier findings by a team led by Dean Falk of Florida State University in Tallahassee. Falk's investigation, using the same method, portrayed Flo's brain as shaped differently from the brains of modern humans, including the brain of a 10-year-old boy from Germany who had microcephaly.

Anthropologist Erik Trinkaus of Washington University in St. Louis is struck by Flo's similarities to *H. sapiens*. For instance, bony protrusions that shore up her lower jaw appear in a modern human skull that is from Eastern Europe more than 100,000 years old, Trinkaus says. Brown's team had previously cited these protrusions as a unique feature of the Flores fossils.

Flo's upper-leg bones display much thinner walls than do any comparable bones from previously identified Stone Age individuals, Trinkaus says. "It reminds me of [modern] cases of long-term limb paralysis," he remarks.

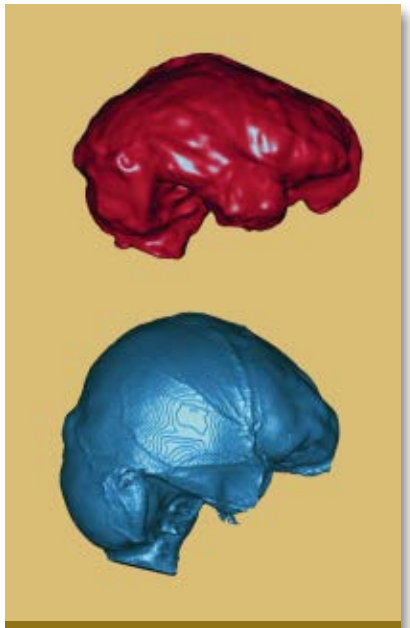
It's not clear whether such characteristics say more about Flo's unique growth pattern or her species identity, in his view. "Whatever these Flores fossils are, let's sort out their biology before talking about their evolutionary status," Trinkaus says.

Inspired by that idea, evolutionary biologist Gary D. Richards of the University of California, Berkeley reviewed genetic and biological factors that contribute to microcephaly and short stature in people today. Mutations of one gene or a few genes that influence growth hormones in *H. sapiens* could have yielded an individual such as Flo, Richards concludes in an article published in the November *Journal of Evolutionary Biology*.

Unlike Jacob and his coworkers, Richards suspects that Flo had no developmental problems such as microcephaly. In his view, she was a typical member of a pygmy *H. sapiens* group.

Genetically induced reductions of brain and body size show up in substantial minorities of people living in small, isolated populations, Richards says. These changes yield survival-enhancing declines in energy needs with only a minimal loss of thinking skills, he notes.

Individuals in current pygmy populations typically develop "primitive-looking" skeletal features, much like those described for Flo, simply as a result of having small bodies, Richards adds. For Flo and perhaps some of her peers, though, genetically curtailed brain growth might have been more pronounced than that occurring in pygmies today, he contends.



INSIDE VIEWS — Brain reconstructions of Flo (red) and a modern human female with microcephaly (blue) support the view that the Indonesian fossil comes from a new *Homo* species, some researchers argue.

FALK

GO WITH FLO One of the co-discoverers of the Flores fossils finds it difficult to contain his contempt for the new paper from Jacob and his colleagues. Brown brands their analysis "a complete crock."

Jacob's group ignores the unique anatomy of *H. floresiensis*, Brown asserts, such as a thick-boned lower jaw that recalls those of 3-to-4-million-year-old human ancestors in Africa rather than modern human jaws.

The new study erroneously argues that people living on Flores today sometimes lack distinct chins, as Flo's kind does, Brown adds. Projecting teeth can disguise the presence of a chin on Rampassasa individuals, but "all modern humans, including microcephalics, have one," he holds.

Further analysis also supports the notion that the shape of Flo's brain and of the brains of microcephalic people differ substantially, says Falk. She and her coworkers have recently extended their earlier work. They've compared computerized braincase reproductions for Flo, 9 people with microcephaly and growth retardation, and 10 regular-size adults. Members of the modern groups came from various parts of the world.

First, Falk says, her team identified substantial shape disparities between the brains of modern folks with and without microcephaly.

Next, the researchers considered a brain reconstruction from a 3½-foot-tall woman with dwarfism, a genetic condition that causes short stature but not an unusually small brain. On a measure of brain shape, Flo and the regular-size adults looked alike, as did the woman with dwarfism and adults with microcephaly.

These results support the notion that Flo's brain came from an individual free of developmental problems, Falk concludes. Still, she says, Flo possessed enough unusual neural characteristics to uphold her membership in a separate *Homo* species.

When Australian researchers not connected to Brown's team compared Flo's skull with skulls of several modern people and of two fossil individuals with microcephaly, they came to the same conclusion (*SN: 7/15/06, p. 37*).

Such findings are persuasive to anthropologist Bernard Wood of George Washington University in Washington, D.C. Much asymmetry in Flo's skull occurred not during development but after her remains became encased in soil that shifted over time and reshaped the bone, Wood argues.

OUT ON A LIMB Scientific defenders of *H. floresiensis* have also stepped forward with analyses of Flo's arms and legs. In presentations at the Paleoanthropology Society's annual meeting in San Juan, Puerto Rico, last April, Susan G. Larson and William L. Jungers, both of the State University of New York at Stony Brook, described Flo as a healthy *H. floresiensis* with some unusual limb features.

Larson reported that Flo's kind possessed substantially shorter collarbones, relative to arm length, than any modern human has. This trait would have pulled the shoulders in and close to the head.

The leg strength of Flo and her peers was "in another universe," Jungers reported (*SN: 5/13/06, p. 302*). In build and body size, which he estimates at 55 to 75 pounds, Flo resembles Lucy, the 3.2-million-year-old *Australopithecus afarensis* skeleton from eastern Africa, Jungers says.

BRAIN TEASER — The skull of this modern human with microcephaly and its brain reconstruction contribute to the argument that Flo was a *Homo sapiens* with a developmental disorder.

J. WEINSTEIN/FIELD MUSEUM

Jungers rejects the new portrait of Flo as a developmentally disabled human. In his measurements, the specimen shows normal outer-bone thickness, not the thin walls reported by Jacob's group.

Moreover, Jungers contends, marks made by muscles on bone, or the lack of marks, implies nothing about an individual's mobility. He cites animal studies showing that even intensive exercise doesn't alter the appearance of spots where muscle attaches to bone. He also emphasizes that Flo's limb proportions and estimated height don't appear in any known human population, even the smallest pygmies.

Jacob and his colleagues reject these arguments. For example, they regard Jungers' measurements and his estimate of Flo's height as inaccurate.

Another scientific standoff concerns Stone Age tools found at the Liang Bua Cave and at sites dated between 840,000 and 700,000 years old in the nearby Soa Basin (*SN: 6/3/06, p. 341*). Flo's discoverers assert that similarities among these artifacts show that *H. floresiensis* carried on a toolmaking tradition passed down for countless generations by its island forebears.

Critics, such as Martin, argue that only individuals with human-size brains could have fashioned tools as complex as those found at Liang Bua. They suspect that the Soa Basin implements are much younger than 700,000 years.

WHO'S THAT LADY? It's hard to know when the clouds will part and Flo's true evolutionary identity will shine through. To make matters worse, Flo's discoverers say that Jacob and his coworkers studied the Liang Bua fossils after furtively borrowing the bones without first gaining permission to do so from the Indonesian National Center for Archaeology, breaking a written agreement between that body and the University of New England.

Jacob didn't answer a request to respond to this accusation.

Better tests of the competing views of the Flores fossils will come with further fossil discoveries on the island and with extraction of DNA from Flo's bones, says anthropologist Tim D. White of the University of California, Berkeley.

Like any mystery woman, Flo watches impassively as scientific suitors slug it out for the right to give her a lasting name. ■

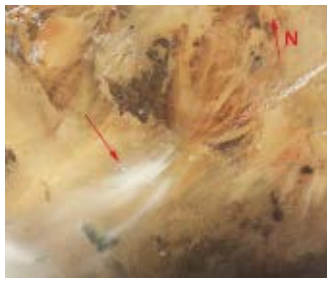
OF NOTE

EARTH SCIENCE

The African source of the Amazon's fertilizer

In the winter months in the Northern Hemisphere, massive dust storms from the African Sahara waft southwest across the Atlantic to drop tons of vital minerals on the Amazon basin in South America. Now, scientists have pinpointed the source of many of those dust storms and estimated their dust content.

The Amazonian rainforest depends on Saharan dust for many of its nutrients, including iron and phosphorus (*SN: 9/29/01, p. 200*). "If it weren't for those nutrients, the Amazon would be a wet desert," says Ilan Koren, an atmospheric scientist at the Weizmann Institute in Rehovot, Israel.



ON THE WAY Satellite photo shows dust (arrow), bound for the Amazon, blowing away from the Sahara's Bodélé depression.

Using satellite measurements of dust clouds, Koren and his colleagues estimate that 40 million tons of Saharan dust reaches South America each year. The images indicate that more than half of that dust originates from the Bodélé depression, a now-dry basin on the southern edge of the Sahara that in wetter times held a body of water the size of Lake Erie.

Although the depression is only 0.2 percent of the Sahara's surface area, it's a prodigious dust source, the researchers report in the October–December *Environmental Research Letters*. Dust storms arise from the area on 40 percent of winter days. On average, the storms loft more than 700,000 tons of dust each day, says Koren. —S.P.

CHEMISTRY

Were Viking landers blind to life?

The Viking landers may have missed potential signs of life when they explored Mars in 1976, an international research team asserts.

NASA's two unmanned Viking craft landed on Mars, took pictures, and conducted a variety of experiments. While some of the data suggested biological activity in the Red Planet's soil, the chemical analyses didn't turn up organic compounds, expected to be present if there were life there.

The data became the basis for arguments against current or past life on Mars, says Rafael Navarro-González, a chemist at the National Autonomous University of Mexico in Mexico City.

The Viking landers used a technique called thermal volatilization–gas chromatography–mass spectrometry (TV-GC-MS) to analyze the soil. In that process, an instrument vaporizes a soil sample, separates the chemical fragments produced, and then identifies those constituents.

To review the technique's effectiveness, Navarro-González and his colleagues used TV-GC-MS on Earth soils that share features with soil on Mars. They tested arid samples from Chile, Egypt, and Antarctica and iron-rich soils from Spain and Hawaii. The researchers also tested all the samples with a different technique for measuring organic matter.

In tests of the arid-soil samples, the latter technique revealed small amounts of organic compounds. But a TV-GC-MS analysis done according to the landers' protocol failed to detect those compounds.

The iron-rich soils also contained organic compounds. However, the researchers found that the iron causes a reaction during TV-GC-MS analysis that converts the compounds' carbon to carbon dioxide. This could explain why the landers detected carbon dioxide but not organic material, notes Navarro-González.

"The question of whether there is life on Mars remains open," he adds.

The researchers describe their work in the Oct. 31 *Proceedings of the National Academy of Sciences*. —A.C.

NASA

ANIMAL SCIENCE

Farm salmon spread deadly lice

In the Pacific Northwest, sea lice that spread from cultivated salmon to their wild counterparts have become major parasites affecting the wild population. The lice, which are visible to the naked eye, attach to fish and draw blood and nutrients.

John Volpe of the University of Victoria in British Columbia and his colleagues previously reported that sea lice spread readily between these groups of fish (*SN: 4/2/05, p. 212*). The team proposed that fish farms imperil wild salmon, which must swim past the farms as they migrate to the sea.

Farms, Volpe says, are "point sources of lice, pumping out tremendous quantities of infectious larvae."

But some researchers questioned that assertion because there was limited evidence that the lice cause substantial harm to wild fish.

In the Oct. 17 *Proceedings of the National Academy of Sciences*, Volpe's team confirms its earlier findings and reports further that sea lice that have spread from fish farms kill 9 to 95 percent of migrating wild salmon, depending on the season and local circumstances.

Volpe says, "Salmon farms are far and away the major contributor to lice on outmigrating salmon [and] the most significant driver of mortality" in the wild fish during their migration.

As part of the new study, the researchers captured migrating salmon and recorded how many lice were attached. Subsequent mortality was significantly higher among salmon that had at least one louse attached than among fish with none. Death of the fish, says Volpe, was "effectively assured with two lice or more." —B.H.

ASTRONOMY

Black hole survey

Scanning the sky for high-energy X rays, NASA's Swift satellite has completed the first comprehensive census of active supermassive black holes that lie within 400 million light-years of Earth. The study, reported in October at a meeting of the American Astronomical Society in San Francisco, found more than 200 supermassive black holes, including several that had been overlooked in previously studied galaxies.

Each black hole, millions to billions times as massive as the sun, lurks at the center of a galaxy but in visible light may lie hidden behind thick layers of dust. However, because X rays penetrate the dust, astronomers can detect black holes by looking for the energetic X rays emitted by the gas swirling around and into them.

Dormant black holes, like the one at the center of the Milky Way, emit too little radiation to be part of the new census.

The Swift satellite was built to record gamma-ray bursts, the most energetic explosions in the universe. But between bursts, Swift's Burst Alert Telescope

searches the sky for X rays, notes study coauthor Jack Tueller of NASA's Goddard Space Flight Center in Greenbelt, Md.

The Swift study builds upon X-ray observations made by the European Space Agency's INTEGRAL satellite and NASA's Chandra X-ray Observatory. INTEGRAL was limited to looking for supermassive black holes in galaxies in the plane of the Milky Way, while Chandra, sensitive to lower-energy X rays than Swift is, could find only more-luminous black holes. —R.C.

PALEONTOLOGY

Asian amber yields oldest known bee

A tiny chunk of amber from Southeast Asia contains the remains of a bee that's at least 35 million years older than any reported fossil of similar bees.

The amber nodule that entombs the newly described *Melittosphex burmensis* was among 100-million-year-old rocks in northern Myanmar. The male bee measures nearly 3 millimeters long, about the size of a modern-day sweat bee, says Bryan N. Danforth, an entomologist at Cornell University.

HONEY OF A FOSSIL This amber-encased, 3-millimeter-long male represents the oldest known species of bee.

Despite its antiquity, the creature has many features of modern bees, including a full-body coating of small, branched hairs, Danforth and his colleague G.O. Poinar Jr. of Oregon State University in Corvallis report in the Oct. 27 *Science*. However, the bottom section of each hind limb is long and slim, as it is in the ancient group of wasps from which scientists propose bees have evolved. A plate on the underside of the bee's abdomen, which modern ground-dwelling bees use to pack soil as they burrow, hints that the species lived underground.

Male bees don't forage for pollen, and this specimen lacks the specialized pollen-gathering structures that a female of its species probably had, says Danforth. Nevertheless, several pollen grains adorn the fossil. Those grains probably stuck to the bee as it searched for nectar, he notes.

Scientists haven't had direct evidence that bees lived 100 million years ago, but they've long suspected that the creatures were around. That's because eudicots, a group of flowers that today largely depends on bees for pollination, first appeared about 120 million years ago, says Danforth. —S.P.

ASTRONOMY

Nearest extrasolar planet

Astronomers have confirmed the existence of the nearest known planet beyond the solar system. The body orbits the young star Epsilon Eridani just 10.5 light-years from Earth, and it's 1.5 times as massive as Jupiter.

The observations, which include measurements taken by the Hubble Space Telescope, also reveal that the planet's orbit has the same tilt as a disk of gas and dust that surrounds the 800-million-year-old star.

The alignment between planet and disk gives fresh support for the long-held notion that debris disks spawn planets, say G. Fritz Benedict and Barbara McArthur of the University of Texas in Austin and their colleagues. They report their findings in the November *Astronomical Journal*.

Six years ago, McArthur observed a subtle back-and-forth motion of Epsilon Eridani. But that indirect evidence of a planet's gravity indicated only what the minimum mass of the orbiting body would be. That evidence also left open the possibility that astronomers might have been fooled by motion of the youthful star's turbulent atmosphere, which can mimic the effect of an unseen planet tugging on a star.

By using Hubble's fine-guidance sensors to track tiny changes in the star's location in the sky over a 3-year period, the researchers removed any doubts about the planet's existence and established its mass and orbit. They combined the Hubble data with data of several ground-based telescopes.

Late in 2007, when the planet makes its closest approach to Epsilon Eridani, it may reflect enough starlight for Hubble and large ground-based telescopes to take its first picture. —R.C.

BEHAVIOR

Revving up recall while fast asleep

Scientists have discovered a way to give memory a modest lift while people slumber. Application of a gentle electrical current to the scalp, which nudges sleepers into a particular phase of sleep, boosts recall the next day for recently learned facts, say neuroscientist Jan Born of the University of Lübeck in Germany and his colleagues.

Born's team explored a particular sleep phase called slow-wave sleep, which some researchers suspect enhances learning (*SN: 6/26/04, p. 414*). A group of 13 volunteers first memorized as many of 46 word pairs as they could during an evening session. As each participant slept that night, the researchers delivered the current through scalp electrodes for 30 minutes just before slow-wave sleep started. The procedure increased the period of individuals' slow-wave sleep.

The same course was followed during a second night, after volunteers had studied another set of word pairs, but this time the scientists used electrodes that delivered no current.

Participants remembered an average of 37 word pairs when tested before going to sleep. The next day, those who received brain stimulation recalled an average of 41 word pairs, versus 39 pairs for those who received sham stimulation.

Born's group reports its findings online Nov. 5 in *Nature*. —B.B.

ZOOLOGY

Hey, that's me!

The antics of an Asian elephant named Happy suggest that her species could be one of the few whose members recognize their own images, researchers say.

When Happy stood in front of a jumbo mirror, she repeatedly touched her trunk to a white X painted on her forehead, says Joshua M. Plotnik of Emory University in Atlanta. Without the mirror, Happy couldn't see the X.

In previous studies, only a few species—people, great apes, and dolphins—reliably attend to marks on themselves that are visible only in mirrors.

Plotnik and his colleagues set up a mirror for three elephants at the Bronx Zoo. Even at first glance, none of the elephants treated its image as another of its own kind, a typical first reaction in other species. The elephants went through stages of self-recognition common to mirror-savvy species. They explored the mirror as an object—poking their trunks around it—and then made experimental motions in front of it. Only Happy, though, touched the mark on her head, the researchers report in the Nov. 7 *Proceedings of the National Academy of Sciences*.

Theresa Schilhab of the Danish University of Education in Copenhagen, who has also studied mirror testing, says that there's plenty of debate about what the mirror test implies about an animal's self-awareness. Failing the test, adds Schilhab, "should not be mistaken as evidence for lack of sense of self." —S.M.

Books

A selection of new and notable books of scientific interest

A FIELD GUIDE TO MAMMALS OF NORTH AMERICA: Fourth Edition

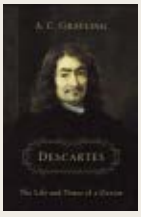
FIONA A. REID

This portable, sturdy, full-color paperback is intended as a tool for animal enthusiasts. It presents a comprehensive range of mammals, from shrews to bobcats, elk, and dolphins. Reid, a nature writer and illustrator, provides a brief introductory section with advice on how to use the book, which consists of full-color plates and concise accounts of hundreds of mammal species. The texts are arranged by taxonomic relationships to aid readers in identifying a species in the field. The guide contains 80 color plates, including skull plates for identifying animal remains, more than 100 color photographs, and detailed illustrations. ***Houghton Mifflin, 2006, 579 p., color plates and photos, paperback, $20.00.***

DESCARTES: The Life and Times of a Genius

A.C. GRAYLING

Though René Descartes died 4 centuries ago, his emphasis on rational thought formed the foundation for modern scientific inquiry. In this detailed biography, Grayling fleshes out the sketchy impression most people have of Descartes the scholar and illuminates his life as a man. The task is difficult because Descartes was intensely private. Grayling traces Descartes' life, starting with the philosopher's formal education in France, which Descartes' himself described as lacking. After that, the young man joined the military and there met Isaac Beekman, a physician who would stimulate Descartes' intellectual development. Grayling also examines the possibility that Descartes worked as a Jesuit spy, infiltrating the ranks of the Rosicrucians, whose scientific ideas were deemed subversive to Christian orthodoxy. Grayling describes Descartes' uneasiness during the prosecution of Galileo for his ideas about the solar system. Descartes eventually published three great works: *Discourse*, *Meditations*, and *The Principles of Philosophy*. In these treatises, he outlined notions as diverse as mind-body dualism and algebra. Grayling provides a new, personal perspective on a man integral to the formation of modern science. ***Walker & Co., 2006, 301 p., color plates, hardcover, $26.95.***



SATURN: A New View

LAURA LOVETT, JOAN HORVATH, AND JEFF CUZZI

Since its discovery, Saturn, with its majestic rings, has captured humankind's imagination. Its beauty inspired researchers at the Jet Propulsion Lab in Pasadena, Calif., to plan a mission to get an up close view. That mission resulted in the spacecraft known as Cassini, which carried a probe called Huygens that was developed by the European Space Agency. This book provides large, detailed images from those spacecraft. Lovett is a publisher with a background in space-related projects, and Horvath and Cuzzi are researchers who worked on the Cassini-Huygens mission. The authors tell the history of the mission, describe various onboard instruments, and include personal stories of some of the key players in the mission. They also provide information on Saturn and its many moons, including its largest, Titan, on which the Huygens probe landed in 2005. ***Abrams, 2006, 191 p., b&w and color photos, hardcover, $40.00.***

THE SECRET OF SCENT: Adventures in Perfume and the Science of Smell

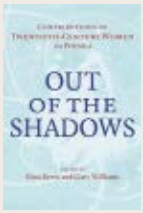
LUCA TURIN

Scents permeate the air, as fragrances of all sorts are being added to an increasing number of products. Remarkably, scientists are still working out the mechanism with which our noses read molecules and translate the resulting nerve signals into the experience of smell. Turin, an olfaction researcher, illustrates for the reader the unique combination of art and science that typifies fragrance production. He explains the processes of extracting scents from their natural sources and of making synthetic scents, both of which are essential to perfumes. He surveys the landscape of common scents, from vanilla to sandalwood to musk, revealing their molecular makeups and detailing the rich variety of flavors that they and variations of them can create. He then outlines the prevailing theories on how olfactory systems recognize scents. Finally, Turin details his own theory of olfaction, which guides him in designing new fragrances. ***HarperCollins, 2006, 207 p., b&w images, hardcover, $23.95.***

OUT OF THE SHADOWS: Contributions of Twentieth-Century Women to Physics

NINA BYERS AND GARY WILLIAMS, EDS.

Although the greatest barriers against women in higher education and research have been removed, women's historical achievements in the male-dominated field of physics are generally unknown. Byers and Williams, both physicists at the University of California, Los Angeles, detail the careers and discoveries of 40 women who made their contributions between 1876 and 1976. Examples include Inge Lehmann, who discovered that Earth has a solid core; Lise Meitner, a codiscoverer of the neutrino; Mary Lucy Cartwright, who made strides in formulating chaos theory; and the well-known Marie Curie, who discovered natural radioactivity. The book's essays, written by various academics from physics and chemistry, highlight the women's accomplishments, provide brief biographies, and suggest further readings. ***Cambridge, 2006, 471 p., b&w photos, hardcover, $35.00.***



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LETTERS

Sunny side heads up

"Rare Uranian eclipse" (*SN: 9/9/06, p. 166*) tells us, "Because the moons of Uranus orbit at the planet's equator, the sun seldom illuminates them directly." I think what you mean is that the moons seldom pass directly between Uranus and the sun. But surely the sun still illuminates them, even when they're not casting shadows on the planet.

GREGORY KUSNICK, SEATTLE, WASH.

Economic depression

"Mood disorder cuts work performance" (*SN: 9/23/06, p. 206*) said that people with bipolar disorder tend to have more lost workdays than those with major depression do. The data shows this is true. However, the authors point out that in the sample of 3,378 workers, 1 percent suffered from bipolar disorder while 6 percent experienced major depression. Clearly, the greater impact on employers is depression.

SKIP SIMONDS, SAUGUS, CALIF.

You call that tourism?

I was extremely disappointed to read the definition of ecotourism as being "the practice of visiting sites where exotic landscapes and rare animals are the main attractions" (*"Good Gone Wild," SN: 9/30/06, p. 218*). Ecotourism was founded with the specific goal of countering the overuse of the kind of travel described in the article. A better definition would be one used by the Ecotourism Society since 1990: "Responsible travel to natural areas that conserves the environment and improves the well-being of local people." The word *responsible* would not describe much of the travel described in the article.

RON LEVALLEY, ARCATA, CALIF.

Good trip, bad trip

The "mystical journey" described in "Chemical Enlightenment" (*SN: 9/30/06, p. 216*) has long been available drug free and under carefully controlled conditions via biofeedback. The results of these sessions are very similar to those described by people who received psilocybin. In the rare circumstances when clients become uncomfortable in their altered states, a session can be terminated immediately.

DOREEN E. MCMAHON, MCLEAN, VA.

My experience cries for researchers to reconsider giving psilocybin to volunteers. I ate drug-containing mushrooms in 1978, and what started out as interesting sensory changes devolved into massive depression that mentally altered me for years.

NAME WITHHELD

"This sleek, compact music maker couldn't be easier to operate…an extraordinary performer."
– Jonathan Takiff,
Philadelphia Daily News

"Turn it up, close your eyes and you'll think you're listening to a…sound system that costs five times more."
– Forbes FYI

"The sound that came out of this little thing was unbelievable... A marvel of technology."
– David Novak,
the Gadget Guy

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