

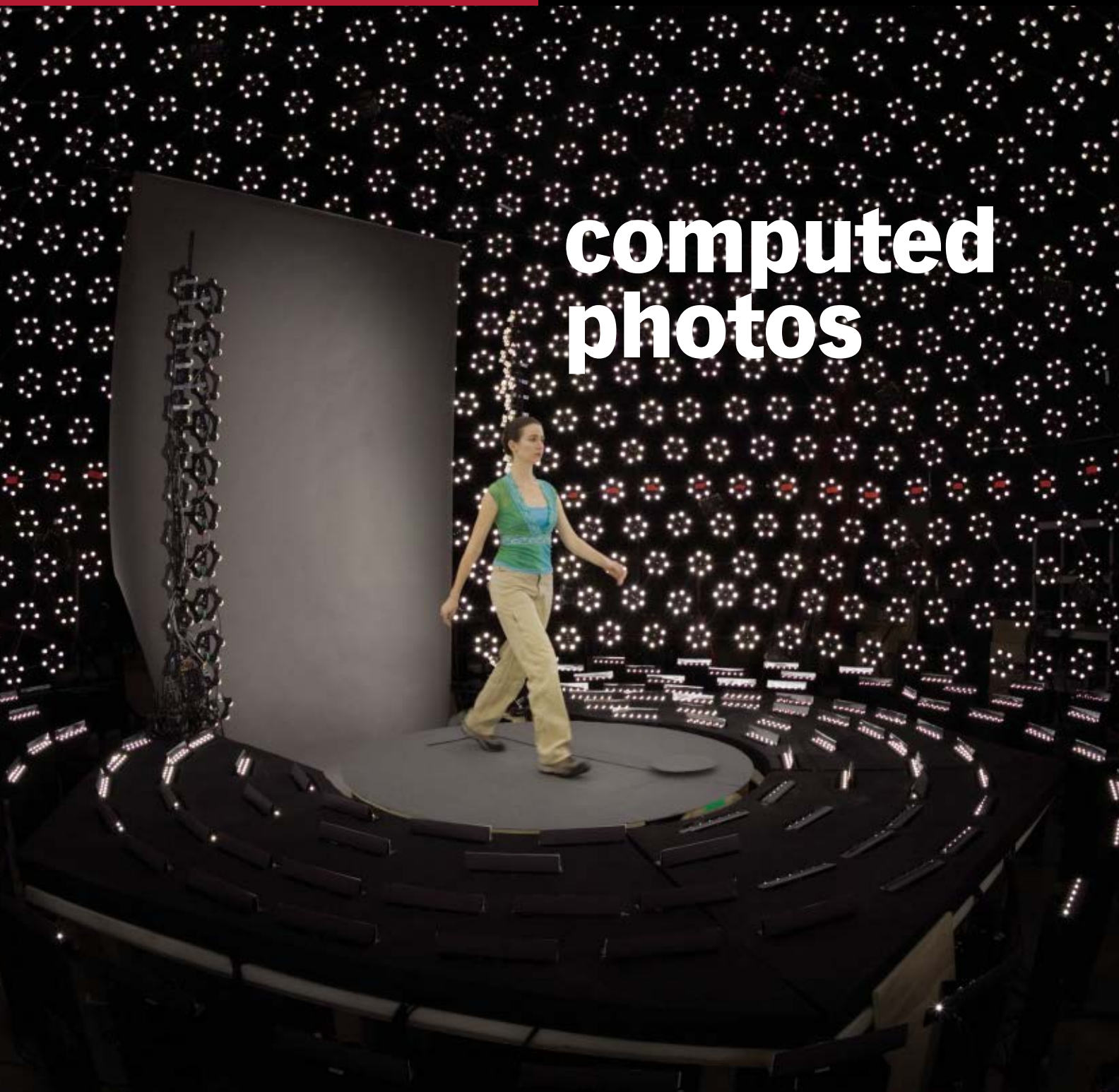
SCIENCE NEWS

THE WEEKLY NEWSMAGAZINE OF SCIENCE

APRIL 7, 2007 PAGES 209-224 VOL. 171, NO. 14

taking sleep apnea to heart
a mecca for panic prevention
martian global warming
jaw-dropping fossil find

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SCIENCE NEWS

APRIL 7, 2007 VOL. 171, NO. 14

Features

216 Pictures Posing Questions

The next steps in photography could blur reality
by Patrick L. Barry

218 A Gasping Heart Cardiac quirk may worsen sleep apnea, invite altitude sickness
by Ben Harder



This Week

- 211 Fossil puts ancient humans in Far East**
by Bruce Bower
- 211 Polymer coatings fortify pancreas cells**
by Aimee Cunningham
- 212 Mushroom records show climate-change boost**
by Susan Milius
- 212 Countering drug tests with niacin proves dangerous**
by Nathan Seppa
- 213 Crowd-motion findings may prevent stampedes**
by Davide Castelvecchi
- 213 Drug-resistant Japanese flu strains appear transmissible**
by Brian Vastag
- 214 There's global warming on Mars too**
by Sid Perkins

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

Food for Thought Scientists cook up ideas for making pizza healthful.

MathTrek Some toys never topple.

Of Note

- 221 Rare flower needs prickly neighbors**
Wave's-eye view of a hurricane
Kill-save gene combo might fight malaria
Freeze-thaw cycles: How not to mix oil
- 222 New solutions for unused drugs**
On the move
Patches take sting out of canker sores
Meningitis vaccine stops ear infections

Departments

- 223 Books**
- 223 Letters**

Cover In one new aspect of computational photography, a dome contains hundreds of precisely positioned flash units. A high-speed camera captures a frame as each flash fires in sequence. Computers can then relight the scene as they reconstruct it. (Paul Debevec/University of Southern California) [Page 216](#)

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Asian Trek

Fossil puts ancient humans in Far East

Researchers have unearthed a 40,000-year-old partial human skeleton in a northern Chinese cave. This rare find underscores the vast distances covered by human groups that left eastern Africa starting around 60,000 years ago. It also intensifies debate about whether prehistoric people replaced or interbred with humanlike species encountered during migration.

In 2001, tree-farm workers discovered a few bones from the ancient skeleton at Tianyuan Cave, located 56 kilometers southwest of Beijing. Chinese paleontologists led by Hong Shang of the Chinese Academy of Sciences in Beijing then excavated the site in 2003 and 2004.

Findings included limb bones, a lower jaw, and a few teeth from one individual. The lack of a preserved pelvis obscures the individual's sex. Investigators found no stone artifacts or other cultural remains at the site.

Radiocarbon measurements of one of the specimen's leg bones and of animal bones

at the site provided an age estimate.

In an upcoming *Proceedings of the National Academy of Sciences*, Shang and his coworkers describe a mix of modern-human and so-called archaic skeletal traits. This anatomical mosaic reflects interbreeding between ancient-human immigrants and humanlike species that already inhabited eastern Asia, in the researchers' view.

"As early modern humans spread out of eastern Africa, they interbred with other [*Homo*] populations [to different degrees]," says study coauthor Erik Trinkaus of Washington University in St. Louis.

The Chinese skeleton includes a jaw, legs, and arms that resemble those of people today. In contrast, its teeth and hand bones display features like those of the archaic *Homo* species known as Neandertals. These creatures inhabited Europe and western Asia from 130,000 to 30,000 years ago. Remains of eastern Asian *Homo* species from that period are too scarce to compare with the new find.

Only one other modern-human fossil in eastern Asia is as old as the Chinese skeleton. A skull found on Borneo in 1958 dates to between 45,000 and 39,000 years ago, report Graeme Barker of the University of Cambridge in England and his colleagues in the March *Journal of Human Evolution*.

Still, scientists disagree about whether modern humans interbred with Neandertals and other archaic Stone Age populations (*SN*: 3/24/07, p. 186).

Modern humans in eastern Africa may have initially evolved some archaic-looking traits on their own, suggests anthropologist Katerina Harvati of the Max Planck Institute for Evolutionary Anthropology in Leipzig, Germany. Later generations that moved to Asia would have

inherited those traits without interbreeding, she says.

However, too few fossils of modern humans from the period just before and during ancient migrations from Africa exist to test for this possibility.

"I will keep an open mind on the extent of hypothesized [interbreeding]," remarks anthropologist Chris Stringer of the Natural History Museum in London. For now, he suspects that little or no ancient interbreeding occurred.

Aside from its controversial blend of traits, the Chinese skeleton displays the oldest known evidence of regular footwear use, Trinkaus says. The specimen's strong legs contrast with an unusually delicate toe that must have been protected from the stress of barefoot walking, he asserts. —B. BOWER

That's a Wrap

Polymer coatings fortify pancreas cells

A technique that encapsulates cells in polymer might someday benefit people who receive pancreas-cell transplants for diabetes, researchers say.

In type 1 diabetes, the immune system destroys insulin-producing cells in pancreatic-cell clusters called islets. Patients then must inject themselves regularly with insulin to control blood glucose.

An experimental treatment that transfers a deceased donor's islets to another person can reduce the need for insulin, but the recipient must continuously take immunosuppressive drugs—which have serious side effects—to prevent the body from rejecting the transplanted cells.

Shielding the islets from the immune system might ease this problem, says chemist Milan Mrksich of the University of Chicago. For example, a polymer coating that lets the insulin molecules, which are small, flow out while blocking the entry of larger immune system molecules, "might be able to maintain function of the islet but mask the islet from the recipient's immune system," he says.

However, islets vary in diameter. Prior coating efforts gave larger islets thin layers and smaller islets thick layers, and those variations altered the islets' function, says Mrksich.

To make uniform coatings, Mrksich, physicist Sidney R. Nagel, surgeon Marc R. Garfinkel, and their University of Chicago coworkers use a technique called selective withdrawal. They start with a layer of water atop a layer of high-density oil. Within the water are islets from rats and the ingredients for a biocompatible polymer.

Applying suction near the upper boundary of the oil layer, the researchers draw off



SHANG ET AL.

MOUTHING OFF Excavations at a Chinese cave have yielded a 40,000-year-old partial human skeleton, including this lower jaw.

oil along with a small amount of water. The water, carrying islets, forms a thin stream within the flow of oil.

As the liquids travel down the suction tube, the water stream narrows to the point where it's no wider than an islet. It then pinches off, leaving the cells suspended in oil but enclosed in a thin shell of water. Finally, the assembly line of islets encounters a laser, which forms the coat by initiating a reaction in the chemicals dissolved in the water, Mrksich says.

The researchers found that they needed to send cells through the device twice to ensure complete coverage of each islet.

The final uniformity of the coatings is "extremely remarkable," comments physicist David A. Weitz of Harvard University. "Techniques to do that are really quite rare."

The researchers found that the islets' coatings blocked proteins slightly smaller than immune system molecules of concern but didn't stop transport of molecules approximately the size of insulin. The coated islets' release of insulin in response to changing concentrations of glucose was indistinguishable from that of uncoated islets, the team reports in the April *Small*.

The work "shows the potential of this technology," says Elliot L. Chaikof, a surgeon and bioengineer at Emory University in Atlanta. He notes that the next challenge will be to scale up the procedure so that many cells can be coated at once. Experimental transplantations use about 10,000 islets per kilogram of a patient's weight, he says. A single run-through of the Chicago team's device coats 100 cells per hour. —A. CUNNINGHAM

Mushroom Boom

Hobby records show climate-change boost

Mushrooms in England are both popping up earlier and staying around longer than they used to, according to 50 years of amateur naturalists' records. Some species have changed their habits so drastically that they're reproducing twice in the same year.

"This is the first time anybody has bothered to look at how fungi are responding [to warming]," says Alan C. Gange of Royal Holloway, University of London. "The trends are dramatic."

He says that the inspiration for the study

came from his father, Edward Gange, who for decades had kept detailed records of local mushrooms. After retiring from stone masonry, the elder Gange bought a computer, learned how to use a spreadsheet program, and entered his sightings, along with those of other fungi enthusiasts in southern England. He ended up with 52,000 observations.

"I suddenly realized, here was an enormous resource," says Alan Gange. A researcher in microbial ecology, he worked through the records with his father and two colleagues. Many climate-change studies focus on spring events such as advances in blooming or bird nesting. The mushroom analysis, however, focused on 315 species that normally fruit in the fall. The team checked the history of each species to see how its fruiting dates related to changes in regional temperature and rainfall.



SNOW CONES A late-spring snow covers sulfur tuft mushrooms in southern England, where they once fruited only in the fall.

In the 1950s, the average fruiting season for the mushrooms in the sample lasted 33 days. In this decade, the season has more than doubled, to almost 75 days. Eighty-five of the species have started fruiting earlier, advancing almost 9 days per decade, while 105 species have been hanging around about a week longer.

Several species have advanced dramatically. The common fairy-ring mushroom used to send up its rings of beige caps in lawns and fields in September. "Now, it's July," says Alan Gange. Sulfur tuft mushrooms, which once fruited only in the fall, often send up clumps of little caps early in the spring as well. Gange and his colleagues report their findings in the April 6 *Science*.

Compared with other creatures shown to be affected by climate change, "fungi are

especially sensitive," says Gange. Would he expect such changes elsewhere? "In North America—certainly," he says.

"I was surprised at the study," says mycologist David Hibbett of Clark University in Worcester, Mass. The work shows unusually big shifts in species' habits, but "I buy it," he says.

The species in the study perform valuable services in their ecosystems, Hibbett points out. Some break down leaf litter and other debris, and many of them envelop tree roots. The fungi siphon carbon from a plant but boost its supply of nutrients such as nitrogen and phosphorus.

Mycologist Rytas Vilgalys of Duke University in Durham, N.C., also welcomes the new work, though he cautions that, so far, "you can't really predict what the effect will be" of the longer fungal seasons. He and his colleagues reported last year that, in a patch of forest, enhancing the planet-warming gas carbon dioxide changes the soil-fungus community, possibly influencing nutrient flow to the trees.

In addition to Gange's findings, the final report in which the Intergovernmental Panel on Climate Change considers a wide range of ecological effects of warming trends is scheduled for release this week. —S. MILIUS

Not-So-Artful Dodgers

Countering drug tests with niacin proves dangerous

Attempts to hide illicit drug use by taking niacin have landed four people in Philadelphia hospitals over the past 2 years, two with life-threatening reactions to high doses of the nutrient, doctors report.

Niacin, also known as vitamin B₃, plays roles in digestion, hormone production, skin upkeep, and nervous system maintenance. Because the vitamin promotes fat metabolism, doctors sometimes give niacin in large doses to people with high concentrations of cholesterol and triglycerides. That property has led some people to believe that niacin can also cleanse the body of illicit drugs, particularly marijuana.

Two of the four Philadelphia patients experienced nausea, rapid heartbeat, dizziness, dehydration, low blood sugar, blood-clotting abnormalities, liver toxicity, and a dangerous drop in blood pH.

One patient, a 14-year-old boy, also experienced abdominal pain, a run-up in his white blood cell count, and an irregular heartbeat. The other severely affected patient, a 17-year-old girl, was in a coma when an emergency team found her, says study coauthor Manoj K. Mittal, an emergency physi-

cian at Children's Hospital of Philadelphia. He and his colleagues report their findings in an upcoming *Annals of Emergency Medicine*.

The two patients had marijuana-positive urine, Mittal notes.

The boy had taken 11 niacin tablets, each containing 500 milligrams of the vitamin, and the girl had taken 5 such tablets, although the recommended daily niacin dose for adults is just 14 to 16 mg. Both patients recovered, Mittal says. Niacin supplements, even in these large doses, are available over the counter.

The two other people described were a man and a woman in their early 20s. Both showed up at emergency rooms with rashes and flushed skin after taking single 500-mg niacin tablets. They were monitored and released after their symptoms subsided, Mittal says.

Philadelphia isn't the only city with incidents of niacin overdosing. In 2006, the Rocky Mountain Poison and Drug Center in Denver received 16 calls from people who admitted using niacin while attempting to dodge drug screens, says Kenyon Heard, an emergency physician at the center. Twelve other niacin-related calls seemed drug related as well. "Attempts to defeat drug screening with niacin may be a growing problem," Heard says.

Niacin overdosing is not something that emergency rooms encounter often, and it can be confused with an allergic reaction, Mittal says.

"When doctors publish [findings] like this, they are sending up a signal flare to their colleagues," says Donna M. Bush, a forensic toxicologist at the U.S. Substance Abuse and Mental Health Services Administration in Rockville, Md. "Other emergency room doctors will read this study and take note." —N. SEPPA

Formula for Panic

Crowd-motion findings may prevent stampedes

Wherever dense crowds gather, an eruption of panic can have deadly consequences, as in the stampede that killed hundreds during a mass pilgrimage to Mecca in 2006. With methods from the physics of fluids, scientists have now dissected the events of that tragic day and come up with recommendations that may have contributed to making this year's pilgrimage proceed smoothly.

Every year toward the end of the week-long Hajj pilgrimage, millions of pilgrims visit the place in the desert outside Mecca, Saudi Arabia, where Abraham is said to have thrown stones at the devil. Every



DANGEROUS BRIDGE Every year, millions of Muslim pilgrims walk across the Jamarat Bridge near Mecca, Saudi Arabia, for the stoning of the pillars ritual. New research may have prevented catastrophic stampedes this year.

able-bodied Muslim is supposed to make the trip at least once. When they arrive, pilgrims throw pebbles at three walls, which symbolize three apparitions of the Evil One.

Catastrophic stampedes have periodically afflicted the event. The most recent one, on Jan. 12, 2006, killed 345 people and injured 289.

In collaboration with Saudi authorities, physicists at Dresden University of Technology in Germany studied video recordings of the 2006 stampede. They wrote visual-recognition software to track and measure the motion of individuals in the crowd and, by following those individuals, analyzed the crowd's movements as the disaster unfolded.

In normal conditions, pedestrians tend to spontaneously fall into ordered patterns, such as lanes going in opposite directions, previous research had shown. As crowds get denser, stop-and-go patterns begin to propagate in waves, as is typical for cars on heavily trafficked highways. But in critical situations—as when cars get into gridlock—people can break out in panics that result in random patterns of motion, similar to the turbulence of water in the wake of a boat. Crowd members can get squeezed and asphyxiated or fall and be trampled.

The video recordings enabled the Dresden team to identify for the first time a factor that correlates with these transitions in crowd behavior. It can be regarded as a thermometer of chaos.

"We tried dozens of different measurements," says team member Anders Johansson, but he and his colleagues found only one factor, which they called crowd pressure, that proved useful. It combines crowd

density and the rate of change in the velocity of the flow.

The team found that critical thresholds in crowd pressure correlate with the onset of stop-and-go patterns and turbulence. The findings are due to appear in *Physical Review E*.

The results are "remarkable," says Hani Mahmassani, a traffic-dynamics expert at the University of Maryland at College Park. "It sheds incredible light on the anatomy of a major crowd disaster." But Mahmassani, who has also advised the Saudi government on preventing stampedes during the Hajj, warns that understanding the dynamics of crowd panic is not the same as preventing it. "Panic has a psychological dimension," he says.

However, Salim Al-Bosta, a civil engineer in the Saudi government, says that measures based on the research helped the Hajj run smoothly this year. Image-recognition software now tracks the flow of pilgrims and warns organizers to slow the influx of pilgrims to the site when crowd pressure approaches a critical value, he says. —D. CASTELVECCHI

Drug-Resistant Flu Detected

Japanese strains appear transmissible

For the first time, researchers report drug resistance in type B influenza virus, which causes about 30 percent of flu cases in the United States. Furthermore, the researchers

say that unlike a previously noted drug-resistant type A strain, this strain may jump from person to person.

“We’ve found a very clear case of resistance in the presence of antiviral drugs,” says Yoshihiro Kawaoka of the University of Tokyo and the University of Wisconsin–Madison.

Kawaoka’s team studied flu in children infected during a 2004–2005 type B outbreak in Japan. They collected viruses before and after the children had been treated with zanamivir or oseltamivir, two drugs more commonly prescribed in Japan than elsewhere.

While no virus displayed resistance before the drug treatment, a strain from one of 74 children showed resistance to oseltamivir after treatment. This strain harbored mutations in the gene for neuraminidase, the enzyme targeted by the antiviral drugs. Kawaoka says that there is a good chance that resistance arose because of the drug treatment.

The team also studied viruses from 348 ill but untreated adults and children. Seven patients carried drug-resistant viruses—a surprising find. “This is good evidence that the [resistant viruses are] circulating in the community,” Kawaoka says.

Three of the seven carriers may have caught the bug from siblings infected with a resistant strain. The other four probably caught it from nonfamily members in the community, the researchers say, although they acknowledge that the resistant bugs might have evolved spontaneously in the patients. All seven resistant strains carried mutations in the neuraminidase gene.

In 2004, the same research team found drug-resistant strains of the more common type A influenza in 18 children in Japan. The researchers found no evidence that those bugs could hop from person to person.

The new report suggests that drug-resistant type A strains could become transmissible, a scenario that worries Anne Moscona of the Weill Medical College of Cornell University in New York City.

In a commentary accompanying the Japanese report in the April 4 *Journal of the American Medical Association*, Moscona says that earlier laboratory and animal studies suggested that drug-resistant flu strains would be less infectious and less transmissible than normal strains. The new report, though, shows that “contrary to what had been hoped until now, some resistant variants are vigorous pathogens [that] may be here to stay,” Moscona says.

Japan’s reliance on antiviral medications makes the country an ideal breeding ground for drug-resistant flu strains, Kawaoka says. Both he and Moscona urge monitoring of seasonal outbreaks for further drug resistance and call for especially close scrutiny of any appearances of avian influenza, a type A virus.

“Influenza viruses evolve rapidly and nimbly,” Moscona says. She wants pharmaceutical companies to develop new drugs that target weak points on the influenza virus other than neuraminidase. She also says that policy makers and physicians should rethink their antiviral-medication policies to ensure that the drugs aren’t overused. —B. VASTAG

No Escape

There’s global warming on Mars too

The overall darkening of Mars’ surface in recent decades has significantly raised the Red Planet’s temperature, a possible cause for the substantial shrinkage of the planet’s southern ice cap, observed in the past few years.

The brightness of an object is characterized by its albedo, the percentage of light that’s reflected from its surface. Because dark objects in general absorb more solar radiation and get hotter than light ones do, albedo changes on Earth in arctic regions may be playing a part in climate change (*SN: 11/12/05, p. 312*).

Viking orbiters, which circled Mars in the late 1970s, measured the planet’s albedo at latitudes up to about 60° in both hemispheres, says Paul E. Geissler, a planetary geologist with the U.S. Geological Survey in Flagstaff, Ariz. However, data gathered in 1999 and 2000 by another probe, the Mars Global Surveyor, reveal that albedo for much of that area has changed, he notes.

As much as one-third of the Martian landscape had either darkened or lightened by 10 percent or more between the two sets of observations. Many scientists presume that winds blow light-colored dust from one part of the planet to another, exposing the darker rocks beneath, Geissler notes. On balance, the planet grew darker between the late 1970s and the turn of the millennium.

New climate simulations by Geissler and his colleagues indicate that albedo variations may be driving big changes in the Martian climate. Modeling conditions on Mars using albedo data from the Mars Global Surveyor, the team calculated an average air temperature at the planet’s surface about 0.65°C higher than in comparable simulations using the Viking-era data.

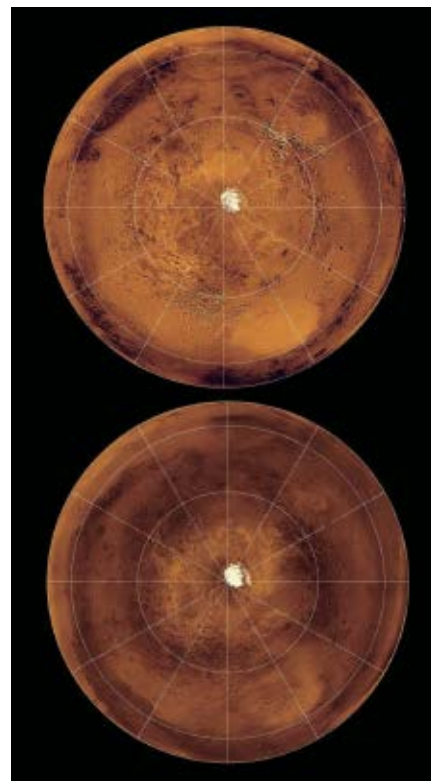
In some areas, particularly those over the planet’s southern ice cap, air temperatures might have increased as much as 4°C, the researchers report in the April 5 *Nature*.

Mars’ southern ice cap is shrinking and has lost billions of tons of carbon dioxide over just the past 4 Martian years, says Geissler. The team’s simulations suggest that the planet’s albedo-induced warming may be responsible for as much as 60 percent of that loss.

Geissler and his colleagues have conducted “a very straightforward study,” says R. John Wilson, an atmospheric scientist with the National Oceanic and Atmospheric Administration in Princeton, N.J. The team’s link between planetary albedo and climate is “nothing surprising,” he says. He adds that some of the team’s other predicted effects—such as slightly stronger winds and an increased frequency of dust devils—are quite subtle and may be difficult to confirm.

The researchers have identified “a plausible mechanism” for the recent shrinkage of Mars’ southern polar ice cap, says Richard Zurek, an atmospheric scientist at NASA’s Jet Propulsion Laboratory in Pasadena, Calif.

The team’s findings don’t point to an external influence, such as an increase in solar radiation, that some climate-change skeptics have suggested may be behind Earth’s recent warming, Geissler says. —S. PERKINS



DARKNESS FALLS These images reveal changes in albedo on Mars between the late 1970s (top) and 2000 (bottom). The white feature at the center of each image is the planet’s southern polar ice cap.

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PICTURES POSING QUESTIONS

The next steps in photography could blur reality

BY PATRICK L. BARRY

When a celebrity appears in a fan-magazine photo, there's no telling whether the person ever wore the clothes depicted visited that locale. The picture may have been "photoshopped," we say, using a word coined from the name of the popular image-editing software Adobe Photoshop.

But today's image processing is just a prelude. Imagine photographs in which the lighting in the room, the position of the camera, the point of focus, and even the expressions on people's faces were all chosen after the picture was taken. The moment that the picture beautifully captures never actually happened. Welcome to the world of computational photography, arguably the biggest step in photography since the move away from film.

Digital photography replaced the film in traditional cameras with a tiny wafer of silicon. While that switch swapped the darkroom for far more-powerful image-enhancement software, the camera itself changed little. Its aperture, shutter, flash, and other components remained essentially the same.

Computational photography, however, transforms the act of capturing the image. Some researchers use curved mirrors to distort their camera's field of view. Others replace the camera lens with an array of thousands of microlenses or with a virtual lens that exists only in software. Some use what they call smart flashes to illuminate a scene with complex patterns of light, or set up domes containing hundreds of flashes to light a subject from many angles. The list goes on: three-dimensional apertures, multiple exposures, cameras stacked in arrays, and more.

In the hands of professional photographers and filmmakers, the creative potential of these technologies is tremendous. "I expect it to lead to new art forms," says Marc Levoy, a professor of computer science at Stanford University.

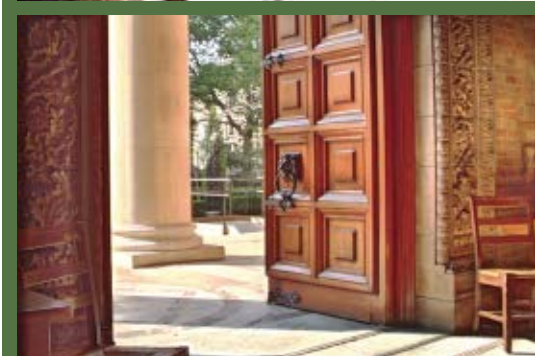
Medicine and science could also benefit from imaging techniques that transcend the limitations of conventional microscopes and telescopes. The military is interested as well. The Defense

Advanced Research Projects Agency, for example, has funded research on camera arrays that can see through dense foliage.

For consumers, some of these new technologies could improve family snapshots. Imagine fixing the focus of a blurry shot after the fact, or creating group shots of your friends and family in which

no one is blinking or making a silly face. Or posing your children in front of a sunset and seeing details of their faces instead of just silhouettes.

Since the late 1990s, inexpensive computing power and improvements in digital camera technology have fueled research in all these areas of computational photography. Levoy says that scientists "look around and see more and more everyday people using digital cameras, and they begin to think, 'Well, this is getting interesting.'"



SUN AND SHADOWS — A conventional camera poorly captures scenes with both extreme brightness and dark shadows (top). Using computational photography techniques, it's possible to create an image that preserves more detail (bottom).

ROBOTS TO SUPERHEROES

Computational photography has roots in robotics, astronomy, and animation technology. "It's almost a convergence of computer vision and computer graphics," says Shree Nayar, professor of computer science at Columbia University.

Attaching a video camera to a robot is easy, but it's difficult to get the robot to distinguish objects, faces, and walls and to compute its position in a room. "The recovery of 3-D information from [2-D] images is kind of the backbone of computer vision itself," Nayar says.

Other important optics and digital-imaging advances have come from astronomy. In that field, researchers have been pushing boundaries to view

ever-fainter and more-distant objects in the sky. In one technique, for example, the telescope's primary mirror continuously adjusts its shape to compensate for the twinkling effect created by Earth's atmosphere (*SN*: 3/4/00, p. 156).

Rapid progress in computer animation during the 1980s and 1990s provided another cornerstone of the new photography. The stunning visual realism of modern animated movies such as *Shrek* and *The Incredibles* comes from accurately computing how light bounces around a 3-D scene and ultimately reaches a viewer's eye (*SN*: 1/26/02, p. 56). Those calculations can be run in reverse—starting from the light that entered the lens of a camera and tracing it back—to deduce something about the real scene.

Such calculations make it possible to decode the often-distorted

images taken by these unconventional cameras. "What the computational camera does is it captures an optically coded image that's not ready for human consumption," Nayar explains. By unscrambling the raw images, scientists can extract extra information about a scene, such as the shapes of the photographed objects or the unique way in which those objects reflect and absorb light.

PHOTO FUSION One powerful way to do computational photography is to take multiple shots of a scene and mathematically combine those images. For example, even the best digital cameras have difficulty capturing extreme brightness and darkness at the same time. Just look at an amateur snapshot of a person standing in front of a sunlit window.

Compared with a single photo, a sequence of shots taken with different exposures can capture a scene with a wide range of brightness, called the dynamic range. Both a bright outdoor scene and the person in front of it can have good color and detail when the set of images is merged. The method was described by Nayar and others at a conference in 1999.

In a similar way, a series of frames in which the focus varies can produce a single, sharp image of the entire scene. Both these types of mergers can be arduously performed with standard image-editing software, but computational photography automates the process.

A related technique fuses a series of family portraits into a single image that's free of blinking eyes and unflattering expressions. After using a conventional camera to take a set of pictures of a group of people, the photographer might feed the pictures into a program described during a 2004 conference on computer graphics by Michael Cohen and his colleagues at Microsoft Research in Redmond, Wash.

The user indicates the photos in which each face looks best, and the software then splices them into a seamless image that makes everyone attractive at the same time—even though the depicted moment never happened. This software is now being offered with a high-end version of Microsoft's Windows Vista.

Want that family photo in 3-D? Nayar's group takes three-dimensional pictures with a normal camera by placing a cone-shaped mirror, like a cheerleader's megaphone, in front of the lens. Because some of the light from an object comes directly into the lens and the rest of the light first bounces off spots inside the cone, the camera captures images from multiple vantage points. From those data, computer software constructs a full 3-D model, as Nayar's group explained at the SIGGRAPH meeting last year in Boston.

A mirrored cone on a video camera might be especially useful to capture an actor's performance in 3-D, Nayar says.

Another alteration of a camera's field of view makes it possible to shoot a picture first and focus it later. Todor Georgiev, a physicist working on novel camera designs at Adobe, the San Jose, Calif.-based company that produces Photoshop, has developed a lens that splits the scene that a camera captures into many separate images.

Georgiev's group etched a grid of square minilenses into a lens, making it look like an insect's compound eye. Each minilens creates a separate image of the scene, effectively shooting the scene from 20 slightly different vantage points. Software merges the mini-images into a single image that the photographer can focus and refocus at will. The photographer can even slightly change the apparent vantage point of the camera. The team described this work last year in Cyprus at the Eurographics Symposium on Rendering.

In essence, the technique replaces the camera's focusing lens with a virtual lens.

LIGHT MOTIFS The refocusing trick made possible by Georgiev's insect-eye lens can also be achieved by placing a tiny array of thou-

sands of microlenses inside the camera body, directly in front of the sensor that captures images.

Conceptually, the microlens array is a digital sensor in which each pixel has been replaced by a tiny camera. This enables the camera to record information about the incoming light that traditional cameras throw away. Each pixel in a normal digital camera receives light focused into a cone shape from the entire lens. Within that cone, the light varies in important ways, but normal cameras average the cone of light into a single color value for the pixel.

By replacing each pixel with a tiny lens, Levoy's research team developed a camera that can preserve this extra information. Mathematically, say the researchers, the change expands the normal 2-D image into a "light field" that has four dimensions. This light field contains all the information necessary to calculate a refocused image after the fact. Ren Ng, now at Refocus Imaging in Mountain View, Calif., explained the process at a 2005 conference.

Capturing more information about incoming light waves can also create powerful new kinds of scientific and medical images. For example, Stephen Boppart and his colleagues at the University of Illinois at Urbana-Champaign create 3-D microscopic photos by processing the out-of-focus parts of an image.

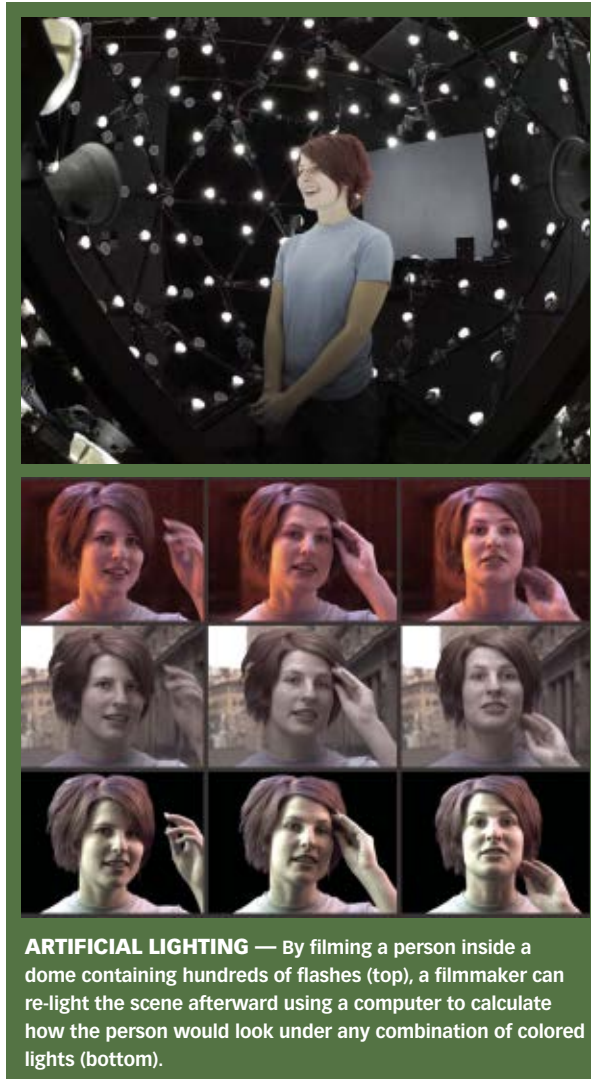
The team devised software to examine how a tissue sample, for

instance, bends and scatters light. In the February 2007 *Nature Physics*, the researchers describe how the device uses that information to discern the structure of the tissue. "What we've done is take this blurred information, descramble it, and reconstruct it into an in-focus image," Boppart says.

In computational photography, the flash becomes more than a simple pulse of light. For example, a room-size dome built by Paul Debevec of the University of Southern California in Los Angeles and his colleagues makes it possible to redo the lighting of a scene after it's been shot. Hundreds of flash units mounted on the dome fire one at a time in a precise sequence that repeats dozens of times per second. A high-speed camera captures a frame for every flash.

The result is complete information about how the subject reflects light from virtually every angle. Software can then compute exactly

(continued on page 219)



ARTIFICIAL LIGHTING — By filming a person inside a dome containing hundreds of flashes (top), a filmmaker can re-light the scene afterward using a computer to calculate how the person would look under any combination of colored lights (bottom).

A GASPING HEART

Cardiac quirk may worsen sleep apnea, invite altitude sickness

BY BEN HARDER

A common imperfection in the structure of the heart may worsen breathing difficulties in people who have sleep apnea and provoke a life-threatening condition called high-altitude pulmonary edema in mountaineers who ascend too quickly. In both scenarios, new studies suggest, the cardiac abnormality contributes to a rapid drop in the blood's oxygen content.

In newborn babies, the wall of tissue that separates the left and right sides of the heart has a small opening called the foramen ovale. Usually, flaps of tissue that surround the hole fuse soon after birth, sealing the opening. In about a quarter of people, however, the flaps remain unsecured—and the opening stays “patent”—into adulthood.

A patent foramen ovale (PFO) generally causes no problem unless the flaps of tissue part and a gap forms between them. That can happen if pressure in the heart's upper-right chamber temporarily becomes too great. Past studies have linked PFO to increased risks of stroke, migraine, and decompression illness, an injury that occurs in scuba divers.

When a gap opens, deoxygenated blood from the heart's right side can mix with oxygenated blood on the left, attenuating the latter's oxygen content.

SLEEP STRUGGLE The abnormality can be a problem for people who experience obstructive sleep apnea, says Magnus C. Johansson, a clinical physiologist at Sahlgrenska University Hospital/Östra in Gothenburg, Sweden. Apnea affects up to one in five adults.

An episode of apnea occurs when a person's upper airways collapse during sleep and breathing ceases for 10 seconds or more. As such a person unconsciously strains to inhale, pressure changes in and around the heart can force open a PFO, Johansson says.

In certain people, bouts of apnea cause oxygen desaturation, which is an unusually large and rapid drop in blood-oxygen concentration. Desaturation appears to be a factor in the high rates of cardiovascular disease associated with apnea, Johansson says.

To see whether PFOs might contribute to oxygen desaturation, Johansson and his colleagues monitored blood-oxygen concentrations throughout the night in people who had apnea. The researchers identified 15 volunteers who frequently experienced oxygen desaturation and another 15 who experienced it rarely. The

scientists then directed sound waves at the heart to assess blood-flow patterns in the 30 participants. Those tests revealed PFOs and quantified how much blood, if any, shunted between chambers.

The abnormality was present in nine members of the frequent-desaturation group but only two members of the other group, Johansson and his colleagues report in the January *European Respiratory Journal*.

Using a minimally invasive procedure, cardiologists can seal a PFO to prevent recurrent decompression illness or stroke. Some researchers are also studying PFO closure as a possible treatment for migraines (*SN*: 2/19/05, p. 119). Closure in people who have sleep apnea might mitigate the problem of oxygen desaturation, too, Johansson suggests.

Franco Ferrillo, a sleep specialist at the University of Genoa in Italy, agrees that closing the hole might help such patients, but he points out that it's not the only potential treatment. He suggests that people who have apnea and a PFO are particularly likely to benefit from continuous positive airway pressure, or CPAP, a widely used mechanical treatment for apnea.

In this therapy, a patient wears a face mask while sleeping. A machine continuously forces air through the mask to prop open the sleeper's airways. Although the treatment has proven effective against apnea, many patients don't use it because they find it hard to sleep while wearing the air mask.

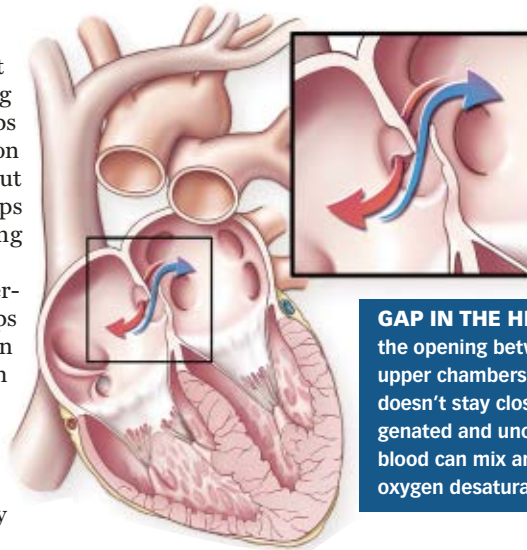
Ferrillo and his collaborators recently completed a 2-year trial of the forced-air treatment in patients who had both apnea and a PFO. They found that, in addition to lessening the severity of apnea, long-term treatment shrank the holes in patients' hearts.

By repeatedly forcing open a PFO, untreated apnea may gradually enlarge the defect, Ferrillo suggests. That would feed a vicious cycle in which the hole worsens apnea and apnea expands the PFO.

It's important to use CPAP to break the cycle, Ferrillo concludes. “Doctors must look for a patent foramen ovale every time they see an apnea patient with higher desaturation than expected,” he says.

SKY HIGH, OXYGEN LOW The 35 intrepid mountaineers in a recent medical study set out from an elevation of about 1,100 meters above sea level. Less than 24 hours later, they reached a small research station called Capanna Regina Margherita, which stands on a 4,559-m-high peak in the Italian Alps near the Swiss border.

Their rapid ascent put them in dangerous territory, as 16 of the veteran climbers knew from personal experience. Those men and



GAP IN THE HEART — If the opening between the two upper chambers of the heart doesn't stay closed, oxygenated and unoxygenated blood can mix and cause oxygen desaturation.

women had previously experienced high-altitude pulmonary edema, a potentially life-threatening condition in which fluid collects in the lungs. Eight of them would soon experience it again.

As people climb mountains, the air they breathe gets thinner and thinner, and the blood pressure in their lungs increases to compensate for the blood's relatively low oxygen content.

For reasons that aren't yet understood, that response is exaggerated in some people, and a quick increase in elevation to an altitude of 2,500 m or higher can cause edema in their lungs. The fluid can block gas exchange and lead to respiratory failure.

Although medical treatments are available, the best way for a climber to reverse high-altitude pulmonary edema and prevent permanent harm is to return promptly to a lower elevation, says Yves Allemann, a cardiologist at the University Hospital's Swiss Cardiovascular Center in Bern. "It's only life threatening if you do not take the necessary therapeutic measures," he says.

The researchers tested each volunteer twice to see whether he or she had a PFO and, if so, to determine the size of the opening. PFOs were more than four times as common in the volunteers who had previously experienced high-altitude pulmonary edema as in the other climbers, Allemann and his colleagues found. In the test conducted at the top of the peak, PFO was present in 69 percent of the former group and just 16 percent of the latter group.

Moreover, blood-oxygen saturation at high elevation was significantly lower in the edema-prone volunteers than in the comparison group, and it was particularly low among volunteers who had large PFOs.

Eight members of the edema-prone group—six of whom had a PFO—again developed pulmonary edema. No one in the control group developed the problem, Allemann's team reported in the Dec. 27, 2006 *Journal of the American Medical Association*.

Professional mountain guides led ill volunteers down to a lower elevation. "As soon as they go down and have normal oxygen [concentrations] in the air, they heal," says Allemann.

The findings suggest a physiological connection between having a PFO and being prone to high-altitude pulmonary edema, Allemann concludes.

Climbers who have experienced pulmonary edema might seek testing to determine whether they have a PFO, and the presence of the abnormality might discourage them from making extreme climbs, Allemann says. In the future, doctors might seal PFOs in an attempt to eliminate such climbers' susceptibility to altitude sickness, he suggests.

There's some precedent for that approach. Allemann's boss, Bernhard Meier, was among the first researchers to link PFO to decompression illness. He's now conducting a trial designed to test whether sealing divers' PFOs can reduce their risk of recurrent illness. ■



OF GASPS AND GAPS — At this research station high in the Alps, a serious form of altitude sickness affected 6 of 11 climbers who had abnormal openings in their hearts.

D. HUTTER/SWISS CARDIOVASCULAR CENTER

(continued from page 217)

how the scene would look in almost any lighting environment, the researchers reported at the 2006 Eurographics Symposium on Rendering. This method is particularly promising for making films.

WHAT IS REALITY?

With all this manipulative power come questions of authenticity. The more that photographs can be computed or synthesized instead of simply snapped, the less confident a viewer is that a picture can be trusted.

"Certainly, all of us have a certain emotional attachment to things that are real, and we don't want to lose that," Nayar says. For example, to get a perfect family portrait, one might prefer that nobody had blinked. But is a bad shot better than a synthesized moment?

Whether film or digital, photographic images have always departed from reality to some degree. "And every generation, I believe, will redefine how much you can depart," Nayar says. "What was completely unacceptable 20 years ago has become more acceptable today."

Perhaps 20 years from now, when a photographer changes a picture's vantage point, people will still consider the scene to be real. But using a computer to change the clothes that a person in the

image is wearing might be going too far, Nayar proposes.

Often, the goal of computational photography isn't to depart from reality but to create a closer facsimile of it. For example, someone

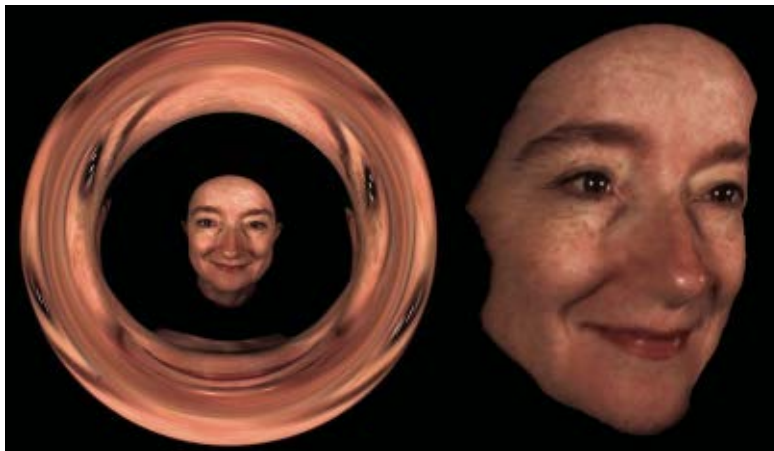
looking at people standing in front of a sunset can see the faces clearly and can focus on any part of the scene. A normal photograph, with its dark silhouettes and fixed focus, offers a viewer less than reality.

So, a manipulated image can be "closer, by some subjective argument, to what the real world is for a person looking at it," Levoy says.

It's difficult to say which of the many technologies under the umbrella of computational photography will ever reach the consumer market. The room-size dome containing hundreds of flash units

will almost certainly remain in the realm of specialized photographers and movie studios. Other techniques may be suitable for everyday use, but whether and when they reach the market will depend on the vagaries of business and marketing.

In whatever form computational photography becomes commonplace, people continue to adopt it over conventional image making will take pictures that capture more of what they actually see, and sometimes what never was at all. ■



3-D FROM A DOUGHNUT — Photographing a person's face with a cone-shaped mirror in front of the lens creates a distorted, doughnut-shaped image (left). The cone provides two extra perspectives of the face on opposite sides of the center point, providing enough information to construct a 3-D model (right).

COMPUTER VISION LAB., COLUMBIA UNIV.



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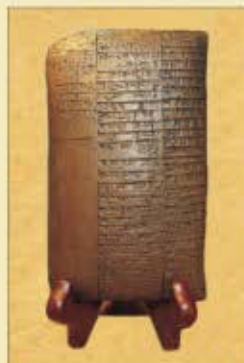
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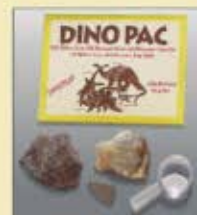


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BIOLOGY

Rare flower needs prickly neighbors

In a newly discovered twist on the importance of good neighbors, a member of the mallow family makes more fruit when it grows beside a tangle of pandanus plants.

Researchers had been studying pollination of *Trochetia blackburniana*, a rare plant found only on the island of Mauritius. Geckos of the species *Phelsuma cepediana* transfer pollen as they poke their heads into the plants' large red flowers to sip nectar. When Dennis Hansen of the University of Zurich and his colleagues recently caged the plants to keep away geckos, the plants were less successful in making fruit.

Hansen and his colleagues also found that the *Trochetia* flowers were nearly twice as likely to form fruit when located near a tangle of pandanus plants. Growing widely throughout the tropics, these small trees form dense clusters of long bladelike leaves.

The *P. cepediana* geckos forage during the day, when many predators are also active. The dense pandanus clusters could be providing valuable hiding places for them, Hansen and his colleagues argue in the April *American Naturalist*. Hansen says, "Who would have thought that to conserve *Trochetia blackburniana* we would end up saying 'Plant more patches of pandanus'?" —S.M.

EARTH SCIENCE

Wave's-eye view of a hurricane

Strong hurricanes aren't as effective as weak ones at transmitting wind energy to the ocean's surface, a counterintuitive finding that may enable researchers to better estimate the size of storm surges.

When winds blow across the ocean, aerodynamic drag—friction where air and water meet—transfers some of the wind's momentum to the water. That transfer creates waves and currents. Scientists have long presumed that higher wind speeds result in higher drag and larger momentum transfers, says William J. Teague, an oceanographer at the Naval Research Lab-

oratory in Bay St. Louis, Miss. However, he and his colleagues now report field data that contradict that notion.

Six current-measuring instruments were fortuitously sitting on the seafloor in the path of Hurricane Ivan, which struck the Gulf Coast in mid-September 2004 (*SN*: 6/11/05, p. 382). From the speed and direction of subsurface currents, Teague and his colleagues estimated the hurricane's wind speed and a parameter called the coefficient of drag, which describes how efficiently the wind's momentum transfers to surface waters.

The coefficient of drag reached its peak when wind speeds measured around 115 kilometers per hour—a pace just shy of the threshold for a category 1 hurricane, the team reports in the March 23 *Science*. Beyond that peak, the drag coefficient steadily dropped as wind speeds increased. That might have been because hurricane-force winds caused large waves to break, dissipating energy through the prodigious generation of ocean spray, bubbles, and foam, Teague says. —S.P.

BIOLOGY

Kill-save gene combo might fight malaria

A technique that might someday enlist mosquitoes in the fight against malaria has passed an early test in lab fruit flies. Researchers have been working for years to genetically engineer mosquitoes so that they don't spread the disease. The effort revealed some malaria-resistance genes, but a thornier problem has been how to disperse those genes throughout a wild population.

California researchers modeled their work on a genetic element, called *Medea*, in flour beetles. It spreads rapidly because offspring of a carrier mother survive only if they also carry it.

The molecular workings of *Medea* in flour beetles remain a mystery, so Bruce Hay of the California Institute of Technology in Pasadena, Calif., and his colleagues invented a genetic construct that has the same effect in fruit flies.

Hay's team used a short bit of RNA, a microRNA, that switches off the activity of *myd88*, a gene critical for development of a fruit fly embryo. They combined the gene

for that microRNA with a version of *myd88* that's insensitive to the microRNA.

If a fruit fly mother carries the combo, she makes egg cells that are packed with the destructive microRNA. After the eggs are fertilized, the resulting embryos thrive if they contain the construct with the insensitive version of *myd88*. But in the embryos that didn't receive the *Medea*-like element with its rescue capability, the microRNA from the egg sabotages the embryo.

When the scientists put their engineered fruit flies in cages with three times as many unaltered fruit flies, all the offspring carried the new gene combo after 9 to 11 generations. The research now appears online at *Science*. —S.M.



WATER METER A seafloor instrument like this one measured Gulf Coast currents as Hurricane Ivan passed overhead in September 2004.

EARTH SCIENCE

Freeze-thaw cycles: How not to mix soil

The repeated cycles of ground freezing and thawing that occur in many places don't do a good job of churning the soil, a new study suggests.

Freeze-thaw cycles and the burrowing of animals are among the many natural phenomena that can mix the upper layers of Earth's soil, says James M. Kaste, a geologist at Dartmouth College in Hanover, N.H. To study the relative effectiveness of these mechanisms, he and his colleagues measured beryllium-7 and other radioactive elements that fall to the ground in precipitation and immediately attach themselves to particles at the surface. By documenting the concentrations of these short-lived elements at various depths, the researchers inferred how quickly surface soil mixes downward.

At forested sites in southeastern Australia, where burrowing insects, worms, and wombats are common, the uppermost 35 centimeters of the soil get thoroughly mixed every 1,200 years. At gopher-ridden grassland sites in Marin County, Calif., the same depth of soil gets churned, on average, every 660 years, the team reports in the March *Geology*.

In New Hampshire's White Mountains, however, where freeze-thaw cycles occur yearly but relatively acidic conditions make soil-dwelling organisms rare, radioactive tracers didn't infiltrate the soil well. The

uppermost 35 cm of soil there seems to get mixed up only once every 5,000 years or so, the team calculates.

The sluggishness of the soil turnover in the New Hampshire forests “was a big surprise to us,” says Kaste. —S.P.

ENVIRONMENT

New solutions for unused drugs

A dilute stream of prescription drugs flows through the nation's rivers. To help cut that flow, representatives of the federal government and a pharmacists' trade group want consumers to stop flushing most old drugs down the toilet.

Some 3 to 7 percent of dispensed medicines go unused, according to estimates by the Pharmaceutical Research and Manufacturers of America in Washington, D.C. Pharmacy groups had generally recommended flushing away these leftovers, arguing that the practice prevents pets and curious children from retrieving drugs from wastebaskets.

However, research has begun linking waterborne pharmaceuticals—many of which move unchecked through sewage-treatment plants—with reproductive problems in fish and the development of drug-resistant germs that can be spread by waterfowl (*SN*: 6/5/99, p. 356).

On March 17, the American Pharmacists Association (APhA) signed a formal agreement with the U.S. Fish and Wildlife Service to create the SMAR_XT Disposal campaign. APhA expects to roll out the program in its members' pharmacies this summer.

The program will recommend that consumers dispose of unused drugs through their municipal hazardous-waste-collection programs, where they exist. Trash will be promoted as the next-best outlet.

Before disposing of the drugs, individuals will be asked to crush pills or dissolve them in water; add them to sawdust, kitty litter, or some other inedible material; and then seal the mix in a plastic bag. Certain potent narcotics will be exempt from this program. Federal officials still want these drugs flushed down the toilet.

“Ultimately, we'd like a national take-back program,” in which pharmacies would

dispose of consumers' unused medications, says Joe Starinchak of the Fish and Wildlife Service in Arlington, Va. —J.R.

INFECTIOUS DISEASES

On the move

A new study suggests how prions—the infectious agents that cause such disorders as chronic wasting disease—behave in soil and landfills.

Previous work showed that prions can persist in soil for 3 years or more, notes Joel A. Pedersen at the University of Wisconsin–Madison. He and his colleagues are interested in the environmental transmission of prions to animals and the risks of disposing of infected carcasses in landfills.

To study the adsorption of prions to quartz, a common component of soils, the team combined quartz particles with a solution of prions derived from infected hamsters. The scientists then varied the mixture's acidity and salinity.

“Those are important parameters in an environment, and especially in a landfill,” says Pedersen. As a landfill ages, there's a decrease in both the salt concentration and the acidity of the liquid, or leachate, that trickles through it.

The researchers found that adsorption of prions to the quartz decreased as the acidity or the salinity of the solution decreased. They describe their results in the April 1 *Environmental Science & Technology*.

The results indicate that as landfills age, prions could move with the leachate and collect at the bottom. This liquid typically goes into sewage treatment plants.

The team is now examining how prions stick to particles as water flows through a soil column. This more closely approximates conditions in soil and landfills. —A.C.

BIOMEDICINE

Patches take sting out of canker sores

Canker sores, painful ulcers that form inside the mouth, can be slow to heal. In the absence of a cure, people often resort to numbing agents and wait out the lesions.

A patch that dispenses licorice extract directly onto the sores lessens their duration and dramatically eases pain, a preliminary test shows. Inventor Jeffrey T. Haley, a biochemist at Orahealth Corp. in Bellevue, Wash., presented the findings at a meeting of the International Association for Dental Research (IADR) in New Orleans in March.

Haley and his research team identified 46 people who each had a new canker sore. Half of the patients received patches—discs about the size of a child's fingernail—while the others went untreated. After 3 days, about four-fifths of the treated people reported no pain, while only two-fifths of the untreated volunteers did. Moreover, after 7 days, canker sores had shrunk by 90 percent in the treated group but had grown slightly in the untreated people.

“These results are very encouraging,” says Christopher H. Fox, a dentist and IADR executive director. “Decreasing the pain and speeding the healing is a positive benefit, [but] we would want further studies with a larger sample size and a control group to verify this,” he says.

The patches, marketed as Cankermelts by Orahealth, adhere to the sores for 2 to 6 hours. Study volunteers replaced their patches during waking hours.

People had tried licorice gargle as a canker sore remedy in the 1960s and 1970s, but it didn't catch on. Researchers don't know what causes canker sores or why licorice seems to work, Haley says. —N.S.

BIOMEDICINE

Meningitis vaccine stops ear infections

A vaccine for meningitis and pneumonia also prevents many ear infections and the complications that they cause, a study shows.

Scientists scanned the medical records of roughly 150,000 children in Tennessee and 27,000 in New York, noting all immunizations received and the number of ear infections acquired by age 2. The team then compared children born before the vaccine against meningitis and pneumonia became available in 2000 with those born afterward. Three-fourths of the latter group received the vaccine in the first year of life.

In Tennessee and New York, children born after 2000 had 17 and 28 percent, respectively, fewer ear infections by age 2 than did their counterparts who were born before the vaccine was available, the researchers report in the April *Pediatrics*.

Children born after 2000 were also less likely to require surgical insertion of tubes for drainage of chronically infected middle ears, says study coauthor Katherine A. Poehling, a pediatrician at Wake Forest University in Winston-Salem, N.C.

The vaccine, marketed as Prevnar by its maker Wyeth of Madison, N.J., fights seven strains of *Streptococcus pneumoniae*. Strains of that microbe cause about one-third of middle ear infections, Poehling says.

An earlier study had shown that a different vaccine used in Europe against meningitis and pneumonia also prevented many ear infections (*SN*: 3/11/06, p. 149). —N.S.



FLUSH NOT Pharmacists that display this logo will also dispense information on environmentally sound methods for disposing of unused medicines.

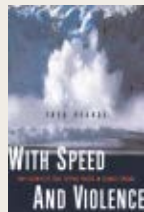
Books

A selection of new and notable books of scientific interest

WITH SPEED AND VIOLENCE: Why Scientists Fear Tipping Points in Climate Change

FRED PEARCE

The scientific community has come to a near consensus that Earth's climate is steadily warming—whatever the cause. Pearce, an environment consultant for *New Scientist* magazine, cites evidence that even greater climate change will come suddenly and with devastating effect as several tipping points are crossed. Pearce outlines what rising temperatures could mean for the fate of the Arctic, Antarctica, oceans, forests, and cities, as each approaches a point of no return. He cites as examples the collapse of the Larsen B Ice Shelf in Antarctica and the acceleration of glaciers there and at northern latitudes toward the sea. As glacial ice melts at an increasing rate—as a direct result of human activity, Pearce asserts—sea level rises will be measured in feet, not inches, and will threaten the existence of islands and coastal areas. The crossing of climatic tipping points could mean fire and drought in the Amazon rainforest, melting permafrost in the Arctic, the release of enormous amounts of methane gas from bogs in northern Europe and ocean-bottom deposits, and mass extinctions in oceans. Pearce accounts for temperature increases in predicted changes in Earth's reflectivity from air pollution, melting ice, and vegetation changes. None of the news is good, according to the author. *Beacon Press, 2007, 278 p., hardcover, \$24.95.*

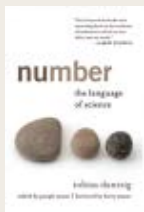


lapse of the Larsen B Ice Shelf in Antarctica and the acceleration of glaciers there and at northern latitudes toward the sea. As glacial ice melts at an increasing rate—as a direct result of human activity, Pearce asserts—sea level rises will be measured in feet, not inches, and will threaten the existence of islands and coastal areas. The crossing of climatic tipping points could mean fire and drought in the Amazon rainforest, melting permafrost in the Arctic, the release of enormous amounts of methane gas from bogs in northern Europe and ocean-bottom deposits, and mass extinctions in oceans. Pearce accounts for temperature increases in predicted changes in Earth's reflectivity from air pollution, melting ice, and vegetation changes. None of the news is good, according to the author. *Beacon Press, 2007, 278 p., hardcover, \$24.95.*

NUMBER: The Language of Science

TOBIAS DANTZIG, JOSEPH MAZUR, ED.

Originally published in 1930, Dantzig's book was a classic of mathematical writing, explaining the concept of numbers in a clear and engaging style that appeals even to lay readers. That groups of objects could be counted and that different groups could be of the same number is a thought-provoking concept. Dantzig traced humans' sense of numbers to finger counting but noted that the ability encompasses more than that. For instance, a person employs a sense of number when he or she looks at two collections and determines, without counting, whether they're equal in number. Dantzig also described the concepts of cardinal and ordinal numbers and the development of a number language. In this new edition, Mazur includes a new foreword, endnotes, an annotated bibliography, and redrawn illustrations. The book delves into the history of mathematical concepts, such as religious numerology, number worship by the Pythagoreans, and the concept of infinity. It then explores the use of symbols and algebra, the concepts of rational and irrational numbers, and how numbers are represented geometri-



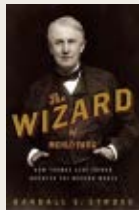
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cally. Appendixes address such topics as recording large numbers, formulas for primes and Fibonacci numbers, and roots and radicals. A final note from Mazur looks at recent progress on longstanding mathematical problems. *Plume, 2007, 398 p., b&w illus. paperback, \$16.00.*

THE WIZARD OF MENLO PARK: How Thomas Alva Edison Invented the Modern World

RANDALL STROSS

The invention that first made Thomas Alva Edison famous wasn't the lightbulb but the phonograph. With the invention of the phonograph, Edison single-handedly set the stage for the modern music industry. However, Stross reveals, the great inventor had mixed success at managing his own fame, often becoming distracted from work by the demands of celebrity. Following the phonograph's release, the press went wild and created the heroic Wizard of Menlo Park, N.J.,



an image that persists to this day. While financial backers were poised to bring his invention to market, Edison's lack of business acumen prevented him from taking advantage of his unchallenged position in recording sound. Although his lab became a tourist destination and throngs of people sought pictures and personal appearances from the inventor, Edison failed to capitalize financially even on his fame. As for the lightbulb, Stross deflates the myth of Edison as its sole inventor. As the author notes, other scientists were hard at work on incandescent lighting before Edison even started on his invention. Though Edison was a remarkable man, rightly credited with many important inventions, the hype surrounding his achievements may have obscured his real creativity. *Crown, 2007, 376 p., b&w plates, hardcover, \$24.95.*

WILD BORNEO: The Wildlife and Scenery of Sabah, Sarawak, Brunei, and Kalimantan

NICK GARBUTT AND J. CEDE PRUDENTE

Darwin once described the island of Borneo as "one great luxuriant hothouse made by nature for herself." The world's third-largest island is home to a diverse assortment of flora and fauna that occupy many ecological niches. It is this biodiversity that inspired this book, a World Wildlife Federation—sponsored celebration of the island's natural resources. More than 200 full-color photographs guide readers through various forest, mountain, beach, and coral reef habitats, and the authors list the island's top wildlife-viewing areas. Garbutt, a wildlife author and photographer, and Prudente, a conservationist and photographer, describe plants such as the parasitic Rafflesia, one species of which bears the world's largest flower. Borneo's animal inhabitants include the aptly named three-horned rhinoceros beetle, flying snakes, and the bizarre-looking proboscis monkey. The authors also profile Borneo's human inhabitants, describing their culture and trade practices. The World Wildlife Federation gets a plug for its efforts to promote conservation and ecotourism. *MIT Press, 2006, 176 p., color photos, hardcover, \$34.95.*



LETTERS

Winter wonders

The theory of "nuclear winter" was originally put forward by an Eastern European mathematician in the 1980s ("Sudden Chill," *SN: 2/3/07, p. 72*). Some months later, it was shown that an error in his original calculations so vastly exaggerated "nuclear winter" as to make it meaningless. Still, the dramatic concept of a "nuclear winter" obviously lives on in the public's mind and now has been taken up, I see, for climate-change advocacy. You do no service to science, nor to the public, by touting such misinformation once again.

J. STRIEGEL, TOFINO, BRITISH COLUMBIA

Any nuclear attack anywhere in the world would result in the end of life as we know it. I would like to reiterate a quote from Albert Einstein: "I know not with what weapons World War III will be fought, but World War IV will be fought with sticks and stones."

DOROTHY HIGSON, NEW ORLEANS, LA.

The article compared nuclear winter to the chilling effect of volcanoes and the little ice age. It didn't talk about the effects of two volcanoes that were particularly chilling. Laki in Iceland and Tambora in Indonesia each immediately killed about 10,000 people but starved many more. Indirect evidence suggests that global chilling by another Indonesian volcano, at Lake Toba, nearly wiped out *Homo sapiens* around 75,000 years ago.

RAYMOND C. BRYAN, ST. PAUL, MINN.

Could the global-cooling mechanism of nuclear winter and volcanoes be intentionally used to combat global warming? A solar-powered excavator on the lunar surface could send tons of dust at the stratosphere.

DENNIS BICKER, SAN RAMON, CALIF.

The thought that counts

"Well-Tooled Primates" (*SN: 2/10/07, p. 88*) states that as a result of an internal representation of their bodies and parts, macaques "gradually come to mentally regard their hands and arms, and then their entire bodies, from a third-person perspective." Isn't that a good definition of self-awareness, one of the supposed differences between humans and other animals and between humans and machines? Have the authors of the study not just shown a major advance in our understanding of intelligence?

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