

SCIENCE NEWS

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a psychedelic's strange trip
exotic matter: getting warmer
milwaukee montessori merits
plants' scents of direction

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A photograph of a penguin, likely a Magellanic penguin, standing on a large, moss-covered log in a forest. The penguin has a white body with brown spots and a distinctive pinkish-red patch around its eye. It is looking upwards and to the right. The background is filled with dense, mossy vegetation and tree trunks.

**evaluating
ecotourism**

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Cover The Humboldt penguins that live on a single island off the coast of Chile attract 10,000 visitors each year. But with rising tourist numbers, the penguins have had poorer breeding success. (T. Mattern) [Page 218](#)

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SCIENCE NEWS

This Week

Hot Stuff

A usually ultracold, odd state forms when warm

An exotic quantum state that had previously appeared only under conditions of astonishing cold has made its room-temperature debut, reports an international team of scientists. In related experiments, other researchers have produced a similar state in different, still-chilly materials but claim that their experiments will lead to room-temperature versions as well.

The new findings, unveiled in independent reports in the Sept. 28 *Nature*, reveal a bizarre new branch of an already exotic family of quantum states of matter known as Bose-Einstein condensates.

Previously produced Bose-Einstein condensates, which form only at temperatures near absolute zero, include a superfluid of liquid helium that flows with no friction (*SN*: 2/26/05, p. 142) and condensates of dilute gases (*SN*: 1/17/04, p. 35). Superconductors, which are materials that permit electric current to flow without resistance at ultracold temperatures (*SN*: 4/1/06, p. 196), exhibit many of the properties of Bose-Einstein condensates, but physicists disagree on whether those materials precisely fit the condensate's definition.

The newest findings might make quantum-physics experiments easier by elimi-

nating tricky cryogenics and might lead to practical payoffs such as extremely low-power lasers. The two new demonstrations also buoy scientists' expectations that they'll someday find a way to dramatically raise the temperatures required for superconductor operation—an achievement that could lead to enormous energy savings.

Room-temperature superconductivity is “definitely at the back of people's minds,” notes David Snoke, a University of Pittsburgh physicist who also does research on novel Bose-Einstein condensates (<http://blogs.nature.com/nature/peerreview/trial/>). However, he adds, the means to achieve such superconductivity remain unclear.

Bose-Einstein condensates typically form when falling temperatures induce the atoms of a gas or other particles to exhibit their wavelike quantum nature and grow larger, as dictated by Heisenberg's uncertainty principle. The expanding waves then overlap and meld into, in essence, a single object—the condensate.

In both the new reports, however, the experimenters used means other than extreme cold to make the condensates. The starting materials, which had not previously been formed into condensates, were what physicists call quasiparticles. According to Sergej O. Demokritov of the University of Münster in Germany, quasiparticles are ephemeral energy excitations that come and go inside solid materials, somewhat like the crests of waves in an ocean do. Quasiparticles can collide and exchange velocity as billiard balls do and otherwise behave fleetingly like standard particles, he notes.

In the set of experiments conducted at room temperature, Demokritov and his colleagues zapped a thin film of the magnetic compound yttrium iron garnet that they had placed in a device akin to a microwave oven. The treatment boosted the film's population of quasiparticles known as magnons.

In the other, much lower-temperature experiments, physicist Benoît Deveaud-Plédran of the École Polytechnique Fédérale de Lausanne in Switzerland and his colleagues fired a laser at a microstructure made of the semiconductor cadmium telluride. In

the material, the procedure produced quasiparticles called exciton polaritons, which form when photons of light and electrons collide.

In each experimental run, the elevated quasiparticle densities caused the wavelike entities to overlap and form condensates, the investigators say.

In a commentary published with the reports, Snoke says that the magnon-making study, while promising, lacks firm evidence that the magnetic waves exactly match each other as they should in a condensate.

Demokritov says that in additional experiments, his team has demonstrated that the waves match. —P. WEISS

The Bad Fight

Immune systems harmed 1918 flu patients

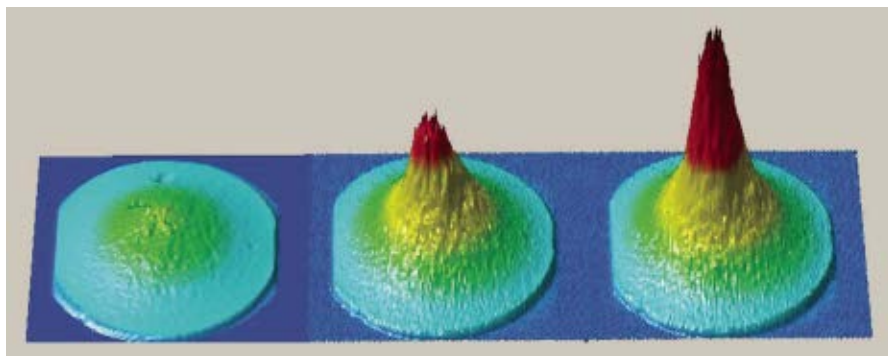
The 1918 Spanish influenza was one of the deadliest pandemics in human history, and researchers still don't know why that particular strain was such an effective killer. A new study suggests that flu patients' immune systems played a surprising role. Rather than striking out against just the flu virus, victims' immune systems may have launched furious attacks that devastated their lungs.

Since removing virus samples from the body of a 1918 flu victim that was excavated from permafrost in 1997, researchers have searched for unique characteristics that made the bug so deadly. Last year, a team led by Jeffrey Taubenberger of the Armed Forces Institute of Pathology in Rockville, Md., finished sequencing the virus' eight unique genes and reconstructed the original killer (*SN*: 10/8/05, p. 227).

Researchers have examined that reconstruction, as well as individual genes from this virus, to determine how the 1918 strain infected cells. However, notes microbiologist Michael G. Katze of the University of Washington in Seattle, scientists hadn't learned much about how an infected person's immune system reacted once the virus had settled in.

To model that reaction, Katze and his colleagues infected groups of mice with one of four viruses: the reconstructed 1918 flu strain, either of two strains constructed to carry subsets of the 1918 flu's genes, or a contemporary flu strain. The researchers collected lung tissue from the animals as their infections progressed.

The team saw a quick and massive influx of immune cells, such as neutrophils and macrophages, in lung tissue from mice infected with the reconstructed 1918 strain. These lung samples were also extremely inflamed and riddled with dead cells. Lungs of mice infected with viruses carrying 1918



BEAM ME UP A single quantum state, a Bose-Einstein condensate (red peak), forms in semiconductor material. The plot depicts telltale light emissions from fleeting half-light, half-matter particles created in the material by increasing laser illumination (left to right).

gene subsets had far fewer immune cells in the lungs and less inflammation and cell death. Lungs from animals infected with the contemporary flu strain showed few, if any, of these effects.

The scientists also compared gene activity among lung samples from the four groups of mice. Genes responsible for launching an immune attack, turning on inflammation, and triggering cell suicide were extremely active in mice infected with the reconstructed 1918 flu. The activity of those genes was weaker in animals exposed to just a portion of the 1918 virus. Most of those genes remained inactive in animals infected with the contemporary strain, the group reports online Sept. 27 for an upcoming *Nature*.

These results suggest that all the genes in the deadly 1918 strain somehow work together to excessively rile the immune system, explains Katze. "Too much of anything is not good," he says. "One trick of this virus, whether intentional or unintentional, seems to be to excite the host's immune response" to such an extent that it becomes deadly.

Epidemiologist David Morens of the National Institute of Allergy and Infectious Diseases in Bethesda, Md., notes that figuring out how to modulate such an overwhelming immune response could improve countermeasures against similarly lethal flu strains that might arrive in the future.

"Any attempt to understand what happened with this flu and learn lessons to help us in the future is very important stuff," he says. —C. BROWNLEE

Montessori Learning Aid

Alternative school shows impact on poor children

A century ago, Italian physician Maria Montessori started an innovative school for children 4 to 7 years old in a destitute section of Rome. A new study, focusing on poor and lower-middle-class children from Milwaukee, now provides the best evidence to date that Montessori's unique educational approach, at least when strictly applied, yields academic and social advances superior to those produced by other schools.

By the end of kindergarten, Montessori children outperformed their peers at pub-



EDUCATED TOUCH Montessori education, exemplified by these children exploring a letter on sandpaper, conferred academic and social advantages on a group of Milwaukee youngsters.

lic and private schools on standardized math and reading tests, say Angeline Lillard of the University of Virginia in Charlottesville and Nicole Else-Quest of the University of Wisconsin–Madison. Montessori kids also did better at controlling their attention during novel tasks, solving social problems, and playing cooperatively.

At the end of elementary school, 12-year-old Montessori children wrote essays with greater creativity and more complexity in sentence structure than their peers at other schools did, the two psychologists report in the Sept. 29 *Science*. Montessori youngsters also exhibited superior social skills and reported an unusually strong sense of community at their school. Non-Montessori students largely caught up to the Montessori group on math and reading tests by age 12.

"Researchers should take a closer look at the Montessori system as one way to improve education in the United States," Lillard says.

Strictly implemented Montessori education uses special educational materials and classroom workstations. Classes include children of different ages who choose activities to work on for long periods of time under a teacher's direction. Classroom activities, which are often collaborative, emphasize increasingly complex projects related to counting or other topics. The Montessori approach eschews textbook learning, grades, formal evaluations, and daily recess.

Lillard and Else-Quest contacted parents who had entered a lottery to gain their children's admission to a Montessori school in Milwaukee. Annual incomes for families, most of which were black, ranged from

\$20,000 to \$50,000. Lottery winners and losers were studied at ages 5 and 12 years, times coinciding with late stages of two main periods of Montessori education: one for children 3 to 6 years old and another for students 6 to 12 years old.

The group of 5-year-olds included 30 Montessori children and 25 youngsters attending public, private, or charter schools. The group of 12-year-olds consisted of 29 Montessori students and 28 youngsters attending the other schools. Many of the non-Montessori schools had enacted special academic and arts programs and had resources equal to those of the Montessori school.

By studying only lottery applicants with similar family backgrounds, the researchers attempted to rule out the possibility that parents of Montessori children provided better learning environments at home than other parents did.

Lillard says that she'd like to see further research that tracks lottery winners and losers throughout their school years and explores how well children do at different Montessori schools, which vary widely in adherence to Montessori principles. Moreover, she says, it's unclear whether a certain component of Montessori education or the whole package stimulates learning.

More than 5,000 U.S. schools classify themselves as Montessori schools.

Alternative-education programs aside from Montessori also deserve closer scrutiny, remarks psychologist Carolyn P. Edwards of the University of Nebraska–Lincoln. Well-trained teachers, coherent sets of activities for specific topics, and

A. VU

other features common to such programs may confer particularly large learning benefits, she suggests. —B. BOWER

Gassy Bugs

Microbes may produce propane under the sea

For decades, scientists have been puzzled by periodic findings of ethane and propane in sediments that they've pulled from deep below the ocean floor. As far as they knew, these gases could be produced only as petroleum is—by great heat applied to ancient, buried organic matter. But sometimes, ethane and propane turn up in areas where that process seems unlikely.

A new report suggests a different source: microbes. Bacteria and archaea within underwater sediments could chew up buried organic material and spew out ethane and propane as waste products, assert Kai-Uwe Hinrichs of the University of Bremen in Germany, and his colleagues.

Heat can produce propane and ethane only at spots along cracks in Earth's crust where the planet's internal heat escapes but is then trapped by thick layers of sediment overlying the crust. Hinrichs' team drew sediment samples from six sites off Peru that don't meet these conditions. All had thin layers of sediment, and two were far

from any cracks in the crust and therefore insulated from Earth's internal heat.

Nevertheless, the researchers found ethane and propane locked in the sediments at all six sites. Adding to the mystery, gases at all the sites were in higher concentrations in pockets at shallow and middle depths in the sediments than in deeper locations. If the gases had been produced by heat, they would have been more abundant farther down, Hinrichs notes.

The researchers conclude that the gases at the sites must have been produced by microbes. "When you can't come up with any geologic source, then biology is an obvious candidate," Hinrichs says. The researchers report in the Oct. 3 *Proceedings of the National Academy of Sciences* that the isotopes in the ethane and propane within the sediment are characteristic of biologically produced materials.

Microbes under the seafloor commonly break down organic matter to produce methane, a gas similar to ethane and propane. Although the researchers haven't isolated microbes that produce these two gasses, they point to chemical reactions that could produce them from materials available in undersea sediment.

The concentration of propane in the sediments is too low for commercial use as fuel. However, Hinrichs says that if the set of reactions producing the propane were better understood, scientists might fine-tune it to turn organic matter directly into propane.

The problem of the source of ethane and propane in ocean sediments had "been brushed under the carpet," says John Parkes of Cardiff University in Wales. The new research "is like a breath of fresh air," he says. The suggestion of a biological source of the gases is reasonable but still unproved, he adds. In particular, researchers must demonstrate that the reaction that they propose takes place in undersea microbes. —J. REHMEYER

Mixed Bag

Islet-cell transplants offer good and bad news

Several years after receiving experimental transplants of insulin-making cells, most people with diabetes still need daily insulin shots, a new study finds. But the transplanted cells that thrive in their new hosts prevent sudden drops in blood sugar that come without warning, a life-changing improvement for some patients.

People with type 1, or juvenile-onset, diabetes lose their insulin-making pancreatic cells when their immune systems attack the clusters, or islets, housing these cells. In a procedure called islet transplantation, physicians take islet cells from a cadaver and infuse them into the portal vein of a patient's liver, where the new cells

Mystery of the Missing Heat

Upper ocean has cooled slightly in recent years, despite warming climate

Between 2003 and 2005, the top layers of the world's oceans cooled slightly, but scientists aren't sure where the heat went.

According to climate data gathered worldwide, 2003, 2004, and 2005 are three of the five warmest years since reliable record keeping of global air temperatures began more than a century ago. However, oceanographic surveys suggest that on average, the upper 750 meters of the world's ice-free oceans cooled about 0.03°C during that 3-year period.

This cooling reverses an oceanic-warming trend observed since the 1950s, oceanographer John M. Lyman and his colleagues report in the Sept. 28 *Geophysical Research Letters*.

Between 1993 and 2003, the average temperature of the upper layers of the ice-free ocean rose about 0.09°C, they note.

The newly documented cooling occurred throughout the top 750 m of ocean and seems to have extended to deeper waters as well, says study coauthor Josh K. Willis, an oceanographer now at NASA's Jet Propulsion Laboratory in Pasadena, Calif. Data used in the new analysis were gathered by buoys tethered in deep water, instruments towed by or dropped from ships, and an armada of robotic probes, says Lyman, who's at the National Oceanographic and Atmospheric Administration (NOAA) laboratory in Seattle.

While the top layers of the ocean have cooled slightly overall, some limited areas have

warmed, says coauthor Gregory C. Johnson, also of NOAA in Seattle. The cooling trend, as well as its patchiness, probably results from variations in climate cycles such as the Pacific Decadal Oscillation, he notes.

"Even within a long-term warming trend, you can have short-term drops in [ocean] temperature due to year-to-year variability," says Lyman.

Scientists are working to identify where the heat went. One possibility: It may have moved to the deepest layers of the ocean. The cooling of surface waters would cause them to contract, triggering a small drop in sea level, says Willis. But satellite data suggest that sea level is still rising. So, the missing heat may have gone deep, causing waters

there to expand and prevent a decline in sea level. However, "it's hard to envision a way to put that much heat down deep so quickly," says Willis.

In another scenario under consideration, the missing heat may have radiated into space. However, satellite observations don't support that notion, says Bruce A. Wielicki, a physicist at NASA's Langley Research Center in Hampton, Va. Yet another possibility is that the heat warmed some of the waters in polar regions and promoted melting of the ice cover there, he notes.

"We have a few more pieces to unravel" about where the heat has gone, comments Sarah T. Gille, an oceanographer at Scripps Institution of Oceanography in La Jolla, Calif. "It's a real conundrum." —S. PERKINS

start making insulin. That indispensable hormone orchestrates sugar metabolism.

In a study published in 2000 by researchers in Edmonton, Alberta, islet transplantation seemed to have cured seven patients with diabetes (*SN*: 9/2/00, p. 156).

Now, in the Sept. 28 *New England Journal of Medicine*, an international team led by the Alberta researchers reports that only 6 of 36 type 1 diabetes patients receiving islet transplants no longer needed insulin injections about 3.5 years later. That suggests that in most of the patients, the transplanted cells couldn't produce a full complement of insulin. The reason may be that the number of cells delivered to the liver was too small, the recipients' immune systems killed too many of the cells, or the cells simply died, say the researchers.

Nevertheless, study coauthor A.M. James Shapiro, a transplant surgeon at the University of Alberta in Edmonton, is heartened by the findings. "Insulin independence isn't the be-all and end-all in these patients," he says.

Indeed, the participants were chosen because, despite taking the best available medicines, they had had dangerous episodes of suddenly plummeting blood sugar. The drops came without the shakiness, sweating, and racing heartbeat that usually alert a person to low blood sugar, or hypoglycemia. As a result, some of the patients couldn't drive cars or care for children.

The researchers found that 24 of the 36 participants retained some functional islet cells from the transplants, and all 24 were subsequently free of severe blood sugar crashes.

Even a small number of transplanted cells "increases insulin concentrations second by second," delivering a trickle of the hormone that appears to prevent the crashes in the participants, Shapiro says. "This allowed a return to some kind of semi-normal existence [and] has had a huge impact on their lives," he says.

Side effects of the transplant procedure stemmed from the immune-suppressing drugs that the patients needed to prevent rejection of the islet cells. Some participants developed pneumonia, a drop in white blood cell counts, chest pain, fever, mouth ulcers, diarrhea, headaches, anemia, nausea, or a combination of complaints. Scientists plan to look for regimens for immune suppression with fewer side effects.

"This is not a procedure that's ready for prime time in the vast majority of people with type 1 diabetes," says endocrinologist



CREEP The tendril of a young dodder plant stretches out to entwine a tomato seedling (left). A dodder tangle steals nutrients and water from a glasswort (right).

Judith E. Fradkin of the National Institute of Diabetes and Digestive and Kidney Diseases in Bethesda, Md. However, she adds, "we shouldn't write it off." —N. SEPPA

Scent Stalking

Parasitic vine grows toward tomato odor

A wiry orange vine finds plants to raid for nutrients by growing toward their smell, researchers report.

One of the parasitic plants called dodders responds to volatile compounds wafting off nearby plants and shows preferences for certain species, says Consuelo De Moraes of Pennsylvania State University in University Park. They say that their new work marks the first time that anyone has shown that a plant will grow toward airborne chemicals from other plants.

The experiment finally identifies a cue—scent—that draws dodder to its victims, adds Mark C. Mescher, also of Penn State.

The U.S. Department of Agriculture lists dodder among the country's 10 worst weeds. When a dodder seed sprouts, it doesn't grow roots. All its energy goes into a tendril that shoots out in search of plants to tap for water and nutrients. If it's going to survive, it must latch on to a victim within about a week. The vine grows into a spaghetti tangle and can attack multiple plants, stunting their growth but not killing them.

Of the 150 species of dodder, the researchers selected *Cuscuta pentagona*, says coauthor Justin Runyon, also of Penn State. This species bedevils tomato growers in California, where it costs them an estimated \$4 million a year in reduced yields.

De Moraes' team and other researchers

have studied the volatile compounds released by plants that are mauled by caterpillars or other pests. In the new study, reported in the Sept. 29 *Science*, the team took a different point of view, looking at how an attacker, the dodder, takes advantage of volatiles to target its prey.

At first, the researchers set various possible targets several centimeters from dodder sprouts. A pot of moist soil alone didn't attract the seedlings, nor did vials of dyed water that created colored light. But a pot with a young tomato plant, and even a cup of perfume made of tomato volatiles, did attract the seedlings (*see movie at www.sciencenews.org/articles/20060930/tomato.mov*).

To minimize any confounding cues, such as shading or light, the researchers then set the possible attractants in chambers connected to the plant by curving pipes. Again, the seedlings grew toward the scent.

Testing various victim species, the researchers found that dodder grows toward impatiens and tomatoes. Wheat won't sustain dodder well, and given a choice, parasite seedlings shunned it and grew toward tomatoes.

When researchers tested seven ingredients in the tomato perfume individually, three of them proved attractive to the dodder. One of those attractants showed up in wheat, but the wheat perfume also contained a substance that repelled the seedlings. Such a repellent might offer a new route for fighting dodder, Mescher speculates.

An insect ecologist who has also studied plant volatiles, Rick Karban of the University of California, Davis comments, "The significance of this [study] to me is that it indicates that without a central nervous system, plants are capable of behaving in ways that appear fairly sophisticated." —S. MILIUS

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CHEMICAL ENLIGHTENMENT

Line up for the scientific, psychedelic mystical tour

BY BRUCE BOWER

The comfortably furnished room in a corner of the Johns Hopkins University School of Medicine in Baltimore seems an unlikely setting for spiritual transcendence. Yet one after another, volunteers last year entered the living room-like space, reclined on the couch, swallowed a pill, and opened themselves to a profound mystical journey lasting several hours. For many of them, the mundane certainty of being a skin-bounded person with an individual existence melted away. In its place arose a sense of merging with an ultimate reality where all things exist in a sacred, unified realm. Participants felt intense joy, peacefulness, and love during these experiences. At times, though, some became fearful, dreading unseen dangers.

The pills that enabled these mystical excursions contained psilocybin, the active ingredient in so-called magic mushrooms that some societies have used for centuries in religious ceremonies. Psilocybin boosts transmission of the brain chemical serotonin, much as LSD and some other hallucinogenic drugs do.

Johns Hopkins psychopharmacologist Roland R. Griffiths and his colleagues have taken psilocybin out of its traditional context and far from the black-light milieu of its hippie-era heyday. Griffiths' team is investigating the drug's reputed mind-expanding effects in a rigorous, scientific way with ordinary people.

In the group's recent test, psilocybin frequently sparked temporary mystical makeovers in volunteers who didn't know what kind of pill they were taking. What's more, some of these participants reported long-lasting positive effects of their experiences.

As a control in the test, the researchers used methylphenidate—an amphetamine known as Ritalin when used to treat attention-deficit hyperactivity disorder. Methylphenidate rarely produced a mystical experience, although the researchers were intrigued that a few people did have that response.

Griffiths' study, published in the August *Psychopharmacology*, combines research on psychedelic-drug effects—which have received little attention in the past 40 years—with a burgeoning scientific interest in the roots of spirituality (*SN*: 2/17/01, p. 104). The new findings put psychedelic studies on the road back to respectability, Griffiths says. In the 1950s and 1960s, preliminary research had suggested that LSD and related substances—now regarded as powerful but nonaddictive drugs—aided in psychotherapy, addiction treatment, and creativity-promoting programs.

However, the excesses of researchers such as the late Harvard University psychologist Timothy Leary, as well as widespread illicit use of psychedelic drugs, led to legal restrictions that halted most psychedelic research.

Now, the scientific and clinical promise of drugs such as psilo-

cybin can be fully explored, in Griffiths' view. "With careful preparation, you can safely and fairly reliably occasion a mystical experience using psilocybin that may lead to positive changes in a person," he says. "Our finding is an early step in what we hope will be scientific work that helps people."

SPIRIT TRIPS Griffiths' recent work was inspired by an unusual 1963 investigation conducted by physician and minister Walter Pahnke. Half of 20 Protestant seminarians randomly received psilocybin before listening to a radio broadcast of a Good Friday service. The rest took a B vitamin that caused the skin to flush.

After the service, many members of the psilocybin group reported unusual spiritual experiences. Four of them had full-blown mystical reactions, which they said included ecstatic visions and a feeling of oneness with God.

In interviews conducted 6 months and 25 years later, members of the psilocybin group attributed many more positive changes in attitude and behavior to the Good Friday service than vitamin takers did. Psilocybin-induced mental states had apparently triggered lasting improvements in people's lives, researchers concluded.

During Pahnke's study, however, participants sat together during the broadcast and could easily tell whether others were acting out of character. Such observations could have affected their reactions to what they had ingested. Griffiths' team tried to minimize the power of expectation by not telling most participants which drug they were taking and by administering pills to one volunteer at a time.

"You can safely and fairly reliably occasion a mystical experience using psilocybin that may lead to positive changes in a person."

— ROLAND R. GRIFFITHS
JOHNS HOPKINS UNIVERSITY

Griffiths' team tried to minimize the power of expectation by not telling most participants which drug they were taking and by administering pills to one volunteer at a time.

The team recruited 36 physically healthy adults, ages 24 to 64, who had no serious mental disorders themselves or in their immediate families. All but one volunteer had graduated from college. None cited any previous use of psychedelic drugs. Each reported at least occasional participation in religious or spiritual activities, including church services, prayer, and meditation.

At the start of the study, each volunteer met several times with a psychologist or social worker, who later sat with participants during drug sessions and offered support if needed.

Each of 30 randomly selected volunteers attended two 8-hour drug sessions, the second occurring 2 months after the first. At one session they received a strong dose of psilocybin and at the other a high dose of methylphenidate. No participant was told which drug he or she ingested—only that it might be either of the two substances.

The remaining six participants received methylphenidate at the two sessions without being told what the pills contained. At a third session, they took psilocybin pills after being told what was in the tablets.

After taking psilocybin, 22 of the 36 volunteers described having mystical experiences, the scientists say. All but three of these cases occurred in volunteers who didn't know what kind of pill they were taking. Mystical events typically included a sense of merging with an overarching reality, perceiving unity in all things, transcending time and space, and basking in overwhelming feelings of love and other positive moods.

At the end of psilocybin sessions, 25 participants—including 3 who hadn't reported mystical encounters—rated the experience as among the five most meaningful and spiritually significant events in their lives.

After taking methylphenidate, four volunteers reported mystical experiences as well. They, too, ranked the experience among the top five in their lives.

Feelings of extreme fear or dread emerged in 11 of the 36 volunteers after taking psilocybin and in none after taking methylphenidate. Those who encountered negative reactions nonetheless completed the sessions with assistance from the psychologist or social worker.

Positive effects of psilocybin seemed to last beyond the sessions. Two months after their last drug session, 29 participants reported moderately or greatly increased well-being and satisfaction with their lives as a result of psilocybin experiences. The others cited no such changes, but none described any declines in well-being in response to the psilocybin use.

Interviews with family members, friends, and coworkers of each volunteer confirmed the reports of long-lived improvements in mood, attitudes, and behavior.

The researchers are now analyzing results of a 1-year follow-up of participants.

Griffiths also plans to explore how brain processes unleashed by psilocybin compare with neural activity in people who experience drug free spiritual epiphanies. "There's good reason to believe that similar brain mechanisms are at work during profound religious experiences, whether they're produced by fasting, meditation, controlled breathing, sleep deprivation, near-death experiences, infectious disease states, or psychoactive substances," he says.

DEEP HYPNOSIS Although it's not news that psilocybin stimulates mystical experiences, Griffiths' study offers important improvements over earlier studies, asserts psychologist Etzel Cardeña of the University of Lund, Sweden. First, in most instances, neither the participants nor those assisting them knew which drug was being administered. This approach enabled researchers to distinguish genuine drug effects from placebo reactions. Second, the researchers verified participants' reports of psilocybin-induced improvements by talking to their families, friends, and coworkers.

Cardeña studies yet another way that people enter life-changing spiritual realms. Some folks spontaneously undergo mystical experiences during periods of "deep hypnosis," he contends.

From a group of 147 college students, Cardeña identified eight women and four men who entered trance states with ease. Dubbed hypnotic virtuosos by Cardeña, such individuals can direct their thoughts inward and, in no more than a minute or two, become hypnotized on their own. None of the 12 students in the study reported being in a meditation program or currently using psychedelic drugs, although 3 had ingested such substances years ago.

In a silent, dimly lit room, each participant induced a self-hypnotic state under three conditions—while lying on a bed, pedaling a stationary bicycle at a comfortable rate, and sitting on a stationary bicycle equipped with a motor that propelled the pedals, moving participants' feet at a moderate rate. Sessions ran for 17 minutes.

Participants reported an initial period of moderate hypnosis characterized by spinning sensations, a feeling of lightness, loss of touch with the external world, and perceived bodily changes, such as enlarged hands.

They then reached a state of deep hypnosis, which became more intense when the students were lying still, Cardeña says. The experiences while in deep hypnosis closely resembled mystical journeys taken in Griffiths' psilocybin sessions. Reports included a sense of floating or flying, of one's mind leaving one's body, of merging with a light, and of being one with everything, as well as powerful feelings of love, wonder, and freedom.

In another parallel to Griffiths' findings, participants occasionally noted that the unusual occurrences of deep hypnosis scared them.

Still, at the end of the experiment and 8 months later, the volunteers mentioned only positive effects of the deep hypnosis, Cardeña

reported in the January 2005 *Journal of Clinical and Experimental Hypnosis*. Favorable results included increased personal insight, fewer nightmares, and enhanced inner peace. In other words, these people enjoyed the inner benefits of a self-induced mystical encounter without ingesting any mind-altering drugs.

"It's about time that psychology and related fields started taking seriously mystical and other anomalous experiences," Cardeña says.

LIFE CHANGERS In 1935, a man named Bill Wilson cofounded Alcoholics Anonymous. He had recently undergone a self-described spiritual revelation that caused him to stop drinking alcohol. Two decades later, before legal restrictions largely ended studies on psycho-

delic drugs, Wilson backed research that suggested a use for drug-induced mystical experiences as part of alcoholism treatment.

Griffiths and his colleagues now plan to follow up on that research. They will try to determine whether psilocybin indeed fosters a spiritual insight that people can use to break alcoholism's grip. They also want to examine whether psilocybin sessions ease depression and anxiety in end-stage cancer patients.

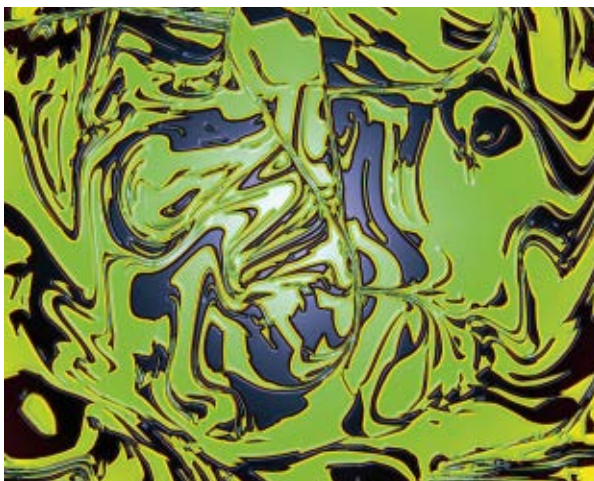
A few treatment-focused investigations of psilocybin are already under way. In pairs of 6-hour sessions separated by 1 month, psychiatrist Charles Grob of the University of California, Los Angeles administers either psilocybin or placebo pills to patients with life-threatening cancer. Patients then typically lie still with their eyes covered while listening to relaxing music. Grob and two assistants sit with each patient during these sessions.

Grob has studied six patients so far, tracking them for 6 months after completing the sessions. He plans to investigate six more patients before publishing his findings.

"Even without having a classic mystical experience, these patients do pretty well after psilocybin sessions, and their anxiety often decreases," Grob says.

Another study, directed by psychiatrist Francisco Moreno of the University of Arizona in Tucson, is examining psilocybin as a treatment for obsessive-compulsive disorder. This condition is marked by anxiety and a need to perform repeatedly certain behaviors,

(continued on page 220)



ALTERED REALITY — Mystical experiences triggered by the drug psilocybin yield lasting, positive changes in people's lives, a new study finds.

GOOD GONE WILD

Sometimes, ecotourism hurts what it sets out to help

BY ERIC JAFFE

The island of Damas is a half-hour boat ride from the Chilean coast. On the island, it's dry and rocky. The Humboldt penguins that live there have no ice slopes to slide down in their black-tie apparel. Instead, these desert penguins seek out caves to shade their eggs from the sun. If they can't find a spot beneath a boulder, they may burrow into seabird dung. Sometimes, they nest inside a cactus.

To see these penguins, visitors usually begin in La Serena, Chile. They drive 40 miles north on a main highway and then cut toward the coast on a gravel road that leads to the fishing village of Punta de Choros. Local fishermen there charge a fee to guide the tourists to Damas by boat. On the island, people are free to walk into the caves where the penguins live. Anyone can watch a mother brooding an egg and snap a picture with a flash camera or a mobile phone.

What began in the early 1990s as a place with a few hundred curious visitors has now become a tourism destination that attracts 10,000 penguin peepers a year. Damas provides an example of ecotourism, defined as the practice of visiting sites where exotic landscapes and rare animals are the main attractions. Ideally, ecotourists learn about the habitats that they visit, provide donations to conserve them, and generate income for host communities.

Since this model of tourism emerged some 25 years ago, many special-interest sites, like Damas, have experienced hikes in visitation. Often, ecotourism is a wild success (*SN: 12/3/05, p. 364*). The United Nations even billed 2002 the "International Year of Ecotourism."

But several recent studies show a more complicated picture of the impact of ecotourism, a practice that remains largely unregulated. The increased crowds lead to population changes in some animals, such as the Humboldt penguin and, some 4,000 miles away in the Bahamas, the Allen Cays rock iguana. A mounting garbage problem caused by over-visitation by turtle viewers threatens the beaches of Tortuguero in Costa Rica. People who live near Ghana's Kakum National Park have lost access to the forest's resources and now suffer high rates of unemployment.

"There comes a time when you have so much interference through ecotourism that you affect the thing you're trying to protect," says

Robert E. Hueter of the Mote Marine Laboratory in Sarasota, Fla., who studies ecotourism's impact on whale sharks. Ecotourism's benefits to conservation and public education are considerable, he says, but the downsides may take a long time to recognize.

"I think there's been a glib ... championing of ecotourism, that it's a win-win situation," says Martha Honey, executive director of the Center on Ecotourism and Sustainable Development in Washington, D.C. But by studying how animals, environments, and cultures respond to ecotourism, "we can set up systems that aren't having adverse impacts," she says.

FLIGHT OF THE PENGUINS Ursula Ellenberg decided to study how human disturbance affects the Humboldt penguins when she

was quietly counting their population, but not quietly enough. While she was looking through binoculars from a cliff about 150 meters away, the penguins began racing in all directions. One of the penguins had spotted Ellenberg, despite her unobtrusive perch. If a cautious researcher can spark such a reaction, she thought, how would the penguins react to a gaggle of shutter-happy tourists?

To study the effects of human-Humboldt interaction, Ellenberg and her colleagues measured the breeding success of penguins on the islands of Damas, Choros, and Chanaral, which together make up the

Humboldt Penguin National Reserve. The island cluster serves as a good point of comparison: Damas receives 10,000 annual visitors, but Choros and Chanaral are much less accessible from the mainland and attract only 1,000 and 100 tourists a year, respectively.

Ellenberg's team was the first to study these penguin populations. The researchers monitored eggs and chicks on each island for 5 months after the penguin mothers laid the eggs. If a nest is abandoned during this period, the chicks usually die. Penguins have many chances to breed during their 20-year life spans, and they would sooner abandon a nest than risk personal harm—say, from an approaching human.

In 2003, the only year that Ellenberg's group studied Chanaral, the penguins there bred an average of 1.34 chicks. On Choros, the average was just below one chick in both 2002 and 2003. But on Damas, female penguins produced, on average, a little less than half a chick in 2002, and the birthrate dipped well below a quarter of a chick in 2003, Ellenberg's team reports online and in the November *Biological Conservation*.



DESERTED ISLE — The population of Humboldt penguins (inset) living on Damas has dwindled since ecotourism began there. Researchers find that the Humboldt birth rates have fallen dramatically.

"It's surprising, when you have islands at such close proximity, that you'd already get a difference," says Ellenberg, a biologist at the University of Otago in New Zealand. "They should do similarly well."

Working in the Bahamas, John Iverson of Earlham College in Richmond, Ind., has discovered similarly detrimental effects of human presence on Allen Cays rock iguanas, an endangered species.

When Iverson began studying these animals 25 years ago, ecotourism was just under way. At that point, male iguanas outnumbered females two to one. Historically, fishermen had captured iguanas to sell or eat, and female iguanas were easier to trap because they guard their nests rather than flee an intruder. Iverson and Geoffrey Smith of Denison University in Granville, Ohio, propose in an upcoming *Canadian Journal of Zoology* that poachers created the observed gender imbalance.

Enter ecotourism. As island management increased protection of its main attraction, poaching declined. The balance of the sexes was restored remarkably quickly. Iverson and Smith found that the increased survival of females that came with the end of poaching wasn't the whole story. Male iguana numbers declined as ecotourism increased, they say.

As part of the study, Iverson and Smith in 2000 tagged the largest male iguanas in two ecotourism areas. At one site, the number of tagged iguanas fell from 30 to 9 by 2005. Using death rates calculated from the previous 20 years, the researchers had predicted that 16 would survive. At the other site, the researchers found none of the 17 tagged iguanas in 2005, though they had expected 9 animals to remain.

Part of the problem, the researchers argue, is that the males tend to be aggressive and interact more with human visitors than females do. Some of the 54,000 people who visit the area each year feed the iguanas hazardous material such as spoiled food or Styrofoam, which can kill them.

But Iverson and Smith found some of the missing males at nearby islets that iguanas couldn't have reached themselves. This displacement led the researchers to suspect that ecotourism guides had removed many of the large, aggressive male iguanas from the most visited sites.

Moving the iguanas could have ecological ramifications, Iverson says. For example, some of the displaced iguanas were found at sites that are home to an endangered species of seabirds called Audubon's shearwaters. Because the iguanas and the birds require similar nesting territories, the iguanas might crowd out the shearwaters, he says.

In other words, ecotourism may sometimes rescue some animals at the expense of others.

WASTE OF SPACE Visitors travel 3 to 5 hours by boat to reach the beaches of Costa Rica's Tortuguero National Park—home to hawksbill, green, and leatherback turtles. Since the early 1990s, park officials and conservationists have gone to great lengths to protect these rare animals. The money that tourists pay to watch the turtles nest goes to safeguard the species.

But preservation has taken priority over solving a growing waste-management problem that threatens the environment's well-being and, ultimately the turtles' health, says Zoë Meletis of Duke University's Marine Laboratory in Beaufort, N.C. Since Meletis began going to Tortuguero in 2002, the number of tourists has shot from 35,000 to 87,000 a year. And while tourists don't directly harm the

turtles, they leave trash such as water bottles and snack wrappers in Tortuguero, which lacks an adequate waste-processing center.

The local government doesn't take responsibility for clearing much of the trash, says Meletis, and boat drivers scoff at transporting waste when they can make more money carrying passengers. Many villagers resort to burning garbage, releasing hazardous compounds into the air. Burying the accumulating waste isn't an option, because refuse contaminates the underground water supply used by local villagers, and waste buried on the beach is re-exposed by ocean waves, creating a hazard for the turtles.

"It's a classic example of ecotourism as a double-edged sword," says Meletis. The same things that draw people to Tortuguero—its isolation and wildlife—make it difficult to manage as a high-volume tourist destination. "It raises a lot of money for turtle conservation," she says. "But some important negative impacts aren't getting the attention they deserve."

When ecotourism in an area grows, the site becomes vulnerable to the same problems, such as sewage maintenance, that come with mass tourism, says John Davenport of University College Cork in Ireland. In the March *Estuarine, Coastal and Shelf Science*, he reviewed ecotourism's impact on coastal destinations.

Even for activities that aren't usually destructive, a high volume of tourists can create a problem, he says. Such is the case with scuba diving—traditionally a well-managed, environmentally friendly sport. Throughout the world, researchers have seen a link between dive traffic and coral damage, Davenport says. Divers knock into corals or stir up silt that suffocates the reefs, which regenerate slowly.

When divers add an underwater camera to already cumbersome scuba gear—a juggling act that Davenport compares with "driving while having a shave and a smoke"—the damage becomes worse. In Sodwana Bay in South Africa, divers who took underwater photographs

damaged reefs by bumping into them in on average, during 9 out of 10 dives, whereas divers who didn't take pictures caused such damage in, just 1 out of every 6 dives, he reports.

"Since you've got a million new scuba divers [around the world] each year, it's going to be an uphill battle," Davenport says.

GHOST RAINFOREST At Kakum National Park in Ghana, the mission to protect the rainforest and its diverse wildlife, while opening the area to tourism, has been successful. Tropical evergreens, endangered forest elephants and bongo antelopes, and some 600 species of butterflies have been preserved, and visitors can experience a bird's-eye glimpse of the forest from a unique canopy walk—a hanging bridge connected at the tops of tall trees.

But the people who live around the park have endured "untold hardships" so that conservation can thrive, says Seth Appiah-Opoku of the University of Alabama in Tuscaloosa, who wrote about their plight in the *African Geographical Review* in 2004 and who continues to study the area.

After interviewing residents of 100 households in four villages surrounding Kakum, Appiah-Opoku found that that the local population had relied heavily on the rainforest: on trees to build homes, on herbs for traditional medicine, and on some animals and plants for food. But once the park opened to the public in 1994, the park's resources became off-limits for these uses.

The restriction has effectively eliminated hunting as a native



WALK ON WILD SIDE — Kakum National Park is home to Africa's only canopy walk — a hanging bridge connected at the tops of trees that gives visitors a bird's-eye glimpse of the forest and its hundreds of rare species. However, since the park opened, unemployment has increased among people living nearby.

occupation. In turn, the forest-elephant population has increased, which is bad news for the majority of villagers, who are farmers. The elephants have ravaged roughly 7,800 acres of farmland since the park opened, Appiah-Opoku reports, but killing the animals, even in defense of personal territory, is illegal.

Overall, the unemployment rate has skyrocketed from 3 percent to 27 percent since 1994, and many of the villages are “ghost towns,” Appiah-Opoku says. He adds that Kakum National Park officials have confirmed his observations.

“Ecotourism very often is in direct conflict with host communities for its markets and resources,” he says. “In a place like this, there should have been an agreement that part of the money would go into the [village] economy, that some of the people would be employed in the park.”

But even when local inhabitants participate in the planning, the arrangements often go awry, argues Sanjay Nepal of the University of Texas A&M in College Station. He reports on the cultural impacts of ecotourism in Taiwan in an upcoming *Tourism Management*. If members of the native population don’t reap profits from ecotourism, they may focus on their diminished opportunity to harvest the natural resources they had access to in the past, says Nepal.

“One of the things I’ve lately begun to think is we’re asking too much from the so-called idea of ecotourism,” he says. “Trying to find a balance between the social, economic, and environmental elements—it’s ambitious and it’s complex.”

The key to this balance is more research, says Honey. As scien-

tists study ecotourism’s impacts, new understandings “need to be fed back into the industry, to educate what is acceptable behavior,” she says. “There needs to be a closer alliance between hard science and the tourism industry.”

Currently, good research on ecotourism is difficult to find, says Davenport. Most destinations weren’t studied before ecotourism

began, making before-and-after comparisons difficult. Moreover, many governments are reluctant to provide funding for investigations because they profit from ecotourism.

Perhaps the major barrier is the working assumption that ecotourism, with the conservation funds it raises, must be better than typical mass tourism. Says Hueter, “My concern is, that’s where the analysis ends, and only in rare cases do [researchers] look deeper.”

In the case of the Humboldt penguins, a lack of research led to improper viewing guidelines, says Ellenberg. The Humboldt reserve based its rules for approaching penguins on a related South American

species called the Magellanic penguin, which is far less sensitive to human disturbance.

Now, only a few dozen penguins reside on Damas, says Ellenberg. Local fishermen estimate that three times as many lived there before ecotourism began. As today’s small population slips further, tourists will head to the nearby islands.

If the guidelines aren’t changed quickly, the Humboldt penguins—and ecotourism on Damas and then the other islands—will be gone, says Ellenberg. “And once they’re gone, that’s it.” ■

MELETIS



TRASH TALK — As tourists flock to the beaches of Tortuguero in Costa Rica to glimpse rare turtles, the waste left has become a major problem. This sign tells visitors not to leave trash on the beaches, where the turtles can eat it.

(continued from page 217)

such as hand washing. Results are promising, Moreno says, although he won’t discuss the findings in detail until their upcoming publication in the *Journal of Clinical Psychiatry*.

In the meantime, Griffiths’ paper has attracted some surprising supporters. Psychiatrist Charles R. Schuster of Wayne State University School of Medicine in Detroit says that the new investigation will hasten explorations of the neural basis of drug-induced altered states of consciousness. Schuster, the former director of the National Institute on Drug Abuse, calls the treatment of drug addiction with psychedelic substances “entirely conceivable.”

Psychiatrist Herbert D. Kleber of Columbia University in New York City agrees. Former director of the White House Office of National Drug Control Policy, Kleber cautions that only well-prepared individuals—such as those in Griffiths’ study—are likely to reap lasting benefits from drug-related mystical states.

Kleber looks forward to investigations of whether mystical experiences triggered by methylphenidate and psilocybin activate the same brain regions. Activity in the brains of people who show minimal reactions to psilocybin should also prove intriguing, he says.

Not everyone finds Griffiths’ study enlightening, however. The new data simply confirm the longstanding knowledge that psychedelic substances disturb perception, cause disorientation, and sometimes instigate fear and paranoia, remarks David Murray, special assistant to the current director of the White House Office of National Drug Control Policy. Clinical benefits of psilocybin have yet to be demonstrated, he asserts.

“Psilocybin might grow hair on bald men—we just don’t know,” Murray says with a chuckle.

Even ardent proponents of psychedelic-drug research acknowledge that, after lying dormant for decades, the field faces many unanswered questions. It’s been a long, strange trip, and it’s far from over. ■



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OF NOTE

PHYSICS

Muscling up colors for electronic displays

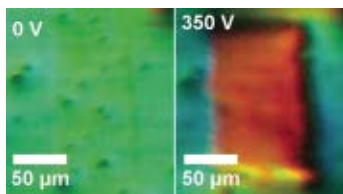
Colorful as they are, today's television and computer screens generate only about half the hues of the visible-light spectrum. Now, experimenters in Switzerland have found a way to provide the complete color palette. To do so, they use a material called artificial muscle because it changes length in response to electricity (SN: 7/1/06, p. 8).

In conventional displays, three light emitters—one red, one green, and one blue—make up each pixel. Varying their relative intensities yields composite colors such as orange. The three fixed hues can't combine to yield every color.

However, three light sources of variable hues could, says electrical engineer Manuel Aschwenden. To make such adjustable color sources, he and Andreas Stemmer, both of the Swiss Federal Institute of Technology in Zurich, have invented a novel diffraction grating—a rippled surface that separates white light into component colors, each of which travels away from the grating at a slightly different angle.

Increasing the spacing between a grating's ripples shrinks the angular spread of colors, and decreasing the spacing increases the spread. This can control which color heads in a given direction, says Aschwenden. To achieve such control, the researchers first fashioned a simple grating out of stretchy plastic. Then, they adhered that grating to a base of rubbery acrylic polymer that acts as an artificial muscle.

Applying a voltage to the acrylic polymer caused it to stretch, increasing the ripple-to-ripple distance of the attached grating, the team reports in the Sept. 1 *Optics Letters*. At a fixed angle from the grating, a camera recorded a wide range of colors corresponding to various voltages. Aschwenden says that to make television and computer screens using such devices, a



GRATE EXERCISE A prototype color source for television and computer screens that's controlled by a plastic artificial muscle transforms from green (left) to red (right) in response to electricity.

manufacturer might place pinholes in front of multiple gratings. Each pinhole would restrict the light coming through to just one color, which would change as its grating stretched or shrank. —P.W.

BIOLOGY

Insecticide gets help from gut bacteria

The world's most widely used organic insecticide relies on an insect's normal gut flora to do its dirty work, a new study suggests.

A bacterium known as *Bacillus thuringiensis* produces a toxin that kills a variety of insects, including moths and mosquitoes. Despite the toxin's popularity as an insecticide, the mechanism by which it kills insects was unknown.

Jo Handelsman of the University of Wisconsin–Madison and her colleagues suspected that the insects' normal gut bacteria play a role.

The researchers fed gypsy moth antibiotics that wiped out their normal gut bacteria. When those insects received the *B. thuringiensis* toxin, few of them died.

However, when the researchers gradually replaced the insects' normal gut bacteria, the toxin became more lethal. The researchers found that a strain of *Enterobacter* microbes seem responsible for turning the toxin into a killer. Further investigation showed that this gut microbe thrives and multiplies when it enters an insect's hemolymph, the equivalent of blood, the researchers write in a study released early online by the *Proceedings of the National Academy of Sciences*.

These results suggest that the toxin might poke holes in insects' guts, explains Handelsman, allowing *Enterobacter* and other infectious gut bacteria to flood out into the hemolymph and take over the rest of a bug's body. —C.B.

ZOOLOGY

Mother deer can't ID their fawns by call

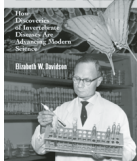
Fawns can distinguish their mom's voice from another deer's, but a mom can't pick out her fawn's call, researchers say.

That's different from recognition skills of sheep or reindeer, according to Marco Torriani of the University of Zurich in Switzerland. In past studies of those species by other research groups, the young recognized the mother's calls and vice versa.

Torriani and his colleagues recorded mother-fawn pairs of fallow deer on Swiss farms. The researchers played both a fawn's mother's call and a recording of another deer. Fawns were more likely to react to their mothers' voice by, for example, turning toward the broadcasting speaker or approaching it. When the researchers played fawn calls to the adults, however, mothers failed to react in any special manner to their own offspring's calls.

That quirk makes sense in terms of newborn behaviors, says Torriani. Young sheep and reindeer quickly start following their mothers around with the herd, and mutual voice recognition would be a big help. Newborn fallow deer, though, hide silently in undergrowth. Mom drops by occasionally and calls. In response to her voice, the fawn steps out to feed. Thus, there may not be much advantage to mothers' recognizing her fawn's voice, the researchers say in the September *American Naturalist*. —S.M.

BIG FLEAS HAVE LITTLE FLEAS

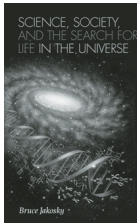


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TEXTILES

Rice-straw sweaters

Fibers from rice stems left in fields after the grain's harvest could wind up in fabrics adorning furniture, car interiors, and people. That's the prediction of textile scientists who have for the first time extracted from rice straw natural cellulose fibers that can be spun into yarn.

Worldwide, about 560 million tons of straw is left behind in rice fields annually, representing a large, untapped resource of cellulose fibers, says Yiqi Yang of the University of Nebraska in Lincoln. Cotton and linen fabrics contain cellulose fibers from cotton and flax plants.

But to make a strong spun yarn, the cellulose fibers need to be at least 2 centimeters long. So, a cellulose-extraction process must remove some of the lignin and hemicellulose from the rice straw but leave behind enough of these two plant components to bind the cellulose fiber, Yang explains.

Yang and his graduate student Narendra Reddy developed a method that produces fibers 2.5 to 8 cm long. For the extraction, they placed the rice-straw fibers in a basic solution, then moved them to an acidic solution containing enzymes. They washed and dried the resulting slurry, and had the fibers spun into yarn.

The rice-straw yarn "feels like linen," Yang says. "It's not quite as soft as cotton."

Yang predicts that more than 80 million tons of fibers could be made from the rice straw left on the world's fields. This exceeds the worldwide consumption of both natural and synthetic fibers, which stands at 67 million tons, he adds.

Producing fabric from rice straw would reduce the need for petroleum-based synthetic fibers, such as polyester and nylon, notes Yang. It could also replace some cotton, a crop that requires large amounts of insecticides. —A.C.

ANIMAL BEHAVIOR

Altering ant uniforms

The chemical coat that an invasive ant species relies upon to recognize its kin may someday serve to turn family into

American Chemical Society
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foe, reports a team of chemists and behavioral ecologists from the University of California, Irvine.

The Argentine ant is now found in Mediterranean-type climates throughout the world. Its success as an invader rests partially in behavior not displayed back home (*SN*: 4/20/02, p. 245). In Argentina, the ants (*Linepithema humile*) form small, territorial colonies. A colony's fights with other colonies over food and space keep its numbers in check, explains behavioral ecologist Neil D. Tsutsui.

However, in their adopted homes, most of the insects live in supercolonies, in which far-flung ants identify each other as nestmates. Therefore, the ants

can collectively turn their aggression toward defeating native species. One such supercolony resides along much of the California coast.

The ants recognize nest mates by smell. They detect hydrocarbons in a waxy coating that covers each insect's exoskeleton. Tsutsui and his colleagues asked which of the 80 to 100 chemicals on the exoskeleton act as



WEARABLE LEFTOVERS These colorful fabrics are a 50-50 blend of rice-straw fibers and cotton.

recognition cues.

"If you can find the chemicals that these ants use to recognize and attack members of different colonies, maybe you can think of a tricky way to get these chemicals on the exoskeletons of [same-colony] ants so they can kill each other off," Tsutsui says.

The team extracted the waxy coats of ants from the California supercolony and from four smaller colonies in the state. Then, the researchers compared the hydrocarbons among the groups to look for those that differed between colonies but not within a colony.

The researchers picked out 15 chemical candidates. So far, they've synthesized five of them and have tested how the chemicals affect the ants.

The team spiked individual ants with one of the five synthesized chemicals, then placed each insect back with its nest mates. In every colony, ants attacked a former mate with an altered coat, although not every chemical led to aggression in every colony, says Tsutsui.

The researchers are now synthesizing and testing the remaining candidates.

Their goal is to learn more about the mechanisms behind the ants' recognition of each other, Tsutsui says. —A.C.

CHEMISTRY

Catalyst cleans up

A new chemical catalyst can remove the pollutant perchlorate from water, chemists report. The catalyst could be used with current methods of ridding drinking water of this contaminant.

Found in, among other places, the brew that fuels a rocket's takeoff, perchlorate has been reported in water and soil in 35 states, according to the Environmental Protection Agency. The pollutant can disrupt thyroid-hormone synthesis thereby disrupting the growth and development of fetuses and young children.

The most common method for removal of perchlorate from drinking water is to use ion-exchange resins, which pull out the pollutant but don't destroy it. The resins are either burned after one use or treated with a concentrated salt solution to regenerate them. The latter technique leaves behind a perchlorate-contaminated brine that's typically incinerated, explains John R. Shapley of the University of Illinois at Urbana-Champaign.

In their search for another approach, Shapley and his graduate student Keith D. Hurley used a powdered catalyst made of carbon and the metal palladium. To it, they added ammonium perrhenate, a salt that contains the metal rhenium surrounded by four oxygen atoms. They put the powder in water, pumped in hydrogen gas, and then added perchlorate, which consists of a chlorine atom that is bound to four oxygen atoms.

The resulting reaction sequentially stripped the perchlorate of its oxygen, explains Shapley. First, the palladium broke the bonds between two hydrogen atoms. Water formed when these two hydrogens removed an oxygen atom attached to the rhenium. Meanwhile, the rhenium filled its oxygen void by grabbing one of the oxygen atoms attached to the perchlorate. The reaction continued until the perchlorate lost all its oxygen and became chloride.

The catalyst works most effectively in acidic conditions, so it can't directly treat drinking water. But Shapley says the catalyst could be used to remove the perchlorate from the brine left over after the regeneration of used ion-exchange resins. Along with testing the catalyst on the brine, "we are certainly going to be looking at how to deal with the [acid] problem" to move toward direct water purification with the catalyst, says Shapley. —A.C.

Books

A selection of new and notable books of scientific interest

RIVERS OF AMERICA

TIM PALMER

Award-winning photographer and conservationist Palmer illustrates in 200 full-color photographs his lifelong passion for the rivers that create and



weave through the landscape of North America. His introduction recounts his childhood playing along the Ohio River and his later decision to canoe and map the Youghiogheny River. These experiences awakened him to the practical, economic, and

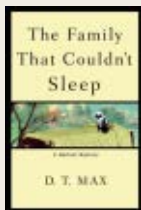
ecological importance of rivers. Here he recounts how that last function is threatened across the United States. Palmer toured the nation and photographed its rivers from the shore, a canoe, mountaintops, and airplanes. His book reveals the majesty and beauty of rivers throughout the country.

Palmer's photographs convey the changing nature of rivers, from the violence of rapids to the calm of shoreline eddies. **Abrams, 2006, 223 p., color photos, hardcover, \$40.00.**

THE FAMILY THAT COULDN'T SLEEP: A Medical Mystery

DANIEL T. MAX

In 2001, Max attended a reunion for an Italian family that for 200 years had been afflicted with a mysterious and devastating disease. The symptoms are horrific: The afflicted, upon reaching middle age, suddenly find themselves unable to sleep. Within



months, the person dies of exhaustion. Scientists have discovered that the condition, called fatal familial insomnia, arises from a genetic mutation that creates prions, the same kind of misshapen proteins that cause scrapie, mad cow disease, kuru, and Creutzfeldt-Jakob disease. The author explains that

scientists have been baffled by many aspects of these diseases because they're like infections and yet aren't caused by microbes. Max examines how prion diseases arise and considers the evidence that many of them are human-made. For example, mad cow disease emerged from the practice of feeding cow-flesh scraps to other cows. He also outlines how the similarity between symptoms of prion diseases and those of Alzheimer's disease and Parkinson's have led to increasing research into prions. **Random House, 2006, 299 p., hardcover, \$25.95.**

ORGANIC, INC.: Natural Foods and How They Grew

SAMUEL FROMARTZ

While traditional foods are losing profitability in an era of rock-bottom pricing, the popularity of organic foods is on the rise. Fromartz analyzes the catalysts that propelled the organic-food industry from an anti-industrial, natural-food movement to a major

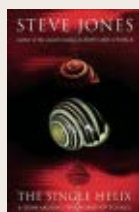
market force. Organic foods, Fromartz explains, appeal to consumers in several ways. Health-conscious food buyers worry about the potential deleterious effects of pesticides and chemical fertilizers. The marketing of tofu and soy milk as alternatives to traditional protein sources also marked a surge in the popularity of these organic items. In the book, Fromartz addresses the backlash against "Big Organic," the large-scale organic companies that many

organic-food purists accuse of selling out to the traditional-food corporations, threatening the small-farm ideals of the organic movement. To prevent abuse of the organic designation, standards have been developed, defining what can legally be considered organic. **Harcourt, 2006, 294 p., hardcover, \$25.00.**

THE SINGLE HELIX: A Turn around the World of Science

STEVE JONES

In 100 succinct essays, Jones takes a whimsical survey of what is known and unknown within the world of science. He reviews each topic not from the perspective of an expert but from



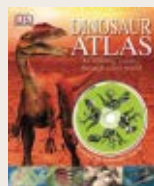
that of anyone who has pondered the science behind everyday phenomena. For example, Jones investigates whether drinking alcohol releases creativity, the evidence of glaciers at Earth's equator, the public perception of science, and the role of statistics in e-mail spam. Jones, professor

of genetics at the University College London, includes the connection between sleep and memory and Alzheimer's disease, the battle against creationism, and questions about blood replacement. With the mathematics of elections and the threats posed by pigs on the Galápagos Islands, Jones offers a bit of science for everyone. **Little Brown, 2006, 288 p., paperback, \$15.95.**

DINOSAUR ATLAS: An Amazing Journey through a Lost World

JOHN MALAM AND JOHN WOODWARD

Few things capture a child's imagination as dinosaurs do. This atlas covers the prehistoric era, reviewing how life emerged on Earth and how the creatures lived before dinosaurs evolved. Divided



into sections for each continent, the atlas gives a detailed overview of the prehistoric climate and descriptions of the dinosaurs that lived in it. At the beginning of each section, a map identifies the habitat, fossil locations, and statistics for each

dinosaur. Vivid computer generated images recreate how prehistoric Earth looked in each area, and fact boxes show how these areas look today. The book also provides information on famous paleontologists. See-through overlay sheets provide an up-close look at various dinosaur skeletal features. The atlas ends with answers to commonly asked questions and a glossary. An interactive CD-ROM gives a 360-degree look at these famous beasts. For ages 8–12. **DK, 2006, 96 p., color images, hardcover, \$19.99.**

LETTERS

Not a pretty picture

"Deadly Disorder: Imagined-ugliness illness yields high suicide rate" (*SN*: 7/22/06, p. 52) raises some questions. What about people who are physically unattractive—those whom a majority of the society considers ugly? I suspect that many people treated for body dysmorphic disorder (BDD) are unattractive by that definition. The psychiatric profession tends to deny that many of the "illnesses" it treats are the result of realities that can't be "cured" by denial.

FRED KOHLER, ASHLAND, ORE.

Excuse me? Two out of nine study participants who attempted suicide succeeded, and this is "double" the suicide rate of some other group? What if one of those two successful attempts had failed because the attempt was discovered sooner? Is the suicide rate suddenly "normal"?

JOSEPH C. NEMETH, FORT COLLINS, COLO.

Actual ugliness is irrelevant to BDD. Only people who are seriously distressed by their belief that they're ugly have the disorder. Many people whom others find unattractive are fine with their appearances. The researchers were cautious about the findings because some groups were small. —E. JAFFE

Out of Africa too

What about circumcision in the United States and Europe, not just sub-Saharan Africa, as a means of reducing AIDS? ("Male circumcision could avert millions of HIV infections," *SN*: 7/29/06, p. 77) As I recall, the most recent trend among U.S. doctors is to discourage this practice as painful and unnecessary.

JAMES SEESER, ST. LOUIS, MO.

Slime mold forever

I applaud your coverage of the BioBlitz in the National Capital Area ("30 Hours with Team Slime Mold," *SN*: 7/29/06, p. 74). You only touched the surface, however. BioBlitzes are just a part of All Taxa Biodiversity Inventories that are being conducted from Great Smoky Mountains National Park to some protected areas in Europe. Specifically related to slime molds, the National Science Foundation has funded a planetary inventory of all species of slime molds, and a team at the University of Arkansas is using national parks and monuments as representative habitats for the study of slime mold diversity in North America.

PAUL E. SUPER, APPALACHIAN HIGHLANDS SCIENCE LEARNING CENTER AT PURCHASE KNOB, LAKE JUNALUSKA, N.C.

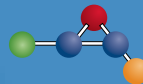
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S E R V I C E



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Isabella Dominguez • Key Biscayne, FL
Cyanna Edwards • San Antonio, TX
Erin Edwards • Pleasant Grove, UT
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Anthony Hennig • Powhatan, VA
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Theo Jones • Tucson, AZ
Nolan Kamitaki • Hilo, HI
Manpreet Kaur • Houston, TX
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Kushal Naik • Hockessin, DE
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