

SCIENCE NEWS

THE WEEKLY NEWSMAGAZINE OF SCIENCE

JULY 1, 2006 PAGES 1-16 VOL. 170, NO. 1

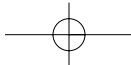
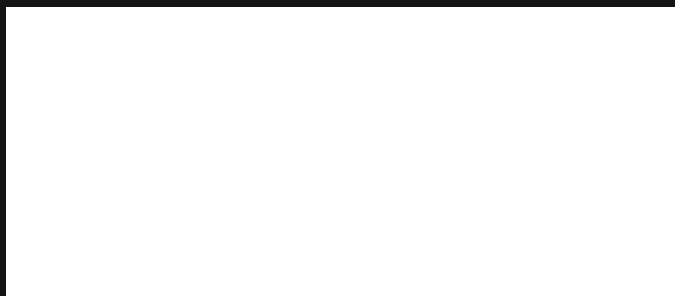
muscle machine
a galactic feast
sibling link to homosexuality
cleaner-burning engines

www.sciencenews.org



shadowy syndrome

A GLIMPSE OF CHRONIC FATIGUE



THE WEEKLY NEWSMAGAZINE OF SCIENCE

SCIENCE NEWS

JULY 1, 2006 VOL. 170, NO. 1

Features

- 8 Pumping Alloy** A new way to power artificial muscles may lead to lifelike machines by Peter Weiss
- 10 A Vexing Enigma** New insights confront chronic fatigue syndrome by Ben Harder
- 12 Galactic de Gustibus** Milky Way's snacks shed light on dark matter and galaxy growth by Ron Cowen



This Week

- 3 Men's homosexuality tied to having older brothers** by Bruce Bower
- 3 T. rex vision was among nature's best** by Eric Jaffe
- 4 Simple burner keeps pollution counts down** by Peter Weiss
- 4 Enzyme treatment might stem wheat intolerance** by Christen Brownlee
- 5 Spinal tap test tracks Alzheimer's compound** by Nathan Seppa
- 5 Planet-making disk has a banana split** by Ron Cowen
- 6 Fructose product could replace chemicals from oil** by Aimee Cunningham
- 6 Plant essences linked to enlarged breasts in boys** by Ben Harder


www.sciencenewsforkids.org

Of Note

- 13 Mexican find reveals ancient dental work**
Cells in bloodstream don't refill ovaries
Pregnancy risk from blood pressure drugs?
With permission to nap, doctors stay more alert
- 14 Humanlike touch from chemical film**
Mammalian ear cells can regenerate
Seeing the light
Blinding spies' digital eyes

Departments

- 15 Books**
- 15 Letters**

Cover While no lab test or drug is approved for chronic fatigue syndrome, new research into its biology is improving understanding of the disorder, and trials of a medication give promising results. (iStockphoto) Page 10

A SCIENCE SERVICE PUBLICATION

PUBLISHER Elizabeth Marincola
 EDITOR IN CHIEF Julie Ann Miller
 MANAGING EDITOR Keith Haglund
 DESIGN/PRODUCTION DIRECTOR Eric R. Roell
 PRODUCTION MANAGER Spencer K.C. Norcross
 ASSOCIATE EDITOR Kate Travis
 SENIOR EDITOR/ENVIRONMENT/POLICY Janet Raloff
 WEB EDITOR/MATHEMATICS Ivars Peterson
 BEHAVIORAL SCIENCES Bruce Bower
 ASTRONOMY Ron Cowen
 BIOMEDICINE Nathan Seppa
 LIFE SCIENCES Susan Milius
 PHYSICS/TECHNOLOGY Peter Weiss
 EARTH SCIENCE Sid Perkins
 ENVIRONMENT/POLICY/HEALTH Ben Harder
 BIOLOGY Christen Brownlee
 CHEMISTRY/MATERIALS SCIENCE Aimee Cunningham
 MATHEMATICS CORRESPONDENT Erica Klarreich
 SCIENCE WRITER INTERN Eric Jaffe
 COPY EDITOR Linda Harteker
 EDITORIAL ASSISTANT Kelly A. Malcom
 WEBMASTER Vernon Miller
 WEB SPECIALIST/EDIT. SECRETARY Gwendolyn Gillespie
 BOOKS/ADVERTISING Cait Goldberg
 SUBSCRIPTIONS Christina Smith
 CIRCULATION/MARKETING DIRECTOR Marcia Leach
 BUSINESS MANAGER Larry Sigler

BOARD OF TRUSTEES AND OFFICERS

CHAIRMAN Dudley Herschbach; VICE CHAIRMAN Robert W. Fri; SECRETARY David A. Goslin; TREASURER Frederick M. Bernthal; MEMBERS Jeanette Grasselli Brown; Samuel Gubins; J. David Hann; Shirley M. Malcom; Cora Marrett; Eve L. Menger; Mario J. Molina; C. Bradley Moore; Ben Patrusky; Anna C. Roosevelt; Vera Rubin; H. Guyford Stever; Jennifer E. Yruegas; HONORARY Bowen C. Dees; Elena O. Nightingale; John Troan
 PRESIDENT Elizabeth Marincola
 BUSINESS MANAGER Larry Sigler

Science News (ISSN 0036-8423) is published weekly on Saturday, except the last week in December, for \$54.50 for 1 year or \$98.00 for 2 years (foreign postage is \$18.00 additional per year) by Science Service, 1719 N Street, N.W., Washington, DC 20036. Preferred periodicals postage paid at Washington, D.C., and an additional mailing office.

POSTMASTER

Send address changes to **Science News**, P.O. Box 1925, Marion, OH 43306. Change of address: Two to four weeks' notice is required—old and new addresses, including zip codes, must be provided. Copyright © 2006 by Science Service. Title registered as trademark U.S. and Canadian Patent Offices. Printed in U.S.A. on recycled paper. ♻️
 Republication of any portion of **Science News** without written permission of the publisher is prohibited. For permission to photocopy articles, contact Copyright Clearance Center at 978-750-8400 (phone) or 978-750-4470 (fax).

EDITORIAL, BUSINESS, AND ADVERTISING

OFFICES 1719 N St. N.W., Washington, D.C. 20036
 202-785-2255; scinews@sciencenews.org
LETTERS editors@sciencenews.org

SUBSCRIPTION DEPARTMENT P.O. Box 1925, Marion, OH 43306. For new subscriptions and customer service, call 1-800-552-4412.

Science News (www.sciencenews.org) is published by Science Service, a nonprofit corporation founded in 1921. The mission of Science Service is to advance the understanding and appreciation of science through publications and educational programs. Visit Science Service at www.sciserv.org.

SCIENCE NEWS

This Week

Gay Males' Sibling Link

Men's homosexuality tied to having older brothers

Birth order may steer some men toward homosexuality in a process that perhaps begins before birth. A new study finds that homosexuality grows more likely with the greater number of biological older brothers—those sharing both father and mother—that a male has.

Men display this tendency toward homosexuality even if they weren't raised with biological older brothers, finds psychologist Anthony F. Bogaert of Brock University in St. Catharines, Ontario. No gay connection appears in men raised with half-brothers, stepbrothers, or adoptive brothers, all deemed non-biological by Bogaert.

"The mechanism underlying this fraternal birth-order effect remains unknown," Bogaert says. It's possible that succeeding pregnancies with male fetuses trigger a maternal immune response. A mother's immune system may treat male fetuses as foreign bodies, attacking them with antibodies that alter sex-related brain development, the Canadian psychologist suggests.

Scientists haven't yet looked for any specific immune reaction during pregnancy that targets later-born boys who become homosexual.

Bogaert's analysis of men's family histories appears in an upcoming *Proceedings of the National Academy of Sciences*. It confirms an analysis of sexual orientation in 604 men reported in 1996 by Bogaert and a colleague. That report didn't include men raised with non-biological older brothers, leaving open the possibility that some psychological reaction to older brothers fostered homosexuality.

The new investigation consists of 944 Canadian men for whom Bogaert verified background information, including sexual

orientation and age, number of biological and non-biological siblings, whether siblings occupied the same house as children, and the biological mother's age at the participant's birth.

Critically, 521 of the men had grown up with one or more non-biological siblings.

The number of biological older brothers correlated with the likelihood of a man being homosexual, regardless of the amount of time spent with those siblings during childhood, Bogaert says. No other sibling characteristic, such as number of older sisters, displayed a link to male sexual orientation.

By accounting for potential psychological effects of having older brothers, Bogaert's data "strengthen the notion that the common denominator between biological brothers, the mother, provides a prenatal environment that fosters homosexuality in her younger sons," say neuroscientist S. Marc Breedlove of Michigan State University in East Lansing and his coworkers in a comment to be published with the new report.

The release of maternal antibodies that boost a boy's probability of becoming gay is a provocative but untested hypothesis, Breedlove and his coworkers note.

It makes sense, though, in light of previous failures to find any older-sibling influences on female homosexuality, they say.

Breedlove's group suspects that some boys are "born to become gay" as a result of genetic and prenatal factors. However, psychologist Daryl J. Bem of Cornell University argues that

the new findings don't necessarily support that view.

Bem has proposed that genes and biology orchestrate temperaments that gear kids toward sex-typical or sex-atypical activities. Boys who don't like rough-and-tumble play

perceive males as different from themselves, a feeling that may turn erotic during adolescence, Bem says (*SN*: 8/10/96, p. 88).

Bogaert's work indicates that for homosexuality to develop, it doesn't matter whether boys feel different from sex-typical older brothers, only that they have older brothers, Bem acknowledges. Still, a maternal immune response could promote homosexuality by lowering a boy's aggression, rather than by stamping a same-sex orientation into the brain, Bem says. —B. BOWER

Sight for 'Saur Eyes

T. rex vision was among nature's best

In the 1993 movie *Jurassic Park*, one human character tells another that a *Tyrannosaurus rex* can't see them if they don't move, even though the beast is right in front of them. Now, a scientist reports that *T. rex* had some of the best vision in animal history. This sensory prowess strengthens arguments for *T. rex*'s role as predator instead of scavenger.

Scientists had some evidence from measurements of *T. rex* skulls that the animal could see well. Recently, Kent A. Stevens of the University of Oregon in Eugene went further.

He used facial models of seven types of dinosaurs to reconstruct their binocular range, the area viewed simultaneously by both eyes. The wider an animal's binocular range, the better its depth perception and capacity to distinguish objects—even those that are motionless or camouflaged.

T. rex had a binocular range of 55°, which is wider than that of modern hawks,

QUOTE



The mechanism underlying the fraternal birth-order effect [on homosexuality] remains unknown."

ANTHONY F. BOGAERT, Brock University



INSIGHT *Tyrannosaurus rex*'s cheek grooves (below the eye sockets) and narrow snout cleared its sight lines, giving it impressive vision, according to a new study.

SCIENCE NEWS

This Week

Stevens reports in the summer *Journal of Vertebrate Paleontology*. Moreover, over the millennia, *T. rex* evolved features that improved its vision: Its snout grew lower and narrower, cheek grooves cleared its sight lines, and its eyeballs enlarged.

"It was a selective advantage for this animal to see three-dimensionally ahead of it," Stevens says.

Stevens also considered visual acuity and limiting far point—the greatest distance at which objects remain distinct. For these vision tests, he took the known optics of reptiles and birds, ranging from the poor-sighted crocodile to the exceptional eagle, and adjusted them to see how they would perform inside an eye as large as that of *T. rex*. "With the size of its eyeballs, it couldn't help but have excellent vision," Stevens says.

He found that *T. rex* might have had visual acuity as much as 13 times that of people. By comparison, an eagle's acuity is 3.6 times that of a person.

T. rex might also have had a limiting far point of 6 kilometers, compared with the human far point of 1.6 km. These are best-case estimates, Stevens says, but even toward the cautious end of the scale, *T. rex* still displays better vision than what's needed for scavenging.

The vision argument takes the scavenger-versus-predator debate in a new direction. The debate had focused on whether *T. rex*'s legs and teeth made it better suited for either lifestyle (*SN*: 3/2/02, p. 131).

Stevens notes that visual ranges in hunting birds and snapping turtles typically are 20° wider than those in grain-eating birds and herbivorous turtles.

In modern animals, predators have better binocular vision than scavengers do, agrees Thomas R. Holtz Jr. of the University of Maryland at College Park. Binocular vision "almost certainly was a predatory adaptation," he says.

But a scavenging *T. rex* could have inherited its vision from predatory ancestors, says Jack Horner, curator of paleontology at the Museum of the Rockies in Bozeman, Mont. "It isn't a characteristic that was likely to hinder the scavenging abilities of *T. rex* and therefore wasn't selected out of the population," Horner says.

Stevens says the unconvincing scene in *Jurassic Park* inspired him to examine *T. rex*'s vision because, with its "very sophisticated visual apparatus," the dinosaur couldn't possibly miss people so close by. Sight aside, says Stevens, "if you're

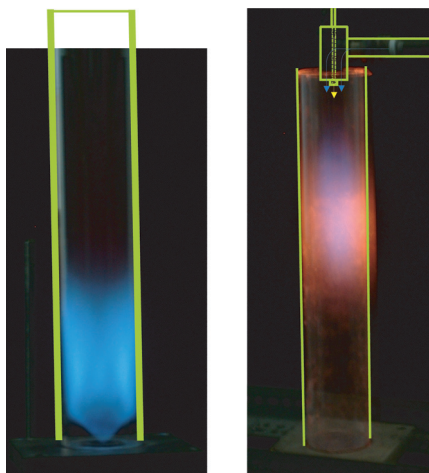
sweating in fear 1 inch from the nostrils of the *T. rex*, it would figure out you were there anyway." —E. JAFFE

Hot Prospect

Simple burner keeps pollution counts down

A new type of combustion chamber reduces pollution with less complexity and a safer, more reliable design than other low-emission burners, the device's developers say.

The novel chamber, or combustor, could replace conventional chambers in water heaters, power turbines, and perhaps even jet-aircraft engines, says Ben T. Zinn of the Georgia Institute of Technology in Atlanta, who heads the invention team.



FIRE HOUSES A typical combustion chamber (left) receives its fuel-air mixture at the bottom, burns it there, and expels exhaust from the top. A new design (right), closed at the bottom, both takes in fuel and air and releases hot exhaust gases at the top, achieving low emissions in a novel way. Combustion appears blue or red.

As one way to meet increasingly stringent legal limits on emissions of pollutants such as nitrogen oxides (NO_x) and carbon monoxide, combustor makers incorporate premixers that function much like carburetors in old car engines. In a typical pre-mixer, internal baffles force a dilute blend of fuel in air to swirl around and mix thoroughly before being ignited. Without regions of concentrated fuel, the mixture burns coolly, which limits NO_x production.

There are penalties to premixing, however, says Zinn. For one, the flame in the chamber can ignite the fuel-air mixture in the pre-mixer—an event known as flashback—sometimes causing an explosion. Also, premixers add complexity and costs to combustor design and manufacturing, he says.

The Georgia Tech combustor differs dramatically from typical low-emission com-

bustors, Zinn says. A conventional pipelike combustor takes in an air-fuel mixture at one end, burns it, and then expels exhaust out the other end. In contrast, the new device both receives its air and fuel—as separate streams—and rejects its exhaust at the same end. The other end is closed.

A nozzle injects fuel and air down the middle of the combustor cylinder as hot exhaust gases rise along the walls, explains team member Jerry M. Seitzman. Ignition of some incoming material by hot exhaust as the flows meet roils the remaining air and fuel so that they mix well. The result is a constant flame. The device can cleanly burn either gases or liquid fuels.

Because there's no pre-mixer, flashback can't occur. Moreover, the design keeps the device simple and potentially cheap, Zinn contends. He adds that the prototypes also avoid two other problems of low-emission combustors—an easily blown-out flame and potentially damaging pressure fluctuations.

"The real breakthrough here is that they burn the nonpremixed gas or liquid fuel and get those low emission numbers," comments Robert K. Cheng of Lawrence Berkeley (Calif.) National Laboratory.

Priya Gopalakrishnan of the Georgia Tech team plans to describe the device in August at a combustor symposium in Heidelberg, Germany. —P. WEISS

Getting Back at Celiac

Enzyme treatment might stem wheat intolerance

A combination of two enzymes could eventually treat celiac disease, an inherited digestive disorder that affects about 1 percent of people worldwide.

People with this condition, also known as celiac sprue, can't tolerate gluten, a protein present in grains such as wheat, barley, and rye. When celiac patients ingest the protein, it sets off an immune response that inflames the small intestine and leads to weight loss, diarrhea, and other symptoms.

Currently, the only effective therapy for celiac disease is for patients to exclude gluten-containing foods from their diets. However, since the protein lurks in many nongrain foods, people can have a hard time completely eliminating dietary gluten. "If you wanted to buy a soup or any yogurt or some kind of product that didn't overtly have bread or pasta... chances are it still contains gluten," says Chaitan Khosla of Stanford University.

Seeking an alternative approach, Khosla and his colleagues looked to an enzyme derived from barley. When a barley seed is ready to sprout, this enzyme, called EP-B2, breaks down a gluten component called

glutamine and thereby frees up starches that nourish the growing plant.

To see whether the enzyme might break up gluten in patients' stomachs, Khosla's team first equipped lab-grown *Escherichia coli* bacteria with the gene for EP-B2. The maneuver turned the microbes into enzyme-making machines.

The researchers then added the product to simulated stomachs: test tubes containing various stomach acids along with doses of gluten. Other test tubes received identical measures of stomach acids and gluten, but no EP-B2.

After an hour, the researchers took samples from all the test tubes and added them individually to lab dishes containing immune cells from people with celiac disease. The samples in which the gluten had remained intact prompted the cells to quickly multiply, indicating a raging immune response. Immune cells exposed to the enzyme-treated gluten reproduced at a slower rate.

However, Khosla notes that even the immune response brought on by the enzyme-treated gluten was beyond what scientists currently consider safe. To further digest gluten, the researchers devised a similar experiment with prolyl endopeptidase (PEP), a well-studied digestive enzyme that breaks up another gluten component called proline.

Like EP-B2, PEP alone didn't adequately dampen the immune response. However, when the researchers exposed cells to gluten treated with both enzymes, the cells' division slowed to a crawl.

Khosla's team presents these results in two reports in the June *Chemistry & Biology*.

Khosla explains that someday patients with celiac disease might take these two enzymes in a pill with gluten-heavy meals, much as lactose-intolerant people can take a pill if they want to eat dairy products.

"It's a very attractive idea," says Peter H. R. Green, a celiac disease researcher at Columbia University. However, he notes that even if such a pill comes to market, it's unlikely that it will replace careful eating and a doctor's care.

"The worrying thing to me is the idea of people taking a pill and not having the correct therapy," Green says. —C. BROWNLEE

Measuring Stick

Spinal tap test tracks Alzheimer's compound

Scientists point to high concentrations of amyloid-beta in the brain as the chief culprit in Alzheimer's disease. But they don't know whether the increased amounts of this peptide arise from its overproduction or from a failure of the body to dispose of an excess.

In the July *Nature Medicine*, researchers describe a test that enables them for the first time to track amyloid-beta production and clearance in cerebrospinal fluid in people.

While other researchers have used spinal taps to provide a snapshot of amyloid-beta concentrations (*SN*: 2/18/06, p. 102), measuring the ongoing production and disposal of the peptide could provide insights into the origins of Alzheimer's and lead to advances in diagnosis and treatment, says study coauthor Randall J. Bateman, a neurologist at Washington University School of Medicine in St. Louis.

He and his colleagues gave six young, healthy volunteers a modified form of the amino acid leucine, a building block of amyloid-beta, and then monitored their cerebrospinal fluid with a spinal tap. After as little as 5 hours of the intravenous leucine drip, the participants' cerebrospinal fluid showed amyloid-beta that contained some of the modified leucine—a sign that the amyloid-beta was newly produced.

After 9 to 12 hours, when the percentage of amyloid-beta tagged with the modified leucine leveled off, the scientists stopped the leucine drip. They then saw a gradual reduction of tagged amyloid-beta, signaling

that the marked peptides were being cleared from the body and replaced.

The rates of amyloid-beta production and clearance were similar. The data indicate that the central nervous system recycles half its supply of amyloid-beta about every 6 hours, says Bateman, who volunteered for the first spinal tap in the study.

The risk of Alzheimer's rises considerably with age. One hypothesis holds that the capacity to remove amyloid-beta "decreases with age until it reaches a threshold where [amyloid-beta is] produced faster than you can clear it out," Bateman says.

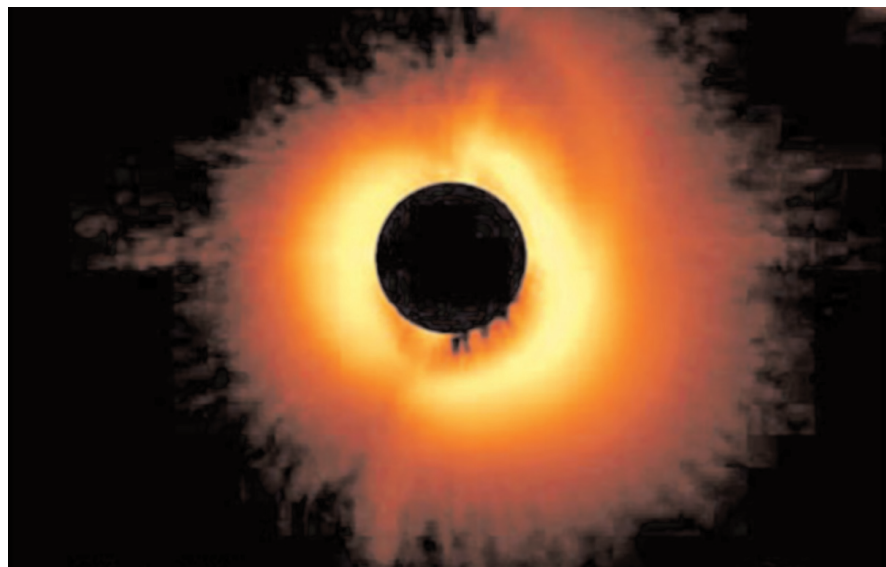
Now, scientists can apply the new testing method to gauge clearance rates in different age groups. Bateman and his colleagues have begun tests in older people, some with Alzheimer's disease.

The new method might also enable doctors to spot imbalances of amyloid-beta production and clearance in people with the earliest stages of lapsing memory, he says.

Meanwhile, drug companies are working to develop agents that stifle amyloid-beta production or hasten its clearance. An accurate measurement of amyloid-beta production and clearance "would be fantastic as a tool for knowing whether the drugs are

STATS

4.5
million
People in the
United States
with
Alzheimer's
disease



Planet-making disk has a banana split

Two bright-yellow, banana-shaped arcs of gas and dust face each other within a newly discovered disk surrounding a young star called HD 142527. The disk, with a radius about six times the average distance between Neptune and the sun, may already have spawned one planet and could make several more, say researchers in Japan. A passing star or an outlying planet would have sculpted the banana-shaped arcs, Hideaki Fujiwara of the University of Tokyo and his colleagues suggest in the June 20 *Astrophysical Journal Letters*. Using the Subaru Telescope atop Hawaii's Mauna Kea, the team also discerned a large gap between the outer and inner regions of the disk. The gap, not shown in this near-infrared image, was probably cleared by a planet that coalesced within the disk, the group says. —R. COWEN

SCIENCE NEWS

This Week

really working,” says neuroscientist David Teplow of the University of California, Los Angeles School of Medicine.

Until now, Bateman says, the effectiveness of any Alzheimer’s drug could be assessed only by monitoring a patient’s mental performance over months or years. Therefore, the new amyloid-beta analysis might speed testing of novel drugs, he says. —N. SEPPA

Sweet Synthesis

Fructose product could replace chemicals from oil

The production of many chemicals starts with petroleum, but as worldwide oil supplies wane, scientists are looking for renewable building blocks. A Wisconsin team describes the efficient use of fructose toward making one starting material. The strategy could lead to sugar-based polyesters and other products.

The Department of Energy (DOE) has identified 12 high-value chemicals that can be made from sugars. On the list is furandicarboxylic acid (FDCA), which the agency pegs as a possible replacement for terephthalic acid, a petrochemical found in polyesters.

One pathway to FDCA contains hydroxymethylfurfural (HMF), a fructose product. Previous HMF-synthesis routes, however, were plagued by either energy-intensive separation steps or low yields, both of which would make for high production costs, says James A. Dumesic, a chemical engineer at the University of Wisconsin–Madison.

“We tried to tweak the process,” he says, to “combine good yield with easy separation.”

Dumesic and his colleagues put fructose and an acidic catalyst in a continually stirred mix of water and the solvent called methylisobutylketone. After the conversion, they stopped stirring, and the water and organic solvent separated into two layers, as oil and vinegar do.

The water at the bottom retained the catalyst and any remaining fructose, while the organic solvent held the HMF, which could then be easily isolated by evaporation, Dumesic says.

The group found that spiking the organic solvent with the alcohol 2-butanol

“more efficiently pulls HMF up to the organic layer where you want it to be,” Dumesic adds.

This and other adjustments improved the reaction’s yield. At its best, the technique converted 80 percent of the fructose to HMF and made only 10 percent of the sugar into by-products. The team describes its procedures in the June 30 *Science*.

Chemicals made from renewable materials have the potential to become new and useful molecules, according to the DOE. Sugar-inspired chemistry could form the basis for a biorefinery—the renewable equivalent of a petrochemical refinery—that could turn HMF and other key chemicals into any of thousands of different products.

“When you look at the literature for converting renewables into chemicals, HMF always shows up as one of the usual suspects,” says Joseph J. Bozell, an organic chemist at the University of Tennessee in Knoxville. “But no one has been able to produce it in a high yield that you could isolate easily.”

Dumesic’s system, he says, “may be a first step in that path.” —A. CUNNINGHAM

Lavender Revolution

Plant essences linked to enlarged breasts in boys

Two ingredients common in many hair- and skin-care products have been linked to abnormal development of breasts in boys. Lavender oil and tea tree oil contain compounds that act like female sex hormones and interfere with male hormones, researchers have determined.

Enlarged male breasts, or gynecomastia, result from an imbalance between the activity of estrogens, which stimulate breast growth, and estrogen-inhibiting androgens. The condition is extremely rare before puberty, says Denver-area pediatric endocrinologist Clifford Bloch.

Nevertheless, since the mid-1990s, Bloch has treated gynecomastia in a series of boys age 10 or younger. Most had normal ratios of sex hormones in their blood, indicating that theirs wasn’t a problem of hormone production.

From the youngsters and their parents, Bloch learned that at least five boys had

been using a shampoo, hair gel, soap, or another topical product that listed lavender oil among its ingredients. One of the products also contained tea tree oil. “A couple of patients were putting pure lavender oil on their skin,” he says.

Bloch recommended that the boys stop using lavender-containing products. When they followed his advice, gynecomastia disappeared within a few months.

To verify his hunch that the plant oils were hormonally active, Bloch contacted Derek Henley and Kenneth Korach of the National Institute of Environmental Health Sciences in Research Triangle Park, N.C. In their lab, the two investigators exposed human-breast cells to lavender oil and, separately, to tea tree oil. They found that each oil turned on estrogen-regulated genes and inhibited an androgen-regulated gene.

“These oils possess both estrogenic and anti-androgenic properties,” Henley reported at the Endocrine Society meeting in Boston this week. He adds that the finding is the first to implicate “essential oils” from plants in gynecomastia.

Young boys should avoid the oils, Bloch advises. Many personal-care products contain them. Other plant products act like estrogens in the body (*SN*: 5/25/02, p. 325).

Pediatric endocrinologist Edward Reiter of Tufts University School of Medicine in Springfield, Mass., applauds Bloch for his “impressive, Sherlock Holmes” performance in unearthing what the boys had in com-

mon. While similar patients probably trickle in to other endocrinology clinics, he says, the cause of their enlarged breasts could escape diagnosis because doctors don’t make the connection to personal-care products.

“If I had seen [just] one of those kids, I’m sure I would have missed it,” he says.

The rapid reversal of gynecomastia that Bloch accomplished is a rare achievement in medicine, comments Ken Ong, a pediatric endocrinologist at the Medical Research Council in Cambridge, England. As such, it strongly suggested a link between the products and the boys’ problem.

The plant essences presumably have similar potential effects in young girls, Reiter says. Studies show a recent

rise of early breast development in girls (*SN*: 9/9/00, p. 165). Prepubertal children have low sex hormone concentrations, so relatively small amounts of hormone-mimicking compounds might

upset their physiological balance at that age, says Reiter. —B. HARDER



PURPLE POSE Skin and hair products containing the essence of lavender plants could disrupt the balance of sex hormone activity in children.

BRAND X PHOTOS

SO MANY GREAT TOPICS, ONE GREAT SCIENCE WEEKLY

- EARTH SCIENCE • ANTHROPOLOGY •
- COSMOLOGY • SEISMOLOGY • BOTANY •
- ENVIRONMENT • PLANETARY SCIENCE •
- BIOMEDICINE • BEHAVIOR • ARCHAEOLOGY •
- PHYSICS • ASTRONOMY • BIOTECHNOLOGY •
- OCEANOGRAPHY • GENETICS • TECHNOLOGY •
- NANOTECHNOLOGY • ZOOLOGY •
- INFECTIOUS DISEASES • CHEMISTRY •
- MATERIALS SCIENCE • PALEONTOLOGY •
- SCIENCE AND SOCIETY • ASTROPHYSICS •
- BIOLOGY • FOOD AND NUTRITION •
- PHARMACOLOGY • CELL BIOLOGY •
- AGRICULTURE • MICROBIOLOGY •
- ENDOCRINOLOGY • NEUROSCIENCE •
- IMMUNOLOGY • PSYCHOLOGY •
- MATHEMATICS • EPIDEMIOLOGY •

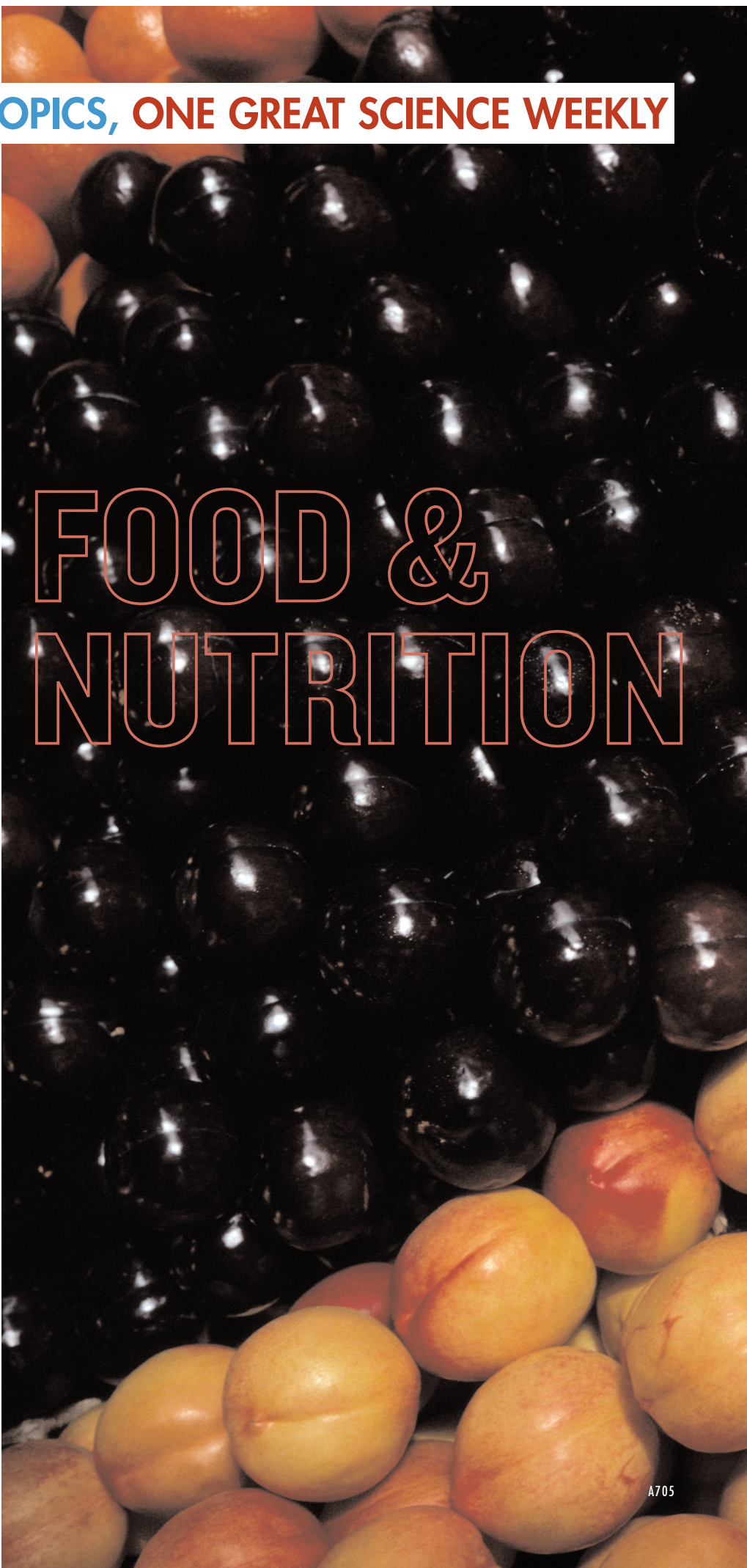
SUBSCRIBE TODAY SPECIAL SAVINGS!

A 1-year subscription to *Science News* is \$54.50.
 Each additional subscription that you order is only \$49.
You may include your own renewal or new subscriptions at this money-saving rate.

SEND GIFT ORDERS NOW!

For fastest service, call
1-800-552-4412
 or visit our web site at
www.sciencenews.org

**SCIENCE
NEWS**



PUMPING ALLOY

A new way to power artificial muscles may lead to lifelike machines

BY PETER WEISS

In a Texas laboratory, a toy mechanical arm just the length of an index finger perches, folded up, at the edge of an empty glass bowl. A young man in a lab coat squirts a volatile fluid, methanol, into the bowl. Moments later, the arm jerks and then hesitantly reaches forward. Although clumsy and slow, the gesture is a remarkable one never previously achieved in any lab: The arm moves when parts of its structure contract in response to reactions triggered by local chemical fuel—much as our own limbs do.

The toy arm's sinews, made of wire, respond to the methanol because they're coated with a fine film of platinum nanoparticles. This unique design enables the wires both to harness chemical energy and to carry out the motion, says the leader of the project, Ray H. Baughman of the University of Texas at Dallas.

That two-in-one capability could become a new design principle for scientists as they create humanlike machines. "It could transform the way complex mechanical systems are built," says John D.W. Madden of the University of British Columbia in Vancouver.

These advances may eventually lead to major improvements in prosthetic limbs and to robots that can carry out tasks ranging from repairing spaceships to assisting people in their everyday lives.

To specialists in robotics, says John A. Main of the Defense Advanced Research Projects Agency (DARPA) in Arlington, Va., the advent of artificial muscles directly powered by high-energy fuels is "a very big deal."

MOVING TARGET The human body is difficult to rival in its mechanical skill, strength, and grace. These enviable capabilities rely on muscles that extend and contract linearly, as pistons do. To power those muscles, a person consumes foods such as proteins and fats that are so densely packed with energy that a small quantity fuels long periods of hard physical work.

Achieving comparable performance from a machine today, says Main, requires an internal combustion engine plus a lot of heavy hardware—including gears, belts, pumps, and reservoirs—between the engine and the pistons it drives. Such power-hungry motors

add complexity to designs and introduce heat, noise, and fumes.

While batteries offer an attractive alternative, they store little energy—only about one thirtieth as much as the same weight of methanol. To run a long time, a machine must lug around a heavy bank of batteries, as electric cars do, Main notes.

The challenge to researchers, then, is to develop an efficient way to tap a high-energy, compact power source to make artificial muscles contract and stretch.

In the now-defunct television show *Futurama*, the rude-talking cartoon robot Bender Bending Rodriguez was a hard drinker. But his habit was what kept him going; he and the other robots of 3000 A.D. were fueled primarily by alcohol. The idea of making robots and robotic components powered by high-energy fuel, rather than by motors or batteries, doesn't need to wait until the 31st century to become reality.

Today, some artificial muscles respond to temperature changes, as the Texas toy arm does, and others are stimulated by electrical or chemical changes. A temperature-sensitive artificial muscle

appears in many products, such as automatic shut-off valves in showerheads and teakettles, medical stents, and pipe couplings and fasteners. It typically consists of a polymer or an alloy of metals—say, nickel and titanium. Known as a shape-memory material, the polymer or alloy switches, at a threshold temperature, between two specific shapes while simultaneously changing from one crystalline structure to another.

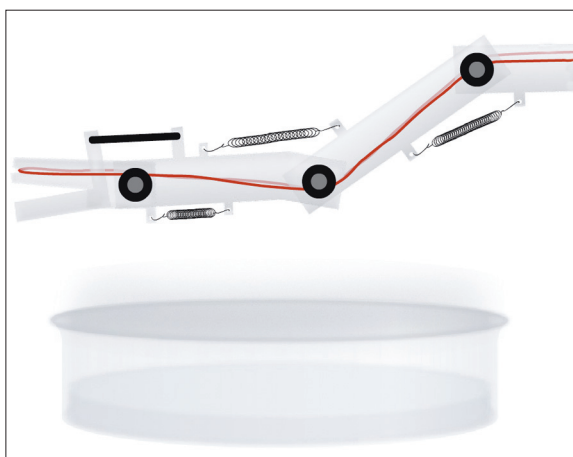
Voltage changes activate other artificial-muscle materials, including rubberlike elastomers, electrically conductive polymers, and flat strips made of carbon nanotubes. Less mature than their shape-memory cousins, these materials still come with certain drawbacks. Some require high operating voltages, and some operate slowly, Baughman says.

GIVE ME THE POWER In 2003,

Baughman received a patent on a technique to meld artificial muscles and fuel cells. Fuel cells bring together hydrogen gas and oxygen to create electricity, yielding water as a by-product (*SN*: 2/4/06, p. 72).

DARPA's Main, who had already been pondering fuel-powered artificial muscles, funded the Texas team to further explore the possibilities. The researchers unveiled two markedly different implementations of the concept in the March 17 *Science*.

While each technique has its strengths and weaknesses, both show that—at least in the lab—fuel power can work for artificial muscles, says chemist Von Howard Ebron, a member of the Texas team.



HOT-WIRED — The artificial muscle (red wire) that moves this plastic arm draws its power directly from a chemical reaction. Catalyzed by platinum nanoparticles on the nickel-titanium wire's surface, methanol fumes rising from the bowl become oxidized. The reaction heats the wire, which causes it to shrink and to force the arm to extend.

J. OH, M. KOZLOV/NANOTECH INSTITUTE, UNIV. TEXAS-DALLAS

“This is the first direct, fuel-to-mechanical-energy conversion in an artificial-muscle-like package that we’ve seen,” Main asserts.

The methanol-powered toy mechanical arm illustrates one of the implementations. Although that arm doesn’t represent a serious robot-limb design, notes Ebron, it demonstrates a simple and potentially practical scheme.

Heat-generating chemical reactions occur in the film of platinum nanoparticles that covers the arm’s shape-memory-alloy wires. The platinum coating catalyzes oxidation of methanol. The heat that’s quickly generated causes the shape-memory wires to contract, forcing the robotic arm to straighten and lift.

In a refinement of the approach, the team fashioned the platinum-coated shape-memory wires into a coiled spring that lifted a weight of up to half a kilogram when exposed to methanol.

The other implementation reported in March takes a quite different tack, using a change in electrical charge to cause an artificial muscle to expand or contract.

Baughman’s team and other scientists had found that electric currents influence the lengths of objects made from electrically conductive materials composed primarily of nanometer-diameter cylinders of carbon, called carbon nanotubes (*SN: 12/24/03 31/05, p. 416*). In the new work, a carbon-nanotube strip about the length of a matchstick is laden with platinum particles. The team immerses the strip, which is part of an electrical circuit, in acid in a glass vessel that has ports through which hydrogen and oxygen gas can enter.

In one configuration, oxygen molecules that contact the nanotube strip snatch electrons in a reaction catalyzed by the platinum and then react with hydrogen ions in the surrounding acid bath to form water. The vacancies, or holes, in the strip left by those electrons create positive electric charges that cause the strip to enlarge. The apparatus is acting as a fuel cell as it stores electricity in the carbon-nanotube strip.

When the researchers switch the current back on, electrons flow into the strip, neutralizing the holes and shrinking the strip.

The experiments are a proof of principle of the fuel cell approach, but researchers have not yet configured these devices to apply their strength to weights or other loads. To do so will require more-sophisticated packaging of the components, Baughman says.

“The great thing about this research is it demonstrates that future artificial muscles can be packaged in a much smaller, lighter, and simpler way than previously,” comments artificial-muscle researcher Geoffrey M. Spinks of the University of Wollongong in New South Wales, Australia. The new work suggests that “we don’t need batteries. We just feed in a fuel source and actuation occurs,” he says.

Artificial muscles might someday enable artificial hearts to power themselves from the body’s naturally supplied fuels, Baughman proposes.

FAMILY RESEMBLANCE The new strategies might eventually lead to applications other than humanoid robots and replacement limbs or hearts.

Consider space exploration. “Multifunctional planetary landers are being built smaller and smaller and with more and more functionality,” Spinks says. “NASA would love small, lightweight actuators that deliver high power.”

These applications may be a long way off, but the prototypes already outperform nature in some ways. Each shape-memory muscle, for instance, exerts about 500 times as much force, cor-

rected for size, as human muscle does.

To do so, it undergoes a length change of about 5 percent. Human muscles typically undergo length changes of 20 percent or more. The artificial muscle’s meager change isn’t a problem: If an artificial muscle is formed into a weaker, springlike coil, it can still stretch as much as or more than human muscle while remaining more powerful, the researchers report.

“Nature’s muscles are truly wondrous,” Baughman says, “but the ones we created can provide much higher force capability and larger strokes than natural muscle.” The muscles made of the alloy function about equally well when powered by methanol, hydrogen, or formic acid, he adds.

The Texas team’s carbon-nanotube muscles deliver about 100 times as much force as human muscle does. However, those artificial muscles change little in length, less than 2 percent.

On the other hand, the carbon-nanotube muscles can not only store electricity but can also generate it when the device is inactive mechanically. So, high-performance designs of robots might use idle muscles to build up energy and distribute it to working ones—perhaps even to shape-memory muscles, Ebron says.

Many obstacles must be overcome before practical versions of fuel-powered artificial muscles can be made. The devices currently work too slowly. For instance, the carbon-nanotube actuators take up to 5 seconds to fully extend or contract. Although shape-memory wires can heat up and contract quickly, cooling them rapidly remains a challenge.

Stuart D. Harshbarger, an engineer in a new DARPA-funded prosthetics program, says that today’s artificial muscles—fuel powered or

not—remain too slow for actuating that program’s artificial limbs. “When you think about reaching for an object, the entire process, from intention to grasping, is on the order of 100 milliseconds,” not seconds, he notes.

In some recent tests of carbon-nanotube strips that were not associated with a fuel cell, Spinks, Madden, Baughman, and their other colleagues found that they could speed actuation by using pulses of electricity more than 30 times as high as the typical voltages in the fuel cell arrangement. Those jolts activated strips in milliseconds, the scientists report in the April 4 *Advanced Materials*.

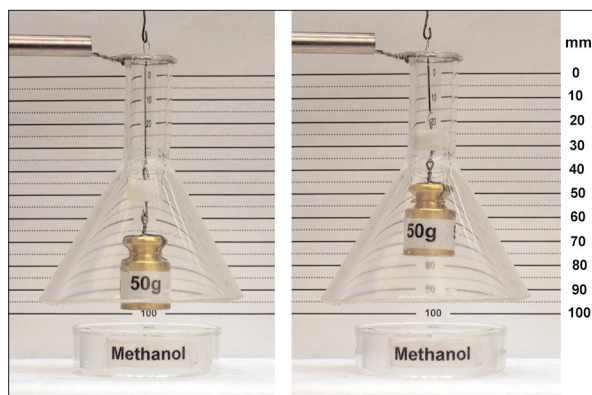
Another way to speed up fuel-cell configurations of artificial muscles might be to switch from carbon nanotubes to electrically conductive polymers, Baughman says.

Among other hurdles ahead, scientists must devise a plumbing-and-control network, somewhat like blood vessels and nerves, to deliver precise dollops of fuel when and where it’s needed. For machines that use muscles built from shape-memory materials, the network might also provide a coolant.

“The new challenge is to create a circulation system that replaces the wires that usually drive these actuators,” says Madden in a commentary that appeared with the Texas team’s reports in the March 17 *Science*.

Baughman says that his team is pursuing research on components of such a network.

Despite these obstacles, there’s strong interest in the development of artificial muscles, adds Harshbarger, who works for the Johns Hopkins Applied Physics Laboratory in Laurel, Md. “It’s something to keep our eyes on.” ■



WEIGHT LIFTER — Methanol fumes rise through a funnel and oxidize at the surface of an artificial-muscle wire (left). The reaction generates heat, making the wire contract and lift a 50-gram weight and a Teflon stopper (right). The stopper then prevents further fumes from reaching the wire, so the wire cools, lengthens, and unstoppers the funnel, restarting the cycle.

A VEXING ENIGMA

New insights confront chronic fatigue syndrome

BY BEN HARDER

Laurel Wright was 52 years old when her well-being plummeted. That May, she began to feel inexplicably tired, day after day. “By September,” she says, “I crashed and burned.” She developed debilitating exhaustion, severe insomnia, muscle aches, and what she calls “brain fog.” Whenever she overexerted herself, aches and pains would spread throughout her body, sending her to the bed or the couch for several days at a stretch. Wright tried ducking out from her job during the day to go home and nap. Later, she cut her hours to halftime, and then went on sick leave. That was 12 years ago. She never returned to work.

Early in Wright’s illness, a doctor determined that she had developed chronic fatigue syndrome. Wright now obtains treatment for it near her home in Salt Lake City. The condition is a poorly understood disorder that affects more than 1 million people in the United States, according to a new estimate that the Centers for Disease Control and Prevention (CDC) plans to publish this fall.

Wright received a diagnosis relatively quickly, but other patients go for years before their illness is recognized. About a decade before her own illness, Wright says, her mother “started getting the flu in the winter, and it started getting longer every year, until she had it all the time. It took her years to get diagnosed [with the syndrome].”

Like many people with the condition, Wright strictly curtails her activity. Sometimes she uses a heart-rate monitor to avoid accidentally exceeding her physical limits. She also takes pills to ease insomnia and other symptoms. But no drug has been approved to treat chronic fatigue syndrome; trial after clinical trial has produced disappointing results. Nor is there a definitive diagnostic test or an understanding of how the disorder develops.

Recent research may begin to enlighten this dark age. A major study now gives scientists an unprecedented perspective on what is awry in the bodies and brains of people who have the syndrome. And promising data on an experimental medicine indicate that the first specific drug for chronic fatigue syndrome may be nearing the market.

AN EVERLASTING FLU Although the term *chronic fatigue syndrome* is still new, historical evidence suggests that the disorder has been around for centuries. Studies show that it sometimes runs in families, and it affects women more often than men.

The daylong or multiday “post-exertional malaise” that sometimes affects Wright is the “hallmark of this disease,” says internist Lucinda Bateman. For the past 6 years, Bateman’s work at her Salt Lake City medical practice, the Fatigue Consultation Clinic, has focused on Wright and other patients with chronic fatigue.

Other symptoms of chronic fatigue syndrome can include low-

grade fever, sore throat, swollen lymph nodes, joint pain, memory impairment, and headache. Developing the illness is “like catching the flu and never getting better,” Bateman says.

Diagnosing chronic fatigue syndrome currently depends on first ruling out other potential causes of fatigue, such as acute viral illness or depression. Past studies of affected people have identified subtle abnormalities in the hypothalamic-pituitary-adrenal systems, which control the interactions of mood- and immunity-related hormones. But there’s no test of those hormones that indicates whether a person has chronic fatigue syndrome.

Some people develop chronic fatigue syndrome gradually, as Wright did, while in other people, it emerges full-blown on the heels of a viral infection. Epstein-Barr virus, cytomegalovirus, and herpes virus-6 are among the agents that have been linked to the disorder.

Among government-approved medicines, Bateman says, “there are no direct treatment options, only supportive treatment options.” Doctors treat chronic fatigue syndrome by helping patients to sleep better, giving medications that improve mood, and advising them on how to pace their activity so that they don’t overexert themselves.

“It’s like catching the flu and never getting better.”

— LUCINDA BATEMAN,
THE FATIGUE
CONSULTATION CLINIC

In addition to these symptom-reducing strategies, treatments include cognitive-behavioral therapy, and what’s known as graded exercise. The latter aims to gradually increase patients’ tolerance for exertion without pushing them so hard as to trigger post-exertional malaise.

But drugs aimed at profound fatigue, the core feature of the illness, have failed in rigorous studies. A series of medical trials over the past 2 decades pitted various neurological and immune-modulating drugs against chronic fatigue syndrome.

The largest published to date, a carefully conducted test of 434 people with newly diagnosed chronic fatigue syndrome, found that the Alzheimer’s drug galantamine wasn’t significantly more effective than a placebo at reducing symptoms. The study appeared in the Sept. 8, 2004 *Journal of the American Medical Association*.

In earlier trials, treatments such as corticosteroids, melatonin, or phototherapy similarly showed no consistent effect.

The available therapies “work for some groups of people but not all groups of people with chronic fatigue syndrome,” says Eleanor Z. Hanna of the Office of Research on Women’s Health at the National Institutes of Health in Bethesda, Md.

The heterogeneity of patients’ responses to treatments suggests that there are different physiological “flavors” of chronic fatigue syndrome, each with a unique cause and different pattern of response to treatment approaches, says Suzanne D. Vernon, a chronic-fatigue researcher at the CDC in Atlanta. One goal of current research efforts is to figure out how to sort patients according to which flavor of the disorder they have.

DISTINGUISHING THE DISEASE Researchers suspect that any number of triggers may throw the immune system or another component of the physiology out of balance, thereby triggering chronic fatigue syndrome.

To investigate what distinguishes people with chronic fatigue syndrome from healthy people, Vernon and a team of investigators undertook an unusual research project. Between 1997 and 2000, they periodically interviewed some 7,000 randomly selected adults living in Wichita, Kan. Using the volunteers' input, the researchers identified which respondents had signs of chronic fatigue. By the end of that phase of the study, 70 volunteers had had symptoms that met an accepted definition of chronic fatigue syndrome, which excludes people with other possible causes of fatigue, such as depression; 158 others had unexplained chronic fatigue that did not meet the chronic fatigue syndrome definition.

Vernon and her CDC colleague William C. Reeves invited both groups to undergo 2 days of intensive medical testing at Wesley Medical Center in Wichita, Kan. Nearly 60 people from each fatigue group agreed. The researchers also tested 55 volunteers without abnormal fatigue and 55 volunteers who had signs of fatigue along with a diagnosis of depression.

The medical workup was thorough, Vernon says. Each subject gave blood samples for genetic and hormonal tests, underwent neurological and psychological examinations, spent a night in a sleep laboratory, and submitted to other tests. In all, the researchers tallied more than 20,000 measures related to gene activity or genetic mutations and more than 500 other measures from each patient.

"We worked them up from head to toe," says Vernon. "We didn't want to leave any stone unturned."

The CDC investigators "did a huge amount of testing that, in a clinical [treatment] setting, you'd never be able to justify," Bateman adds. But that's just the sort of work that might be necessary to yield deeper insights into the disease, she says.

To foster such insights, Vernon and Reeves turned to 20 researchers from the CDC and other U.S.-based and foreign institutions and companies. Those investigators—who included physicians, biologists, mathematicians, and other specialists—formed four teams. Each team got an identical copy of the compiled data and devised its own analytic process.

The teams collectively produced 14 reports, which appear in the April *Pharmacogenomics*.

One team, for example, reported that volunteers could be divided into six groups on the basis of differences in 38 or more biological variables, such as body mass index and blood concentrations of the inflammatory protein interleukin-6. Those groupings correlated well with the symptoms and diagnoses.

For example, one group included nonobese people who had sleep disturbances and chronic fatigue syndrome-related pain but had no significant depression; another group encompassed most of the healthy volunteers who had participated in the study. Uté Vollmer-Conna of the University of New South Wales in Sydney, Australia, led the team effort that produced that result. Grouping patients by subtypes could be useful for determining the causes of and developing treatments for the condition, the researchers say.

Two of the groups that focused on the genetic data from the participants found that chronic fatigue syndrome patients had patterns of abnormal activity in more than 2 dozen genes associated with immune function, cell-to-cell communication, and other physiological processes.

The similarity in the finding by those two research teams, which strengthens its validity, "just thrills me to death," Vernon says.

Another group hunted for genetic mutations unique to chronic fatigue syndrome. Using a computer algorithm, mathematician and computer scientist Benjamin N. Goertzel of Biomind LLC in Rockville, Md., and his collaborators determined that, of the millions of variations called single-nucleotide polymorphisms, a small fraction turned up more often among people with chronic fatigue syndrome than among healthy participants. The researchers found

that by analyzing just 28 of these polymorphisms, they could with 76-percent accuracy sort the volunteers into those with and those without chronic fatigue syndrome.

Vernon lauds the novel approach that the researchers used and speculates that further refinement of the method may achieve 90-percent accuracy.

While the new studies don't put a new diagnostic test or treatment at doctors' fingertips, they do provide evidence that chronic fatigue syndrome is a biologically distinct disease, Vernon adds. Consistent identification of the disease and its subtypes is essential for evaluating current and future drugs, Vernon says. The CDC is now undertaking a second study of similar design to replicate the findings and further investigate chronic fatigue syndrome.

PHARMACEUTICAL POTENTIAL Bateman and some of her patients have a more immediate cause for optimism. They recently took part in a trial of Ampligen. That immune-modulating drug,

known generically as poly I: poly C₁₂U, has been under investigation for 2 decades as a potential treatment for chronic fatigue syndrome and certain viral infections.

Past studies have not provided compelling evidence to support Ampligen's widespread use, at least none sufficient to win the Food and Drug Administration's approval. In 1991, for example, the regulatory agency told the drug's manufacturer, Hemispherx Biopharma of Philadelphia, that evidence of the medicine's

"There is a dramatic reduction in concomitant medication use."

— WILLIAM A. CARTER,
HEMISPHERX CHAIRMAN

safety and efficacy against chronic fatigue syndrome was "incomplete and inadequate."

The new, company-funded study, as yet unpublished, provides strong evidence that the drug has a beneficial effect on the majority of people who have chronic fatigue syndrome, says Hemispherx chairman and chief executive officer William A. Carter. In the trial, Bateman and other investigators infused Ampligen into 93 patients twice a week for 40 weeks. Other volunteers got a fake version of the medicine.

Patients receiving the active drug who completed 40 weeks of treatment were able to exercise more aggressively than the other patients were. On a standard treadmill test, their exercise tolerance increased by 15 percent compared with that of the placebo group. That improvement might reduce or eliminate a patient's need for help with daily activities. The investigators presented their findings in May at a medical conference in Barcelona, Spain.

The company will submit the trial results to the FDA this year, along with a request for permission to market the drug as a therapy for the syndrome, Carter says. If commercialized, Ampligen would probably cost \$15,000 to \$20,000 annually per patient, he says, excluding the expense of having medical staff administer it.

Despite the price tag, the medicine might reduce overall health-care expenditures. "There is a dramatic reduction in concomitant medication use" for insomnia, pain, and other symptoms in chronic fatigue syndrome patients who receive Ampligen, Carter says.

Wright, the Salt Lake City patient, was a volunteer in the study. The treatment wasn't easy for her.

"I started having a really bad headache when I got the drug, [as if] I had post-exertional malaise," she recalls. "Mondays were my good days because I had my infusions on Tuesdays and Fridays. It took me about 4 months to get over the side effects."

The suffering was worth it, she says: "I felt stronger and had more energy after about 2 weeks."

Nevertheless, Wright is no longer taking the experimental medication. Since the trial has ended, she'd have to pay about \$600 a month to get it. She laments, "I don't have that kind of money." ■

GALACTIC DE GUSTIBUS

Milky Way's snacks shed light on dark matter and galaxy growth

BY RON COWEN

Thirteen billion years after its birth, the Milky Way is still packing on the stars. Astronomers have discovered two dwarf galaxies that are being devoured by the Milky Way. They've also found two vast, streams of stars that were most likely torn from star clusters or small galaxies that long ago came too close to our much bigger galaxy.

The studies are giving researchers a new tool for mapping our galaxy's dark matter, the vast, invisible halo of material that astronomers say provides the Milky Way's gravitational glue.

The dwarf galaxies join 10 previously known, nearby, small-fry galaxies, also called satellites, snared by the Milky Way. Two star streams had already been reported. Because of their faintness and diffuse structure, the Milky Way's dwarf galaxies and star streams show up only when astronomers look for groups of stars that have similar color, velocities, and distances from Earth.

STREAMING DATA Several teams of astronomers contributed to the discoveries, but all used the same raw data—the Sloan Digital Sky Survey, a map of stars and galaxies that covers one-fourth of the sky (*SN*: 2/4/06, p. 78).

An inspection by Daniel Zucker of the University of Cambridge in England revealed one of the new dwarf galaxies in a region that's called the Field of Streams because it's crisscrossed with streams of stars. About 640,000 light-years from Earth in the direction of the constellation Canes Venatici, the galaxy is one of the most remote Milky Way satellites ever found.

Zucker immediately e-mailed his discovery to his Cambridge colleague Vasily Belokurov. Within hours, Belokurov replied that he had found yet another Milky Way satellite, a dwarf galaxy in the constellation Bootes. One of the faintest Milky Way satellite ever discovered, it lies about 200,000 light-years from Earth. Zucker, Belokurov, and their colleagues posted their findings in the June 1 *Astrophysical Journal Letters* and on the Internet (<http://xxx.lanl.gov/abs/astro-ph/0604355>).

The team has just reported what appears to be another faint dwarf galaxy, about 100,000 light-years from Earth, in the constellation Ursa Major (<http://xxx.lanl.gov/abs/astro-ph/0606633>).

In a separate set of findings, astronomers looking at the outskirts of the Milky Way found two new star streams, remnants torn from dwarf galaxies or star clusters. Two independent teams—Zucker's group and one led by Carl Grillmair of the California Institute of Technology in Pasadena—discovered one of these ribbons of stars within the Field of Streams. Because its parent body isn't obvious, the scientists dubbed the ribbon the orphan stream.

Separately, Grillmair and Odysseas Dionatos of the Astronomical Observatory in Rome found a second star stream, nicknamed the galactic highway, which is 30,000 light-years from Earth. Grillmair presented the findings in early June at a meeting of the American Astronomical Society in Calgary, Alberta.

DARK TRACERS Streams arise when the Milky Way tugs on a nearby galaxy or star cluster. The gravity of various parts of our galaxy pulls individual stars ahead of or behind the passing galaxy or cluster. "So you get leading and trailing streams bracketing the orbital path of the parent cluster," Grillmair notes. The stream may eventually encircle the Milky Way.

By tracing back in time the positions and velocities of stars in a stream, theorists can figure out the distribution of matter—mostly dark matter—that drew the stars out of the cluster, comments Kathryn Johnston of Wesleyan University in Middletown, Conn.

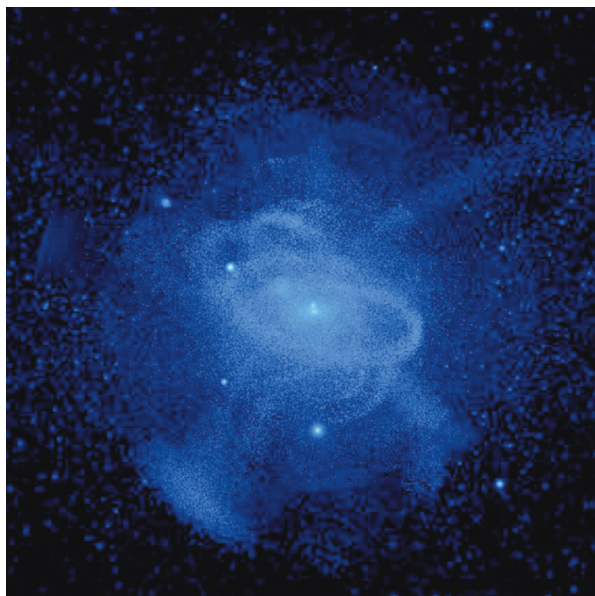
In the case of the recently discovered galactic highway, says Grillmair, "the fact that the stream is very smooth, without any serpentine wiggles, tells us that there aren't any local concentrations of dark matter affecting its path." On the other hand, "the overall curvature of the stream suggests that there's a lot of dark matter in our galaxy," he adds.

The newfound star streams "are clearly another indicator that our

model of hierarchical structure formation—big galaxies growing by eating smaller ones—is going in the right direction," says Johnston.

The dwarf galaxies could help astronomers solve a long-standing problem with dark matter theory, Johnston adds. It predicts that there ought to be a few hundred satellite galaxies—rather than the 12 now known—circling close to the Milky Way. The newly discovered dwarfs suggest that as astronomers scour larger parts of the sky, they could detect another 60 or so dwarfs.

"It's not clear yet if this will solve the missing-satellite problem," says Johnston, but "this is the exciting new result everyone is talking about." ■



STARRY GOURMAND — Researchers propose that the Milky Way and other galaxies were built by gobbling up nearby dwarf galaxies and incorporating them into the large galaxy's gaseous outskirts, as in this artist's depiction.

JOHNSTON, J. BULLOCK

OF NOTE

ANTHROPOLOGY

Mexican find reveals ancient dental work

Researchers excavating an ancient burial site in west-central Mexico have unearthed a man's skeleton containing the earliest American example of intentionally modified teeth.

The discovery, announced June 14 by Tricia Gabany-Guerrero of the University of Connecticut in Storrs and her colleagues, dates to between 4,570 and 4,332 years ago.

Although most of the skeleton's teeth exhibit normal levels of wear, the upper-front teeth were filed down, possibly to make room for a ceremonial denture that would have been fashioned from the palate of an animal such as a wolf or jaguar, Gabany-Guerrero says. "The teeth were filed down so much that the pulp cavities were exposed, leading to an infection," she notes.

The man held some sort of special status at the time of his death, Gabany-Guerrero adds. He was buried with several valuable obsidian artifacts. Moreover, muscle-attachment surfaces on his bones show no sign of strenuous activity, although he didn't suffer from any skeletal disorder. Finally, his grave lies in front of a cliff wall covered with ancient rock art.

Other sites in the region, dating to no more than about 3,000 years ago, have yielded evidence of filed teeth and dentures containing turquoise or animal teeth. —B.B.

BIOLOGY

Cells in bloodstream don't refill ovaries

Blood doesn't carry cells that replenish a female animal's supply of eggs, a new study suggests. The finding contradicts a surprising report last year suggesting that scenario.

Scientists had long held that females

are born with a supply of eggs in their ovaries that isn't replenished. However, Jonathan Tilly of Harvard Medical School in Boston and his colleagues reported in the July 29, 2005 *Cell* that stem cells from bone marrow continually flow to the ovaries and restock the supply of eggs.

"It was a surprise to most people," says stem cell researcher Amy Wagers of the Joslin Diabetes Center in Boston.

To test the hypothesis, Wagers and her colleagues connected the bloodstreams of pairs of mice. Each included a normal animal and an animal with tissues that were engineered to glow green.

After the rodents had spent 6 to 8 months joined, the researchers gave the mice drugs to induce ovulation. If Tilly's hypothesis were correct, the researchers surmised, some eggs produced by the normal mice should glow green and vice versa.

However, the researchers found no evidence that the normal or green-glowing mouse produced any eggs derived from its partner's cells.

If the ovaries are indeed restocked, the stem cells doing it are probably within the ovaries themselves, Wagers' team reports in an upcoming *Nature*. —C.B.

BIOMEDICINE

Pregnancy risk from blood pressure drugs?

Babies exposed in the first trimester of their mother's pregnancy to blood pressure drugs called ACE inhibitors are at an increased risk of birth defects, according to a new study. The drugs already carry a warning against their use during the second and third trimesters of pregnancy because of the danger of kidney damage in the fetus.

A review of the records of 29,507 infants in Tennessee showed that 209 babies had been exposed to ACE inhibitors during the first trimester in the womb. The records reveal that the mothers of another 202 babies had taken other blood pressure drugs during the first trimester and the rest of the infants had no exposure to blood pressure medicines.

The records showed that 7.1 percent of the children exposed to ACE inhibitors had congenital defects—mainly of the heart and central nervous system—compared

with only 1.7 percent of the babies exposed to other blood pressure drugs and 2.6 percent of those not exposed, researchers report in the June 8 *New England Journal of Medicine*.

ACE inhibitors target angiotensin converting enzyme (ACE). Normally, ACE converts the compound angiotensin I into angiotensin II, which induces the blood vessels to constrict and blood pressure to rise. By suppressing ACE, the inhibitors relax blood vessels and lower blood pressure.

Why ACE inhibitors might damage a fetus is unclear, says study coauthor William O. Cooper, a pediatrician at Vanderbilt University School of Medicine in Nashville. "Most organ formation occurs in the first trimester," he says. "It's not likely that relaxing blood vessels led to these problems. It looks like angiotensin plays a role in organ formation." —N.S.

SCIENCE AND SOCIETY

With permission to nap, doctors stay more alert

While on call, doctors-in-training often spend 30 hours at a stretch at a hospital. Although they may catch catnaps when they're not needed at a bedside, these interns develop fatigue that can pose risks to them and to their patients.

A new study tested the effects of giving such doctors greater permission to nap—by permitting them to hand off to another doctor the pager that summons them to the next patient. Increases in the amount of sleep the interns get and fatigue reduction could outweigh any risk of miscommunication about needed care that might occur from handing off patients, according to researchers led by Vineet Arora of the University of Chicago Hospital.

The investigators asked 38 doctors-in-training to wear motion meters on their wrists for 1 month. The meters recorded how much time each intern slept.

For half the study, a staff doctor was available nightly between midnight and 7 a.m. to spell any on-call intern requesting time to nap.

When given that option, interns slept a total of 185 minutes on average per night, compared with 144 minutes on nights when they didn't have a backup. They also reported having less fatigue when nap breaks were permitted.

In the June 6 *Annals of Internal Medicine*, Arora's team suggests that interns with increased nap time may be capable



NO BITE Several top-front teeth (far left) from a more than 4,300-year-old skeleton found in Mexico were filed down, possibly to insert a ceremonial mouthpiece.

OF NOTE

of staying on call for more than 30 consecutive hours, the current nationwide limit. —B.H.

TECHNOLOGY

Humanlike touch from chemical film

A newly unveiled tactile sensor rivals the sensitivity of human skin. When pressed against a penny, for instance, the film can distinguish the wrinkles in Abraham Lincoln's clothing.

The transparent film—broader than a fingertip but less than one ten-thousandth as thick as typical human skin—may ultimately boost the tactile sensitivity of robots, says chemical engineer Ravi F. Saraf of the University of Nebraska in Lincoln. It may also give surgeons using endoscopes a means to remotely evaluate tissue texture.

Saraf and Vivek Maheshwari, also of the Lincoln campus, describe their novel sensor in the June 9 *Science*.

With up to 25 volts of electricity powering it, the 100-nanometer-thick, multilayer membrane translates pressure into light and electric current. To do so, it exploits the quantum phenomenon of electron tunneling, in which electrons pass through seemingly impenetrable barriers.

In an uncompressed sensor, electrons responding to the voltage would tend to flow between layers of gold nanocrystals and layers of cadmium sulfide nanocrystals, but sheets of insulating polymers bar the way. When the sensor touches something, pressure at spots along the film forces the nanoparticle layers closer together, raising the tunneling odds and allowing electricity to flow at those spots. Because an electric current makes cadmium sulfide glow, the sensor yields an image of the topography it contacts.

The sensor can distinguish side-to-side features only 40 micrometers across. Other touch sensors that span comparable

postage-stamp-size areas discern features no finer than a couple of millimeters across, Saraf notes. —P.W.

BIOLOGY

Mammalian ear cells can regenerate

The cells responsible for hearing in mammals are capable of regeneration, a study indicates. The surprising finding could lead to new treatments for hearing loss, say researchers.

In birds and other vertebrates, inner-ear sensory cells called hair cells quickly regrow after they're damaged or destroyed. The regeneration takes place when cells that support each hair cell divide to produce a new hair cell and a new supporting cell. However, researchers have long considered mammalian hair cells irreplaceable. No study had ever shown that mature supporting cells in mammals could divide, much less differentiate into new hair cells (*SN*: 5/20/06, p. 311).

Trying a new tactic, Andrew Groves of the House Ear Institute in Los Angeles and his colleagues isolated supporting cells from the inner ears of newborn mice and put them in culture dishes.

Within days, Groves' team noticed that about half the cells were dividing, and a significant portion of the new cells were growing into hair cells. Genetic tests showed that the dividing cells had switched off a gene known as *p27*, but the gene remained on in the nondividers.

When the researchers performed the same experiment with cells taken from 2-week-old mice, they found that only about 2 percent of the supporting cells divided. This suggests that *p27* becomes more firmly switched on with age, they report in June 22 *Nature*. However, when Groves and his colleagues tried the experiment with 2-week-old mice genetically engineered to lack *p27*, about 10 percent of the cells multiplied.

If researchers could come up with a way to turn off *p27* in the ear, they might induce hair cell growth in people who have lost these cells, says Groves. —C.B.

MATERIALS SCIENCE

Seeing the light

Researchers have developed a "smart petri dish" that signals cell death with intense light. The system could find use in screening drugs for toxic effects.

Rather than growing cells in a plastic dish, Michael J. Sailor of the University of California, San Diego and his colleagues use a photonic crystal, which is a silicon chip that controls the propagation of light. The chip they designed prevents red light from passing through, so when exposed to a light source, the chips reflect red light back.

The researchers grew liver cells on the dime-size chips. The cells act "like little lighthouses," says Sailor, scattering the light from the chip in many directions, such that the cells glow a dim red.

The team exposed the chip-mounted cells to one of two toxins, cadmium chloride or acetaminophen. As the cells began to shrivel and die, they turned "intensely red," says Sailor. The poisoned cells' ragged shapes appear to scatter light more efficiently than the uniform shapes of healthy cells do, he says.

The chip detects cellular distress 2 hours before a conventional cellular dye does, Sailor and his team report in an upcoming *Langmuir*. The system monitors cells continuously without disturbing them, Sailor says. —A.C.

TECHNOLOGY

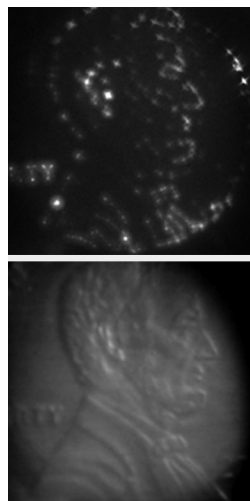
Blinding spies' digital eyes

A businessman at a trade show stealthily raises his camera-equipped cell phone to snap a picture of his competitor's latest gizmo. But before he captures the image, an electronic foe gets the drop on him and blasts his camera with a blinding burst of light.

Although that scenario is fictional—so far—the counter-espionage system is not. Researchers at the Georgia Institute of Technology and spin-off company DominINC, both in Atlanta, have built an automated prototype that uses two infrared-transmitting cameras and a projector to protect a small space from digital spying.

The transmitters project infrared light into the area, and the cameras analyze reflections. An intruding digital camera gives itself away because its picture-making image sensor has an unusual property called retroreflectivity. That is, from any angle it reflects the infrared radiation directly back to the prototype's cameras. Once a spy camera is located, the digital projector sends bright light just to the point where the offender's lens has been spotted.

The prototype, described on June 17 by Georgia Tech, could lead to more-sophisticated systems aimed at pirates who surreptitiously record videos of commercial films in theaters and then sell illicit copies, says computer scientist Gregory D. Abowd of Georgia Tech and DominINC. —P.W.



FEEL THE GLOW

Compressed by a penny, a new, touch-sensitive film lights up (top) to show details of the coin, such as creases in Abraham Lincoln's jacket, that are also visible in an optical-microscope image (bottom).

Books

A selection of new and notable books of scientific interest

THE INFINITE COSMOS: Questions from the Frontiers of Cosmology

JOSEPH SILK

Cosmology captures the imagination because people are curious about their own and the universe's origins. Silk, a professor of astronomy at the University of Oxford, takes readers on a tour of the field and summarizes the knowledge that scientists have amassed about the cosmos. He explains, for instance, how the Big Bang, the reigning theory of the universe's beginning, is finding corroboration with discoveries about the microwave radiation that suffuses the sky. Silk addresses each piece of the universe: stars, black holes, atoms, and even the mysterious dark matter that modern physics predicts but cannot observe. Readers learn about galaxy formation, supermassive black holes, dark energy, the size and shape of the universe, and the likely sequence of events immediately following the Big Bang. Finally, the author broaches philosophical questions, such as whether the universe is infinite, whether nonhuman intelligent life might reach Earth, and whether time has an end. Silk's overview of current cosmology emphasizes the wonder that the universe continuously inspires. *Oxford, 2006, 248 p., hardcover, \$29.95.*



THE GLORY OF GARDENS: 2,000 Years of Writings on Garden Design

SCOTT J. TILDEN, ED.

The beauty of gardens has inspired many people not only to create their own patches of nature but also to write about the process and their emotions while doing so. In this unusual volume, Tilden collects writings from a variety of cultures spanning 2 millennia. The entries are divided among chapters covering the principles of gardening, siting a plot, planning it, and selecting plants. Passages include 17th-century writings on creating a Chinese garden, notes on formal English gardens of the 19th century, and musings on the effect of 1960s minimalism on landscapes. The more than 100 writers offering their perspectives include poets, gardeners, philosophers, and architects. Rounding out the book are 95 full-color photos illustrating gardens throughout the world. *Abrams, 2006, 256 p., color photos, hardcover, \$50.00.*

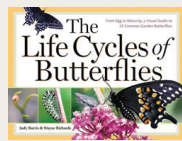


THE LIFE CYCLES OF BUTTERFLIES: From Egg to Maturity, a Visual Guide to 23 Common Garden Butterflies

JUDY BURRIS AND WAYNE RICHARDS

With this guide to butterflies, Burris and Richards encourage other people to have as much enthusiasm as they do for these creatures. Butterflies are remarkable for many reasons, starting with their metamorphosis from egg, to caterpillar, to

chrysalis, to butterfly. In the first chapter, Burris and Richards follow this cycle by offering brief descriptions, nontechnical explanations, and



informative color photographs. Subsequent chapters document the life cycles of 23 common species of butterflies. Each description includes the butterflies' common and Latin names, identifying markings, breeding range, plants on which females lay their eggs, plants from which butterflies derive nourishment, and life cycle. The book ends with an illustrated list of plants that serious butterfly enthusiasts should cultivate, comparison guides for eggs, caterpillars, and chrysalises, and tips for telling a moth from a butterfly. *Storey Books, 2006, 160 p., color photos, paperback, \$16.95.*

THE SHOREBIRD GUIDE

MICHAEL O'BRIEN, RICHARD CROSSLEY, AND KEVIN KARLSON

Worldwide, there are 217 species of shorebirds, and North America hosts approximately 50 of them.



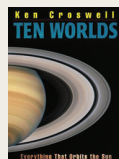
Despite shorebirds' small representation among the world's more than 8,000 bird species, bird-watchers find them a challenge to view and recognize. Identifying shorebirds poses special problems because of the distance at which most of these birds are viewed and their seasonal variations in plumage. The authors simplify this process with emphasis on a holistic approach to shorebird identification. The strategy focuses on the overall features of relative size, structure, behavior, and voice. The book introduces readers to the seven families of North American shorebirds, details current threats to shorebird populations, and outlines plumage patterns, molting, and age changes. More than 870 color photos capture birds close-up and in the context of their habitats. For each species, a small map details natural ranges. Comprehensive notes about each bird detail their overall features. This detailed guide includes a remarkable array of pictures. *Houghton Mifflin, 2006, 477 p., color photos, paperback, \$24.95.*

TEN WORLDS: Everything that Orbits the Sun

KEN CROWELL

In 2005, for the first time in 75 years, astronomers discovered a new planet, suddenly making legends of classroom solar system models obsolete.

Crowell, author of several award-winning astronomy titles, introduces young readers to this new world and the other nine planets and their moons. He includes science's latest discoveries. Readers learn that Neptune's moon Triton is the only moon to orbit its planet clockwise, that Saturn is so light that it would float in water, and that Mars had water flowing over its surface billions of years ago. Except for the tenth planet, each planet's and moon's description is accompanied by bold, digitally reprocessed images. This brief book also includes sections on meteors, comets, and the solar system's birth. Charts detail statistics for the 10 planets, seven big moons, and first four asteroids discovered. *Boyd's Mills Press, 2006, 56 p., color photos, hardcover, \$19.95.*



LETTERS

Looking into the future

Your article states that farsightedness will be treated with these new electric lenses ("Switch-a-Vision: Electric spectacles could aid aging eyes," *SN: 4/22/06, p. 243*). With some tweaking, could nearsightedness and astigmatism be treated as well? Could binoculars, telescopes, and microscopes use this technology?

ROGER CURNOW, GRAND RAPIDS, MICH.

Yes and yes, says Dwight P. Duston of PixelOptics in Roanoke, Va. However, he notes that it's instant switching between focus settings that distinguishes the new, liquid crystal lenses from standard lenses, not better vision correction. —P. WEISS

Gut feeling?

The article "Hot-pepper ingredient slows cancer in mice" (*SN: 4/22/06, p. 254*) raises a couple of questions for me. Recently, I drank some clam-tomato juice that contained jalapeño puree. It seemed to alleviate some of my internal ailments. So, I wonder if jalapeño peppers also contain capsaicin.

NORMAN MOORE, BOCA RATON, FLA.

Jalapeño peppers do contain capsaicin, but it's impossible to say whether the substance delivers the salutary effects. Research shows a connection between nerve cell receptors implicated in inflammatory bowel disease and capsaicin's signal to the brain. —N. SEPPA

Blundering hordes

Something mystified me in your story "Buried Treasures: Constructing—and deconstructing—cave formations" (*SN: 4/29/06, p. 266*). Apparently, preservation experts are concerned that microorganisms could wipe out Stone Age cave paintings, as if this were an urgent threat. Has something altered the caves in which these paintings appear that has invited intensified bacterial growth?

DON MCMILLAN, MODESTO, CALIF.

What threatens the paintings is a modern scourge: tourists. People's exhalations and body heat affect a cave's temperature and humidity, and, as mentioned in the article, cells and hair that people shed can nourish microbes. —S. PERKINS

SEND COMMUNICATIONS TO:

Editor, Science News

1719 N Street, N.W., Washington, D.C. 20036

or editors@sciencenews.org

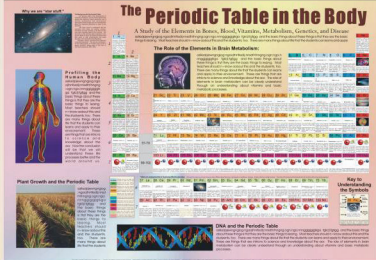
All letters subject to editing.



sciencemall-usa.com

Science Mall shopping

The Periodic Table in the Body poster



The Periodic Table in the Body poster discusses each of the elements on the Periodic Table in relation to how the body uses them. It helps us understand how the elements are used by bones, blood, metabolism, genetics, and disease. There are five sections to this periodic table poster. One section examines why we are indeed "star stuff" and our chemical ties to the universe; other sections profile the chemical makeup of the human body, plant growth, DNA, and the role of the elements in brain metabolism. Full color, laminated, 28"W X 38"H poster, Copyright 2007, #JPT-4191 Cost \$28.95

Vitamins poster



Vitamins poster - Covers all the major vitamins. This poster would make a great match with the "Periodic Table in the Body" poster for health information. Size: 26.75" X 38.5" Order #JPT-vita, Cost: \$15.95, Laminated

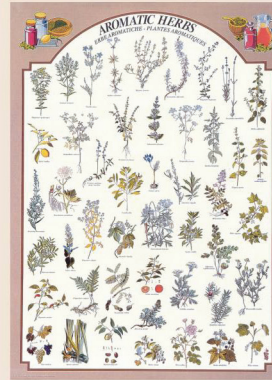
Deluxe Dinosaur Panorama Poster



The Deluxe Dinosaur Panorama poster - A colossal wall poster that embodies the elegance and power of dinosaurs. Painted by Haruo Takino. Size: 64.375"L X 22.75"H and comes laminated. Order #JPT-dinopan cost: \$38.00



Medicinal Plants poster - This poster represents about 50 different medicinal plants. Great for reference and learning! Size: 26.75" X 38.5" Order #JPT-1112, Cost: \$15.95 Laminated



Aromatic Herbs - (above) Covers over 50 different types of aromatic herbs. Size: 26.75" X 38.5" Order JPT-aroma, Cost: \$15.95, Laminated

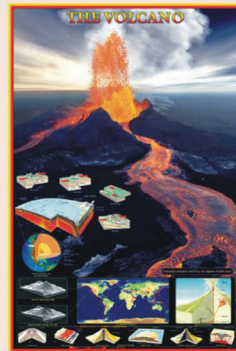


The Hubble Space Telescope poster - New! Eighteen fabulous images from Hubble, with additional information on its design. Size: 24" W X 36"L, Laminated. Order #JPT-2102, Cost: \$15.95

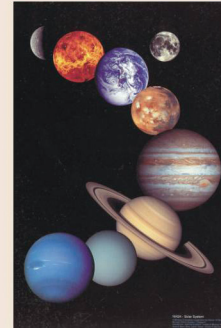
FREE Human Genome Poster with every order over \$45



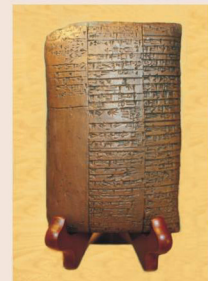
Space Explorers poster - NEW! Over 40 images of different satellites. Size: 24" W X 36"L, Laminated. Order #JPT-2267, Cost \$15.95



The Volcano poster - New! Great color and many interesting graphics depicting the interior of volcanoes. Size: 24" W X 36" L, Laminated. Order #JPT-1999, Cost \$15.95



NASA Solar System Poster - Size: 26.75" W X 38.5" L #JPT-System laminated - \$15.95 Simply beautiful!



Sumerian Medical Tablet - Reproduction of the earliest known prescription written in cuneiform. A detailed booklet comes with the tablet and gives a translation and history. The original was found a Nippur (c. 2100 B.C.). Size: 6" X 3" X about 3/4" thick. Comes with an adjustable walnut wood easel stand. Order # JPT-sumer, Cost: \$69.95



Clear Star-Shaped Leucite Pendant with Gibeon Meteorite - Pendant size: approximately 1" X 1"; comes with 18" stainless steel chain, info and jewelry box, order #JPT-0613, Cost: \$32.95



Beautiful Meteorite Pendant NWA 869 has lot of chondrules and is very showy! Comes with information & authenticity. Size: 1" X 1" Sterling Silver pendant comes with braided sterling silver chain 18" For the person that wants something "out of this world." #JPT-metpndt \$75.00



Mammoth Ivory Rose Pendant

This exquisite, delicately carved Ivory Rose Pendant is wrapped in 14K gold. Comes with 20" braided gold chain. The pendant comes with certificate of authenticity and its history. It is the perfect gift for birthdays or other special occasions. Rose pendant size 1" diameter, rose earrings size 3/8" diameter. Order #JPT-rose..\$185 Order jewelry set - with earrings, pierced ears or clips, #JPT-1733...\$360 for the set.

How To Order: VISA, MC, AMEX, Check, MO postage *not* included

Science Mall-USA.com
P.O. Box 1864
Dubuque, IA 52004-1864

Toll Free: 800-720-5451
sciencemall-usa.com

Free **Human Genome Poster** with every order over \$45