Quark Retrospective | The Moral Lives of Children | Gene Cuts Zzzzs

$3.95 U.S. | www.sciencenews.org

ScienceNews

MAGAZINE OF THE SOCIETY FOR SCIENCE & THE PUBLIC ■ SEPTEMBER 12, 2009

Foe to Friend

Taming food allergies

Draining India's Aquifers

Extrasolar Eccentricities

Walking in Circles

2009 Silver Panda Pre-Sellout Event!

2008 SOLD OUT

Actual size is 40 mm

LOW AS $24.95

The Panda Everyone Is Looking For… But Soon Nearly Impossible To Find!

Everyone loves pandas, but there's one panda that has enduring value. The Panda Silver Dollar struck by the China Mint since 1983—a massive coin of one full troy ounce of precious silver. Each year the panda design changes, which enhances their desirability. But what doesn't change is how hard it is to get your hands on one of these precious yet elusive coins!

Save Money—Buy Direct

As an official distributor, we buy directly from the China Mint and then bring these Silver Pandas directly to you. By ordering from us, you get our best price, plus the security of dealing with a company with 25 years of experience and a top reputation in the coin business. Better yet, your coin comes with a full 30 day money back guarantee of satisfaction (less s&h).

2009 Pre-Sellout Event... Available TODAY… But not for long!

2008 Panda Silver Dollars are sold out at the Mint and already selling for $49.95 each. This is a PRE-SELLOUT event for the 2009's. We are expecting the limited supplies of 2009 Silver Pandas to sell out quickly. We cannot guarantee future availability, so act immediately to avoid disappointment.

Prices and availability subject to change without notice.

Note: GovMint.com is a private distributor of worldwide government coin issues and is not affiliated with the United States Government. Facts and figures were deemed accurate as of July 2009. ©GovMint.com, 2009

A Personal Asset of Lasting Value— A Legacy for Loved Ones

In times of economic uncertainty, few things bring peace of mind better than the rock-solid value of precious metals. So call NOW to secure these Silver Pandas for yourself, for your family, and as a legacy for your children.

The more you buy… the more you'll save!

- **One 2009 Panda Silver Dollar for only $29.95** +s/h
- **Five for only $28.75 each** +s/h **SAVE $6.00**
- **Half Roll (10) for only $27.25 each** +s/h **SAVE $27.00**
- **Bankers Roll (20) for only $24.95 each** +s/h **SAVE $100**

Toll-Free 24 hours a day

1-888-277-8331

Offer Code PSA138

Please mention this code when you call.

GovMint.com

YOUR ONE BEST SOURCE FOR COINS WORLDWIDE

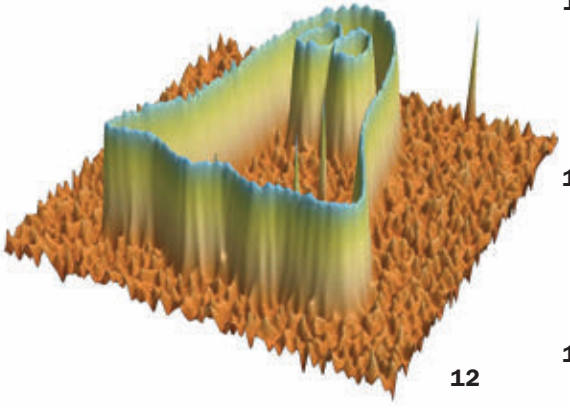
14101 Southcross Drive W., Dept. PSA138

Burnsville, Minnesota 55337

www.GovMint.com

BBB ACCREDITED BUSINESS

SEPTEMBER 12, 2009 • VOL. 176 • NO. 6



SECOND FROM TOP: © 2009 KAREN J. OSBORN

ScienceNews

In The News

Features

Essay

Departments

COVER In the United States, 3 million people are allergic to peanuts, tree nuts or both. But the nuts themselves may offer a way to relief. *Eising/StockFood Creative/Getty Images*

ScienceNews MAGAZINE OF THE SOCIETY FOR SCIENCE & THE PUBLIC

publisher **Elizabeth Marincola** *editor in chief* **Tom Siegfried**

EDITORIAL STAFF *managing editor* **Eva Emerson**
senior editor/policy **Janet Raloff**
assistant managing editor **Kristina Bartlett Brody**
news editor **Elizabeth Quill** *associate editor* **Erika Engelhaupt**

astronomy **Ron Cowen**
behavioral sciences **Bruce Bower**
biomedicine **Nathan Seppa**
earth sciences **Sid Perkins**
environment/chemistry **Rachel Ehrenberg**
life sciences **Susan Milius**
molecular biology **Tina Hesman Saey**
staff writer **Laura Sanders**
editorial assistant **Rachel Zelkowitz**
web specialist/editorial secretary **Gwendolyn K. Gillespie**
science writer intern **Jenny Lauren Lee**

DESIGN *design director* **Beth Rakouskas**
assistant art directors **Joshua Korenblat, Avik Nandy**

ADVERTISING | CIRCULATION
advertising manager **Judy Lewis** *West, Midwest & DC Metro*
circulation manager **Tosh Arimura**
account executives **Gregg Oehler, Rich Cordero,** *Oehler Media, East;* **Rick Johnson,** *National Brands*
advertising/circulation assistant **Kerwin Wilson** *permissions* **Evora Swoopes**

EDITORIAL, ADVERTISING AND BUSINESS OFFICES
1719 N Street NW, Washington, DC 20036 · Phone (202) 785-2255
Audit Bureau of Circulations
Subscriptions subs@sciencenews.org · ***Editorial/Letters*** editors@sciencenews.org
Advertising/Business snsales@sciencenews.org
Texterity Digital edition provided by Texterity, www.texterity.com
Science News (ISSN 0036-8423) is published biweekly, for $54.50 for 1 year or $98 for 2 years (international rate $80.50 for 1 year or $161 for 2 years) by Society for Science & the Public, 1719 N Street NW Washington, DC 20036. Preferred periodicals postage paid at Washington, DC, and an additional mailing office.
Subscription Department: PO Box 1205, Williamsport, PA 17703-1205.
For new subscriptions and customer service, call 1-800-552-4412.
Postmaster: Send address changes to *Science News*, PO Box 1205, Williamsport, PA 17703-1205. Two to four weeks' notice is required. Old and new addresses, including zip codes, must be provided.

FROM THE EDITOR

Save Murray Gell-Mann a spot in physics hall of fame

If physics had a hall of fame like baseball's, Murray Gell-Mann would not be eligible for admission.

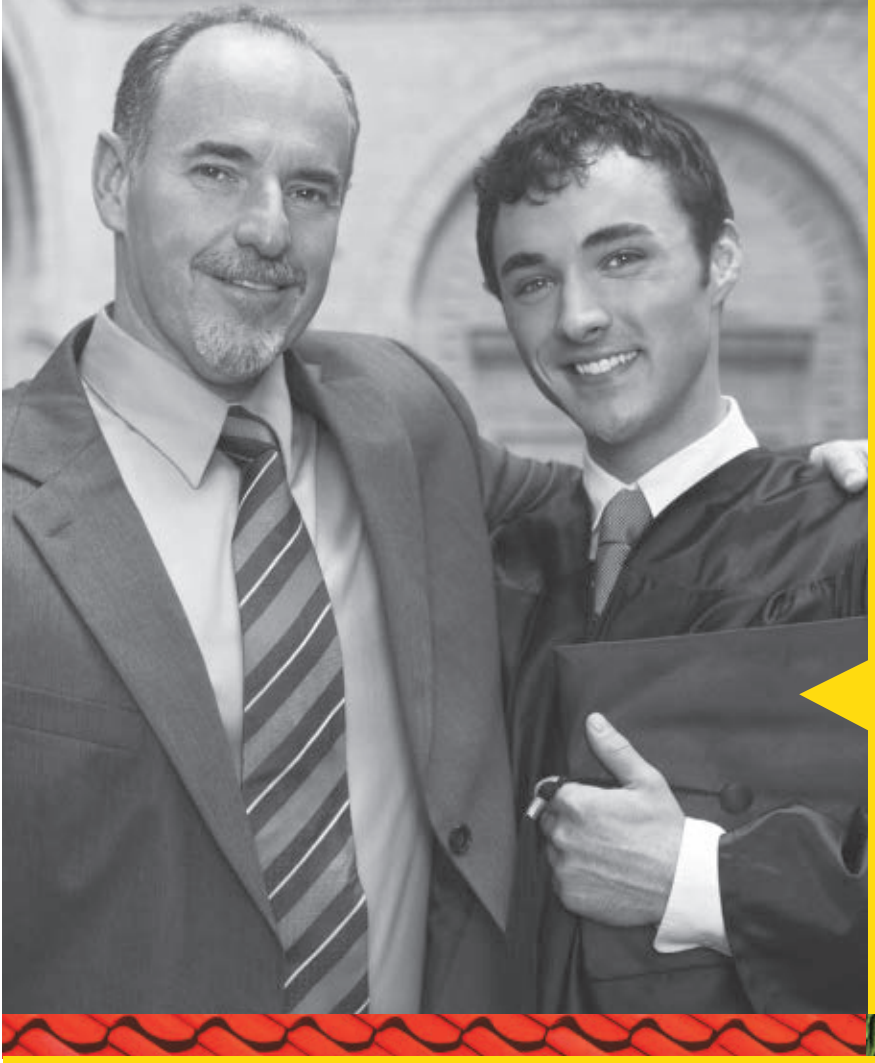
That isn't because his achievements don't warrant such recognition. Gell-Mann is one of the legends of physics, a chief architect of the modern understanding of matter. He was awarded the Nobel Prize 40 years ago. But eligibility for election to the baseball hall of fame does not begin until five years after retirement. And Gell-Mann, who turns 80 on September 15, is still going strong.

He is currently on the active roster at the Santa Fe Institute in New Mexico, a research center he helped to found a quarter of a century ago (see Page 32). There he collaborates with linguists tracing the ancestry of present-day human languages. He also continues working on refining the modern interpretation of quantum mechanics, a topic that still perplexes many experts and engenders endless misunderstanding among nonexperts. He expects a new paper extending his work on quantum physics, in collaboration with physicist James Hartle of the University of California, Santa Barbara, to appear soon.

Gell-Mann is most famous for developing the concept of and coining the word "quark" to describe the ultimate constituent particle of nuclear matter. In an essay in this issue (Page 24), I recount the story of quarks, focusing on the example they provide of a new idea facing resistance from the scientific establishment. As Gell-Mann observed when I spoke with him recently, quarks defied many deeply held principles among physicists of the early 1960s. Because quarks challenged the orthodoxy of the day, they were at first widely disparaged. But over the years, evidence for them accumulated and their reality is now well established.

The quark story and other examples (such as resistance to the idea of continental drift) show how conventional wisdom can retard the advance of science. But as Gell-Mann emphasizes, such examples are exceptions to the general rule. Most challenges to orthodox scientific belief are, in fact, wrong, and some are entirely crackpot. Only rarely do contrarian ideas go on to demolish well-established concepts. It's important, though, to be on the alert for those rare prescient ideas proposed by the deep thinkers who are destined, like Gell-Mann, to become legends.

—Tom Siegfried, Editor in Chief



One day, his son would speak to the world.

He wanted them to understand.

Rosetta Stone. The fastest and easiest way to learn *CHINESE*.

Arabic • Chinese (Mandarin) **• Danish • Dutch • English** (American) **• English** (British) **• Filipino** (Tagalog) **• French • German Greek • Hebrew • Hindi • Indonesian • Irish • Italian • Japanese • Korean • Latin • Pashto • Persian** (Farsi) **• Polish Portuguese** (Brazil) **• Russian • Spanish** (Latin America) **• Spanish** (Spain) **• Swahili • Swedish • Thai • Turkish • Vietnamese • Welsh**

Rosetta Stone® brings you a complete language-learning solution, wherever you are: at home, in-the-car or on-the-go. You'll learn quickly and effectively, without translation or memorization. You'll discover our method, which keeps you excited to learn more and more.

- You'll experience **Dynamic Immersion**® as you match real-world images to words spoken by native speakers so you'll find yourself engaged and learn your second language like you learned your first.
- Our proprietary **Speech Recognition Technology** evaluates your speech and coaches you on more accurate pronunciation. You'll speak naturally.
- Only Rosetta Stone has **Adaptive Recall,**® that brings back material to help you where you need it most, for more effective progress.
- And Rosetta Stone includes **Audio Companion**® so that you can take the Rosetta Stone experience anywhere you use a CD or MP3 player.

Innovative software. Immersive method. Complete mobility. It's the total solution. Get Rosetta Stone—**The Fastest Way to Learn a Language. Guaranteed.**®

SAVE 10%!

100% GUARANTEED
SIX-MONTH MONEY-BACK

Level 1	~~Reg. $229~~	**NOW $206**
Level 1, 2 & 3	~~Reg. $499~~	**NOW $449**

Call
(800) 788-1481

Online
RosettaStone.com/qvs099

Use promotional code qvs099 when ordering.
Offer expires December 31, 2009.

RosettaStone®

Scientific Observations

"Three-quarters of students in the United States attend the country's public colleges and universities, but very few of these institutions have vigorous education, research, and outreach programs focused on energy and climate change. Without a major restructuring of these powerful institutions, we forgo the intellectual power and entrepreneurial spirit that they could tap to solve the energy and climate problems we face. We propose the creation of a public "energy-grant university system" devoted to energy education and research.... [Energy and climate change are] social, economic, and political problems. The next generation of leaders must confront these issues. It's up to colleges and universities to lay the foundation for their success."

PAUL G. FALKOWSKI OF RUTGERS ENERGY INSTITUTE (TOP) AND ROBERT M. GOODMAN OF RUTGERS UNIVERSITY IN NEW BRUNSWICK, N.J., IN THE AUG. 7 *SCIENCE*

Science Past | FROM THE ISSUE OF SEPTEMBER 12, 1959

MUSHROOMS AID MENTAL ILLS — The mentally ill may be able to get peace and quiet with their steak and mushrooms, providing they eat some special mushrooms described at the 9th International Botanical Congress meeting in Montreal. The clue to the possible medical usefulness of these mushrooms was uncovered as a result of studies of the Mexican Indians and their religious rituals.... After years of research in several European laboratories, scientists are now ready with a synthetic substance that duplicates some of the beneficial effects of the mushrooms. Taken in large doses, as [one researcher] did himself for experimental purposes, the substance is a powerful hallucinogen.... In small, therapeutic doses its effects can be beneficial.

Science Future

September 23–26
The Society of Vertebrate Paleontology marks Darwin's bicentennial in Bristol, England. See www.vertpaleo.org/meetings

October 11–17
Celebrate Earth Science Week with the American Geological Institute. Find local events at www.earthsciweek.org

October 31
Deadline to enter the National Engineers Week Future City Competition for students. Visit www.futurecity.org

SN Online

www.sciencenews.org

CHEMISTRY
Researchers take to the grill at the American Chemical Society meeting to study the science behind the perfect cookout. Read "Better BBQ through chemistry."

LIFE
Social networking may be no friend to Tasmanian devils with facial tumor disease. See "Tasmanian devils have no star networkers."

BODY & BRAIN
The human nose can't multitask to sniff competing smells. Read "Nostril rivalry."

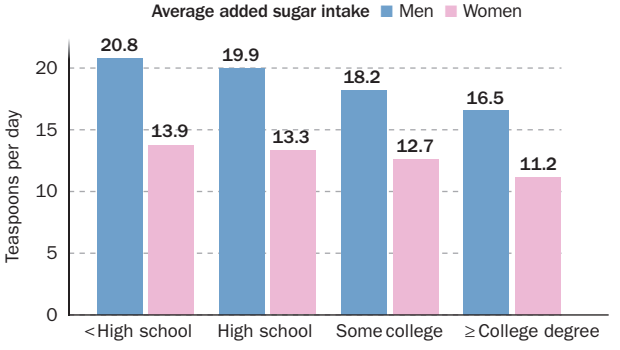
EARTH
Aerosol content in the stratosphere is rising with increased coal usage, especially in China. See "Hazy changes on high."

How Bizarre

Mainland Asia's only known bald songbird has one stripe of plumage running along its head — otherwise its face is as naked as a vulture's. But unlike these carrion eaters, which "stick their heads in disgusting places," this newly described songbird doesn't seem to have such tendencies, says Iain Woxvold of the University of Melbourne in Australia. He and colleagues found the birds, the bald-headed bulbuls (right), in the rugged limestone belt of central Laos and named it *Pycnonotus hualon* in the July *Forktail*.

Science Stats | SWEET TOOTH AND SCHOOLING

Americans' daily added sugar intake in 2005 varied with sex and education



SOURCE: THOMPSON *ET AL./JOURNAL OF THE AMERICAN DIETETIC ASSOCIATION* 2009

CLOCKWISE FROM TOP LEFT: COURTESY OF RUTGERS UNIV.; RODRIGO HAMEDE; I. WOXVOLD/UNIV. OF MELBOURNE; COURTESY OF RUTGERS UNIV.

“Birds are not like sitting ducks.” — ANDRÉ DESROCHERS, PAGE 7

In the News

STORY ONE

New data show quickening loss of groundwater beneath India

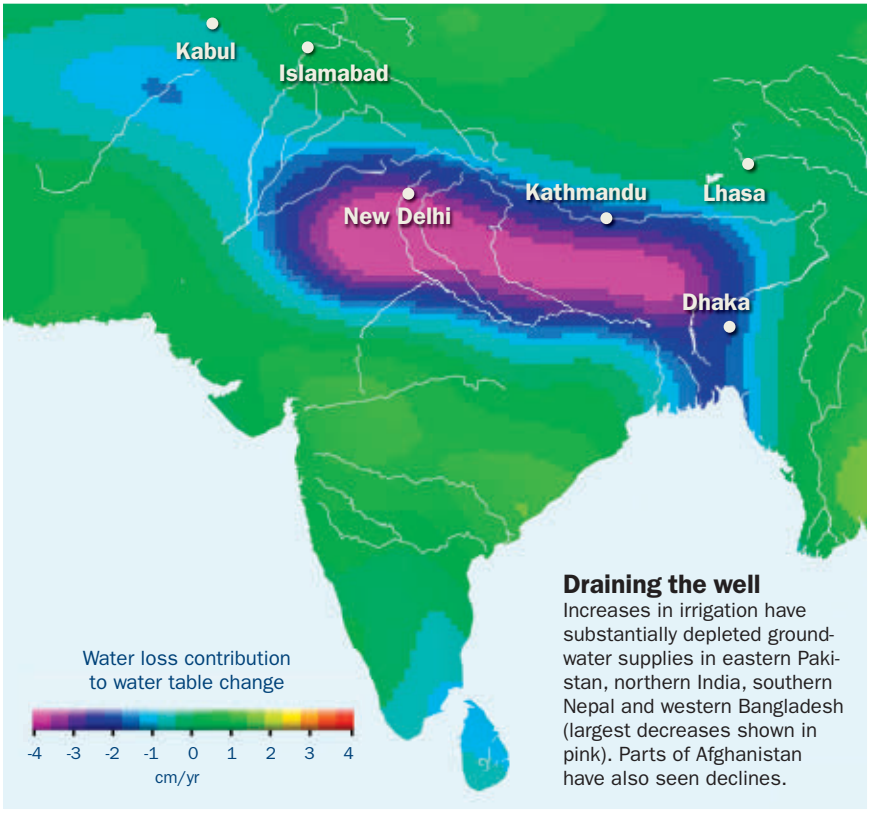
Increased crop irrigation is depleting region’s aquifers

By Sid Perkins

Irrigation in northern India in recent decades has pulled water from the ground faster than the region’s soaking monsoon rains can replenish it. And satellite data reveal that the pace of extraction has accelerated during that time, scientists report in two new studies.

In an area that is home to about 10 percent of the world’s people, that could be a recipe for disaster, policy experts say. A growing population with an increasing standard of living will boost the demand for groundwater, a trend that could eventually lead to reduced agricultural yields, shortages of potable water and an increase in societal unrest.

Northern India and the surrounding areas — a 2,000-kilometer–long swath that rims the Himalayas from Pakistan to Bangladesh — are home to more than 600 million people. The region is also one of the most heavily irrigated areas in the world, says Virendra M. Tiwari, a geophysicist at the National Geophysical Research Institute in Hyderabad, India, and coauthor of a new report to appear in an upcoming *Geophysical Research Letters*. Government policies put in place in the 1960s to boost agricultural productivity nearly tripled the amount of irrigated acreage in India between 1970 and 1999, previous research has found.



Draining the well
Increases in irrigation have substantially depleted groundwater supplies in eastern Pakistan, northern India, southern Nepal and western Bangladesh (largest decreases shown in pink). Parts of Afghanistan have also seen declines.

In the mid-1990s, India’s Central Ground Water Board estimated that farmers pulled more than 172 cubic kilometers of water each year from aquifers in portions of the study region in northeastern India, southern Nepal and western Bangladesh, Tiwari says. That’s more than three times the capacity of India’s largest surface reservoir. New data gleaned from gravity-measuring satellites suggest that the annual rate of extraction in that region has jumped more than 60 percent since then, Tiwari and colleagues report.

Researchers estimate that monsoon rains supply, at most, 246 cubic kilometers of precipitation to the region each year, Tiwari says. So, during the mid-1990s, groundwater supply — which largely comes from rainfall that soaks into the ground — was sufficient to meet agricultural demands. But data gathered from April 2002 to June 2008 by the Gravity Recovery and Climate Experiment’s two satellites show that irrigation now extracts substantially more water than is replenished each year.

GRACE, a joint mission of NASA and DLR, the German aerospace center, is designed to map changes in Earth’s gravitational field (*SN: 1/4/03, p. 6*). The

V. TIWARI ET AL./GEOPHYSICAL RESEARCH LETTERS

For today's top stories, visit
SN Today at **www.sciencenews.org**

craft can discern movements of groundwater—which, Tiwari says, often flows away from a region or evaporates after being pumped from aquifers.

Across northern India and nearby regions, including parts of Afghanistan, the net loss of groundwater averaged 54 cubic kilometers per year between 2002 and 2008, he and colleagues estimate. As a result, the water table, the upper water surface in the aquifers, fell 10 centimeters or so per year. This loss of groundwater has about the same volume as the water that melted from Alaska's glaciers during the period, he notes.

A separate analysis of GRACE data, focused on northwestern India, also reveals groundwater depletion. From August 2002 to October 2008, farmers pumped an average of 17.7 cubic kilometers of water a year from aquifers under three Indian states, says hydrologist Matthew Rodell of NASA's Goddard Space Flight Center in Greenbelt, Md. In that arid region, home to more than 114 million people, the water table fell an average of 33 centimeters per year, the team reports online August 12 in *Nature*.

Because rainfall in the region was normal during the study period, all of the water movement detected by the GRACE satellites is presumed to have come from groundwater depletion, Rodell says. The net loss of groundwater from northwestern India's aquifers is almost three times the volume of Lake Mead, which supplies water for many parts of the southwestern United States.

The pace of groundwater depletion in northern India is greater than expected and mirrors trends seen in many other regions, including China and the western United States, says Sandra Postel, director of the Global Water Policy Project, based in Los Lunas, N.M. When groundwater disappears or becomes too difficult to pump, people who now support themselves on the land will become economic refugees, she contends. In many parts of the world, Postel adds, "water problems are becoming very serious, very fast."

Many governments often aren't forthcoming about groundwater or other resources within their borders, so using remote sensing data is the only way to track usage trends for those resources, says Jay Famiglietti, a hydrologist at the University of California, Irvine and coauthor of the *Nature* report. "Big movements of water can't hide from GRACE," he notes.

GRACE detects shifts in water storage indirectly. The two craft orbit the planet along the same path, with one traveling about 200 kilometers ahead of the other. As the first craft in the pair approaches a gravitational anomaly on Earth's surface—say, a mountain range made of dense rock or a water body—it is pulled forward in its orbit. After the first craft passes over the anomaly, it is pulled backward. The second craft is simultaneously pulled forward as it approaches the anomaly. The magnitude of subtle changes in distance between the two craft reveals the gravitational anomaly's size.

Scientists have used GRACE to measure ice loss from Greenland and Antarctica (*SN: 12/17/05, p. 387*), changes in Amazon Basin water levels (*SN: 8/7/04, p. 94*) and even the movement of tectonic plates that occurred during the massive quake off the western coast of Indonesia in December 2004 (*SN: 1/7/06, p. 6*). ■

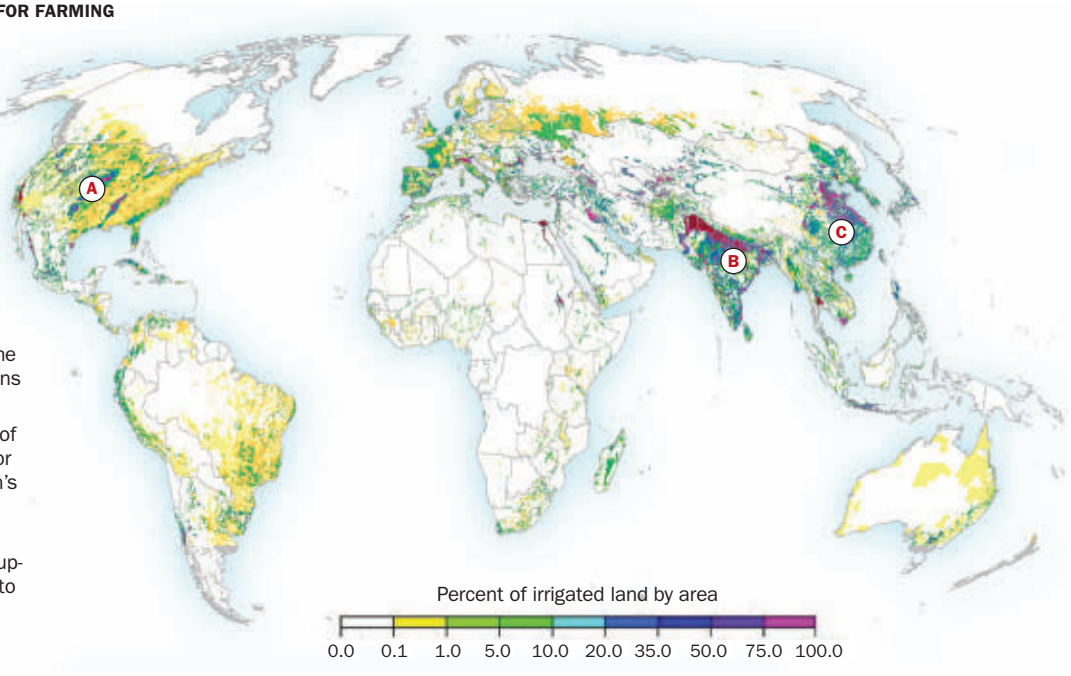
Back Story | MINING AQUIFERS FOR FARMING

Underground water supplies in many of the globe's most heavily irrigated regions, highlighted here in shades of purple, are draining faster than they can be replenished. Overall only about 10 percent of the world's agricultural food production depends on groundwater for crop irrigation, but some regions are much more reliant on aquifers for farming.

A United States: About 43 percent of irrigated lands depend on groundwater. The percentage is especially high in arid regions such as the Great Plains and California.

B India: Water for more than 50 percent of irrigated farmland, an area responsible for between 70 and 80 percent of the nation's crop yields, comes from aquifers.

C China: A booming economy and rising standards of living are straining water supplies here, where aquifers supply water to about 27 percent of irrigated farmlands.



ADAPTED FROM UNITED NATIONS FOOD AND AGRICULTURAL ORGANIZATION

Ornithology

For more reports from meetings, visit **www.sciencenews.org**

Forest birds' wings get makeover, courtesy of evolutionary processes

Logging, recovery may play role in the degree of pointiness

By Susan Milius

When trees fall in the forest, unheard or not, they may reshape birds' wings.

As logging whittled away at Canada's vast boreal forest during the past century, bird species that frequent mature woodlands developed somewhat pointier wing tips, André Desrochers of the Center for Forest Research at Laval University in Québec City reported August 13. During the same period, forests expanded in New England. Mature-woodland species there trended toward rounder wing tips.

Previous work has found that wing shape is highly heritable, Desrochers said, and he thinks rapid evolution is the most straightforward explanation for his new findings.

Sharper points on wings typically prove more efficient than blunter shapes during sustained flight, Desrochers said. But those points also have a cost. On tight maneuvers threading through 3-D mazes of branches, pointy wings lose out to rounder ones.

Several other studies have noted wing-shape differences within the same species if some populations migrate and some don't. House finches in the eastern United States that follow the seasons, for example, tend toward sharper wings than western, couch-potato house finches.

Desrochers said he began to wonder whether human activities that leave forests in fragments might influence wings the same way migratory lifestyles do.

Logging in the conifer forest that once blanketed most of Canada means that birds now fly farther than their ancestors did to find prime territories and mates. Filling the gaping mouths of chicks in tattered forests also means longer commutes, and all the extra flying might change the balance of trade-offs for wing shape.

As forests change, so too do the shapes of some birds' wings, including boreal chickadees (one shown here).

To see if a hundred years of landscape change mattered, Desrochers measured wings of 851 specimens from 21 species of forest birds. Mature-woodland species showed the clearest change in pointiness regardless of body size, Desrochers said. During the past century, their long wing feathers, or primary feathers, gained about 2.23 millimeters on average.

Desrochers also included more southerly species on his list, such as the scarlet tanager and hooded warbler. During the past century, the landscape of New England, previously deforested, rebounded into green woodland again. And here, Desrochers found a trend toward rounder wing tips. The eight mature-woodland species he studied typically had lost, on average, some 2.37 millimeters off those long primary feathers.

"Birds are not like sitting ducks," said Desrochers. Species respond to the extent that they can when they face new challenges.

"It's surprising that there's so much change so fast," said ornithologist David Winkler of Cornell University. He noted that the study doesn't explicitly address whether the wing changes are genetic.

PBONENFANT/FLICKR (URL: BIT.LY/G71YF)

MEETING NOTES

To sing or not to sing

A new study may help explain why birdsong is more of a guy thing in temperate regions but plenty of females join the chorus in the tropics. Jordan Price of St. Mary's College of Maryland and colleagues reported August 15 a tight correlation between lifestyle and female singing in New World blackbirds. Among most of the species that stay put year-round and breed in monogamous, territorial pairs, females still sing. But in migratory and colonially breeding birds, for example, females have typically lost their songs.

Doesn't cluck like a chicken

Sage grouse have unexpected vocal anatomy. Though they belong to the group of galliform birds that includes chickens, sage grouse have a double-barreled sound source with the capacity to produce two sounds at once, Alan Krakauer of the University of California, Davis reported on August 15. He and colleagues found that Japanese quail, the greater prairie chicken and the sharp-tailed grouse also have that ability.

Traffic moves baritone birds

Traffic noise may drive birds with low-pitched songs away from forests. Of eight species surveyed in a new study, the two with the songs most likely to get lost in the din of traffic were especially rare in wooded spots near highways, Sarah Goodwin of the University of Delaware in Newark reported August 13. When Goodwin and a colleague analyzed data from 30 sites, noise was the strongest factor explaining the rarity of yellow-billed cuckoos and white-breasted nuthatches in loud places.

—Susan Milius

Chemistry

For longer versions of these and other meeting stories, visit **www.sciencenews.org**

Comet halo holds ingredient for life

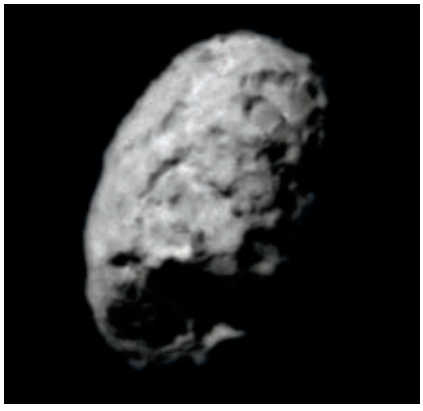
Smallest amino acid could have extraterrestrial source

By Rachel Ehrenberg

A building block of proteins found in samples from an icy comet's halo suggests that the ingredients of life could have hitched a ride to early Earth, researchers reported August 16.

"The early Earth was bombarded with comets and meteorites," said Jamie Elsila of NASA's Goddard Space Flight Center in Greenbelt, Md., who led the new analysis. "This is one more clue to what ingredients could have been present on the early Earth and how they could have gotten there."

NASA's Stardust spacecraft collected the study samples when it flew through the gassy halo, or coma, of the comet Wild 2 (pronounced "vilt 2") in 2004. Two years later the collecting device parachuted to Earth, landing in the dark of night in Utah. Previous analyses by Elsila's NASA colleagues Daniel Glavin and Jason Dworkin revealed that the samples contained amino acids, the building blocks of proteins. Proteins are the major construction material of living things and many are tasked with making fundamental biochemical reactions happen. But the analyses couldn't rule out contamination by earthly proteins.



Samples from the gassy halo of comet Wild 2 (above) contain glycine, an amino acid common in life on Earth.

Now finer instruments reveal that the samples of glycine, the smallest amino acid, are indeed extraterrestrial. Glycine molecules in the comet samples contain more of the heavy version, or isotope, of carbon than earthly glycine does, Elsila reported. A paper describing the discovery has been accepted for publication in *Meteoritics & Planetary Science*.

"This is a really nice confirmation," says Ralf I. Kaiser of the University of Hawaii at Manoa and NASA's Astrobiology Institute. Lab studies have suggested that energy from UV light or solar winds could spur the formation of amino acids in space. Galactic cosmic rays can penetrate meters deep into ice, says Kaiser, suggesting that other amino acids could form inside a comet's icy body.

The find is "very pleasing and satisfying, but not a shock," Elsila said. While previous reported detections of glycine in interstellar space have been disputed, plenty of amino acids have been detected in meteorites and amino acid precursors have been found in comets. Wild 2 is thought to be very old, and it could provide a snapshot of what was around when the solar system formed, Elsila said.

Glycine is small and volatilizes easily, facilitating its detection in the comet's gassy halo. Probing the innards, rather than just the halo, of a comet may reveal even more of life's molecules. The European Space Agency's Rosetta spacecraft is scheduled in 2014 to release a small lander on the icy nucleus of comet 67P/Churyumov-Gerasimenko. ■

Worm-inspired superglue

A new glue may worm its way into the medical realm as a tool for pasting together pieces of fractured bone. Researchers have created the glue based on an adhesive that a marine worm uses to cement its shell. Because the glue can be injected underwater and can stick and harden in an aqueous environment, it may one day be used inside the body, researchers reported August 17. "It literally glues skeletons together underwater, so we thought it would be a good model for wet surgery," said Russell Stewart of the University of Utah in Salt Lake City. Sandcastle worms (one shown growing in the lab) dwell in the intertidal zone where they construct a tubelike shell by gluing together bits of sand, broken shells and other mineral debris. After identifying and analyzing several of the key proteins involved, Stewart and his colleagues formed a new glue by creating similarly charged proteins and mixing in calcium and magnesium, much like the worm does. —*Rachel Ehrenberg*

FROM TOP: JPL/NASA; R. STEWART

"Almost all of the plastic that enters the ocean stays in the ocean."
— JOEL BAKER

Styrofoam degrades in seawater, leaving tiny contaminants behind

Study suggests styrene units are fouling the Pacific Ocean

By Rachel Ehrenberg

From the beer cooler at the bow to flotation devices and bumpers, life on the sea often involves light, white foamed plastic, commonly known by the trademark Styrofoam. But life in the sea encounters the plastic as well. The chemical building blocks of foamed polystyrene have been detected in areas of the Pacific Ocean, and lab experiments demonstrate that the plastic degrades at seawater temperatures, researchers reported August 19.

"Plastics are a contaminant that goes beyond the visual," says Bill Henry of the Long Marine Laboratory at the University of California, Santa Cruz. The researchers' reports are important, he says, because they provide "some of the first evidence of polystyrene as a potential contaminant to wildlife that's more on the molecular level."

Polystyrene foam is a manufactured plastic primarily made up of rings of carbon and hydrogen attached to long hydrocarbon chains. Polystyrene breaks down into smaller styrene units, and studies suggest that the smallest of these units — the styrene monomer — is carcinogenic in mice. Its effect on other organisms isn't yet clear.

Water samples collected off Malaysia and the U.S. Pacific coast and in the northern Pacific Ocean contained styrene monomers, as well as styrene dimers and trimers, reported Katsuhiko Saido of Nihon University in Chiba, Japan. Saido and colleagues also degraded polystyrene foam in the lab at 30° Celsius, similar to seawater temperature in some areas. The team found that the various smaller styrene units were present in the same relative quantities in both the lab and in the water samples, supporting the idea that the foam is breaking down in seawater.

K. SAIDO

The oceans are littered with polystyrene foam (above, on a beach in Japan), and now breakdown products of the plastic have been found in the Pacific.

Much of the research on plastic pollution in the oceans has focused on what can be seen with the naked eye, says Joel Baker of the University of Washington Tacoma. Studies investigate damage from plastic nets or ingestion of visible chunks. But the new work adds to a growing body of evidence that plastics break down in water into pieces too small to see.

"We are concerned that plastic pollution is also caused by these invisible materials and that it will harm marine life," Saido said.

While the potential toxicity of tiny plastic constituents is understudied for much of marine life, plastics are abundant in many forms. Marine litter is now 60 to 80 percent plastic, reaching 95 percent in areas, according to a review in the October 2008 *Environmental Research*. And plastics, including polystyrene, are common in the wads of undigested matter that black-footed albatrosses cough up before fledging, Henry says.

Getting at plastic's effects is challenging — plastics travel long distances, their distribution in the oceans isn't uniform and scientists are still refining methods to detect and analyze the materials. But, Baker says, "almost all of the plastic that enters the ocean stays in the ocean." ■

MEETING NOTES

Drugged money

The smell of money might be as intoxicating as the smell of power in the nation's capital. After studying money supplies in U.S. cities and in countries worldwide, Yuegang Zuo of the University of Massachusetts Dartmouth and colleagues reported August 16 finding cocaine traces in 95 percent of banknotes collected in Washington, D.C. On average, 90 percent of U.S. banknotes studied were contaminated, compared with 85 percent of Canada's paper dollars and 80 percent of Brazil's reais. Of 234 banknotes from 17 U.S. cities, those with the heaviest cocaine residues — up to 1,240 micrograms per bill — came from big cities with serious drug problems. *— Janet Raloff*

Subtracting that smell

Farmers can get the scoop on the poop in livestock feedlots with a new technique for mapping the smelliest and most manure-laden areas. The method could provide a means for targeting odorous spots for treatment, reducing both the foul stench and greenhouse gas emissions, scientists reported August 17. The method uses an all-terrain vehicle equipped with a device that emits radio waves into the ground to determine the concentration of salts in the soil. This concentration serves as a proxy for biosolids, said Bryan Woodbury of the U.S. Meat Animal Research Center in Clay Center, Neb. Generating a map of volatile fatty acids in a pen would allow farmers to judiciously apply treatments, such as thyme oil, that shut down microbes generating the emissions. Such treatments are often too costly for the whole lot, Woodbury said. *— Rachel Ehrenberg*

Life

For more Life stories, visit **www.sciencenews.org**

Tree keeps vigil for extinct moa

Leaves may have defended against big, chomping birds

By Susan Milius

Odd shape shifts and color changes during a New Zealand tree's lifetime may be a botanical form of paranoia.

Skinny, mottled-brown early leaves could still be defending lancewood trees against the long-extinct moa, flightless birds that lived in New Zealand hundreds of years ago, says Kevin Burns of Victoria University of Wellington in New Zealand.

Using information about the visual system of the ostrich, moa's closest living relative, Burns and his colleagues tested what the leaves of lancewoods (*Pseudopanax crassifolius*) might have looked like to a moa.

From a moa's perspective, small lancewood seedlings' narrow, dark leaves would have been hard to see against the background leaf litter, the researchers report in an upcoming *New Phytologist*. As the plants grow, newer leaves develop bright spots that mark hard-to-swallow, snagging spines. "Moa would have to be sword swallowers to get them down," Burns says. The brighter dots could work like other plant markings proposed as easy-to-remember, defensive warnings to browsers, the plant version of eye-popping colors on poison dart frogs.

More conventional leaves without such defenses don't show up until lancewood trees are taller than 300 centimeters, the researchers report. That's the probable top of the browsing reach of the biggest moa, according to paleontologists' calculations.

Bright spots mark the spines on the narrow leaves of lancewood saplings. Spines may have served as a defense.

Researchers also looked at the leaves of a species descended from the New Zealand lancewood. Growing on the Chatham Islands, this species, *Pseudopanax chathamicus*, never had moa to menace its foliage and doesn't show the same defenses, the researchers report. Its seedlings' greener leaves wouldn't have blended in with the background as well as the moa-zone species does, and its sapling leaves don't grow as narrow. Without moa, the offshoot may have lowered its guard.

"Plausible, but how are you going to test it?" Richard N. Holdaway says of the idea that lancewood leaves served as a defense against moa. Holdaway, a paleobiologist at the independent research organization Palaecol Research Ltd. in Christchurch, New Zealand, is analyzing food bits preserved in moa remains and says lancewoods do show up.

Moa would have been the predators to guard against in ancient New Zealand because they were the islands' only big, leaf-chomping animals. Moa's beaks were more robust than ostriches' and could slice through a lot of shrubbery, Holdaway says. "Moa were built like bridge beams."

Various lines of research suggest prey species can keep their defenses for thousands of years after the last of a terrorizing predator has vanished. Pronghorn still run far faster than their modern pursuers. And some of the *Cyanea* plants in Hawaii still sprout prickles that might have defended them against now-extinct browsing birds. Lancewoods now join the list of organisms haunted by ghosts. ■

Bomb-tastic new worms

Newly discovered deep-sea worms launch luminous green bombs that may distract a predator, a study in the Aug. 21 *Science* reports. Remotely operated vehicles found seven new species of worms (one shown) at depths exceeding 1,850 meters off the coasts of California, Oregon and the Philippines. Cameras caught the worms, some several inches long, swimming above the ocean floor, propelled by fans of bristles. Cameras also caught a glimpse of small bulbous packets near some of the species' heads (arrow). After bringing worms back to the lab, the researchers found that they release these packets when prodded and the spheres burst into bright green light. This bioluminescent trick earned the worms the nickname "green bombers," says study coauthor Karen Osborn of the Scripps Institution of Oceanography in La Jolla, Calif. The seven species make up a new genus, named *Swima*. Five species release the packets, probably as a defense mechanism, Osborn says. —*Laura Sanders*

FROM TOP: DAVID COLLINGS; © 2007 C. DUNN

Genes & Cells

For longer versions of these and other Genes & Cells stories, visit **www.sciencenews.org**

Gene may make for shorter nights

Variant in people also reduces shut-eye in mice, fruit flies

By Tina Hesman Saey

Some people have an excuse for getting only six hours of shut-eye each night. One of their genes makes them do it.

Two people who sleep about six hours and 15 minutes per night have a rare variant of a gene called *DEC2*. The variation appears to reduce hours of sleep in the two family members studied and in laboratory mice and fruit flies, researchers report August 14 in *Science*.

Scientists knew that about half the variation in sleep duration is accounted for by genes, says Mehdi Tafti of the University of Lausanne in Switzerland. But the new study is the first to identify a particular gene controlling the duration in people.

DEC2 is known to be involved in regulating the body's daily rhythms. So scientists led by Ying-Hui Fu of the University of California, San Francisco examined the gene in 800 people, some of whom naturally sleep less than average. A variation was found in the *DEC2* gene in the two women with short sleep periods but not in their normal-sleeping family members or in more than 250 other people who also average about eight hours a night.

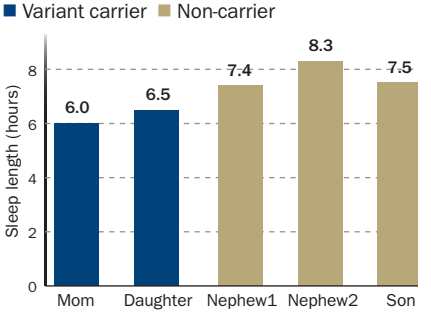
People with the short-sleeping form of the gene don't seem to have any alterations in their daily rhythms and appear healthy and functional, Fu says. "Right now all we can say is that they sleep less. Whether they need less, we don't know."

To see whether the variant causes the shorter sleeping times, researchers genetically engineered mice and fruit flies with the short-sleep form. Studies showed that engineered animals slept less than mice or flies with the standard version.

Because the variant altered the animals' sleep, the researchers can be confident that they have identified the source of the shorter sleep times in the people, says Paul Shaw of Washington University in St. Louis. "They've got it," he says.

But, Tafti notes, the mice with the short-sleep gene form experienced fragmented sleep, suggesting that altering the gene's activity could lead to unexpected sleep disruptions.

Sleep in the family
A new study finds that two family members with a variation in the *DEC2* gene slept less on average than their relatives with the standard version of the gene.



SOURCE: YING HE *ET AL.*/*SCIENCE*

Human cells play Simon Says, too

Research uncovers evidence for mirror neurons in people

By Tina Hesman Saey

Human see. Human do. Some nerve cells in the brain react either way, just as monkey brain cells do.

Macaques have specialized brain cells — called mirror neurons — that activate when the monkeys perform an action involving an object, such as picking up a grape, and also when they watch another monkey or a person do the same task. The discovery of these neurons in 1996 led to speculation that the cells could be involved in simulating others' actions, language development and even autism. But no one had definite proof that such cells exist in humans.

Now a new study in the Aug. 12 *Journal of Neuroscience* provides strong evidence that humans have mirror neurons too.

Researchers used functional MRI scans to examine volunteers' brains for signs of mirror neurons. While in a scanner, volunteers gripped objects and, in the same session but not simultaneously, watched videos of someone else making the movements. Groups of neurons in a part of the brain called the inferior frontal gyrus responded to doing the actions and to watching the same actions, researchers led by James Kilner of the Wellcome Trust Center for Neuroimaging at University College London reported.

Other groups have attempted without success to discover human mirror neurons. In those tests, though, volunteers performed and watched actions — such as rock, paper, scissors — that did not involve objects. But interactions with objects are necessary to activate mirror neurons in monkeys, says Scott Grafton of the University of California, Santa Barbara. Kilner succeeded in finding the neurons because the movements in the new study involve objects, Grafton says.

Objects' role in activating mirror neurons in monkeys and people "might have some deep, important meaning," says Ilan Dinstein of New York University. Some of the functions ascribed to the neurons may not hold true, he adds.

"A flood of theories regarding what mirror neurons do in humans came out before anyone proved they exist or not," Dinstein says. "A lot more groundwork needs to be done before people can talk about these theories of simulation, language and so forth."

Kilner doesn't expect his work to be the last word. Until researchers can watch single mirror neurons firing, as with monkeys that have electrodes implanted in their brains, there will still be questions about the existence of human mirror neurons, he says.

Atom & Cosmos

For longer versions of these and other Atom & Cosmos stories, visit **www.sciencenews.org**

Flurry of planets found at full tilt

Violent interactions may have shaped extrasolar systems

By Ron Cowen

Call them the wrong-way planets. Several giant, extrasolar planets, all residing within sizzling distance of their parent stars, have orbits so tilted that the planets travel backward relative to their parent stars' rotation, new studies reveal. The misalignments attest to rough-and-tumble histories and may suggest that life flourished on Earth because the solar system avoided the brunt of close gravitational encounters between planets.

According to the most popular formation theory, planets coalesce from a swirling disk of gas and dust that surrounds young stars. Since the disk rotates in the same direction as the star, the planets spawned should revolve in that direction as well. But in an overcrowded system, where a gravitational game of billiards is all but inevitable, orbits can get scrambled. A close encounter between planetary siblings can push one body outward while flinging the other inward, elongating and tilting the inner planet's orbit.

In this scenario, the Earth's solar system may have been unusually lucky. Either it avoided catastrophic gravitational encounters between massive planets or it suffered such interactions so long ago that most of the planets had time to resettle into nearly circular orbits with little or no tilt, says Frédéric Pont of the University of Exeter in England.

"The presence of advanced life on Earth may be contingent on our planetary system having avoided the brunt of planet-planet scatter," keeping Earth on a circular, Goldilocks-style orbit — neither too hot nor too cold for known forms of life, he speculates.

In one of the new studies, posted online August 24 at arXiv.org, Pont and colleagues examined the orbit of the planet COROT-1b. This close-in planet, like the others in the new studies, periodically passes across the face of its star as seen from Earth, blocking a fraction of the light and allowing a telescope to measure orbital tilt. By observing the spectra from the star, Pont's team found that the orbital axis of COROT-1b was tilted at an angle of about 77 degrees with respect to the star's spin axis.

Two independent studies, also posted at arXiv.org, find exoplanets with tilts at roughly 150 and 180 degrees. And another team, reporting at the Dynamics of Disks and Planets meeting in Cambridge, England, has detected two more close-in exoplanets with substantially tilted orbits.

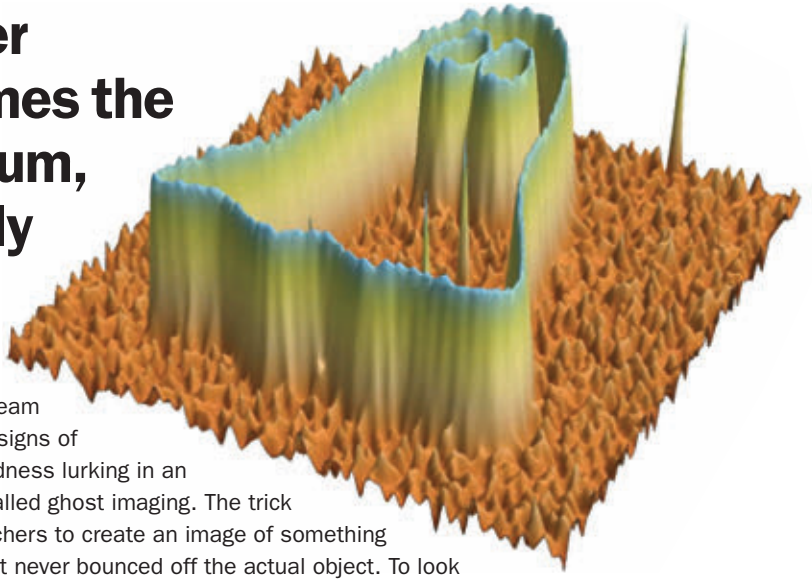
"This has been the most exciting observational result of the summer and certainly the meeting," says Eric Ford of the University of Florida in Gainesville.

With the new findings, between 25 and 50 percent of all exoplanets whose angles of inclination have been measured have tilts exceeding 30 degrees. Earth has the greatest orbital tilt of planets in the solar system, with an angle of 7.1 degrees.

The newly found tilts, Pont says, represent "a spectacular upheaval of the standard view of close-in planet formation ... and probably indicate instead catastrophic encounters between several planets."

Ford speculates that the solar system is special not because it avoided planetary pinball, but because the encounters happened while the disk of rocky debris still survived. The disk's gravity would have damped elongated and inclined orbits, returning the solar system's planets "to the nearly circular and coplanar orbits that we enjoy today," Ford suggests.

Casper becomes the quantum, friendly ghost



B. JACK *ET AL.*

In a spooky new study, a team found telltale signs of quantum weirdness lurking in an optical trick called ghost imaging. The trick allows researchers to create an image of something using light that never bounced off the actual object. To look for evidence of quantum behavior, Miles Padgett of the University of Glasgow in Scotland and colleagues designed a system to create a ghost image of an appropriately ghoulish object (above). Photons in two light streams, one of which bounced off a hologram and never touched the object, were intimately linked, a property known as entanglement, the team found. This "spooky action at a distance" allowed contrast information from the hologram to improve the image of the ghost. The results are "the clearest demonstration that at least some forms of ghost imaging are quantum," Padgett says. "That's not to say that all systems are quantum, but ours is." —*Laura Sanders*

Body & Brain

For longer versions of these and other Body & Brain stories, visit **www.sciencenews.org**

From troublemaker to treatment

Study finds estrogen may fight persistent breast cancer

By Nathan Seppa

In some breast cancer patients who have tried every drug treatment short of chemotherapy, estrogen can stall tumor growth, a new study finds.

The idea is counterintuitive since estrogen acts as a growth stimulant in most breast cancers. But using the hormone as an anticancer weapon is actually an old strategy that might offer a new treatment option, researchers report in the Aug. 19 *Journal of the American Medical Association*. They are cautiously optimistic because a screening test used in the new study can determine with considerable accuracy which breast cancer patients would probably benefit from estrogen.

Most breast cancers are estrogen-receptor positive, meaning cancer cells often multiply when estrogen binds to receptor proteins on the cells. But the hormone's effects on a tumor are not one-dimensional. Estrogen can also send cancer cells into a programmed cell-death response. If dying cells outnumber multiplying cells, tumor growth stalls.

Synthetic estrogen was used as a treatment option for breast cancer for decades until hormone-deprivation drugs, including tamoxifen, gained approval. Still, roughly 40,000 women die of breast cancer in the United States each year, most of them with estrogen-receptor–positive tumors that become insensitive to estrogen-deprivation treatments, says study coauthor Matthew Ellis of Washington University School of Medicine in St. Louis.

A test used in the study can spot patients likely to benefit from estrogen.

In the new study, Ellis and his colleagues enrolled 66 breast cancer patients who had relapsed despite multiple rounds of estrogen-deprivation treatments over more than seven years, on average. Half of the women got a high dose of estrogen and the others a low dose.

After 24 weeks, tumors had stopped growing or shrunk in nearly one-third of volunteers in both groups. That suggests that the cancerous cells had reorganized themselves, becoming susceptible to estrogen's cell-death effects, Ellis says. "We don't have a handle on the precise mechanism by which that happens."

But a test used in the study can spot patients likely to benefit from estrogen, he says. One day after starting therapy, each woman was injected with a dose of glucose containing a labeling compound that could be traced in the body. In some women, the tumors glowed on a combined PET-CT scan. After the 24 weeks, 80 percent of women who had shown the "flare" on the scan benefited from the treatment.

"It's a good way to predict who would respond to this endocrine therapy," says Richard Santen of the University of Virginia in Charlottesville.

New drug shown to preserve bone

Vertebrae density increases in two high-risk populations

By Nathan Seppa

A new drug increases bone density and reduces the number of fractures in men fighting prostate cancer and in elderly women with bone loss, researchers report in two studies appearing August 11 in the *New England Journal of Medicine*.

The results of these clinical trials might clear the way for approval of the drug, called denosumab, by the Food and Drug Administration. "This certainly goes a long way toward fulfilling the criteria the FDA uses," says Sundeep Khosla of the Mayo Clinic in Rochester, Minn.

Denosumab prevents old bone from being dissolved faster than it can be replaced. While bone mineral removal and replacement is a natural balancing act, the loss of hormones — as in postmenopausal women lacking estrogen and men with prostate cancer who are being treated with androgen-deprivation therapy — can put it out of sync.

In one of the new studies, researchers enrolled 1,468 prostate cancer patients, average age 75, who were undergoing androgen-deprivation treatment. Half the volunteers received a denosumab injection every six months for three years, while the others got placebo shots. Those getting the drug showed on average a 5.6 percent increase in vertebrae density in the lower spine after two years, compared with a 1 percent loss in the placebo group. Only 1.5 percent of the men receiving denosumab experienced a vertebra fracture by the end of the third year compared with 3.9 percent of the placebo recipients.

"This demonstrates clinically meaningful improvements in bone density," says coauthor Matthew Smith of Massachusetts General Hospital Cancer Center and Harvard Medical School in Boston.

In the other study, an international team identified nearly 8,000 women, average age 72, with low bone-density scores. Half received denosumab shots every six months for three years, while the others got placebo injections. The bone density of vertebrae rose, on average, by 9.2 percent and hip bone density by 6 percent in women getting denosumab, whereas women in the placebo group showed no gains. Also, 2.3 percent of women getting denosumab had a vertebra fracture, compared with 7.2 percent of the placebo group.

Humans

For longer versions of these and other Humans stories, visit **www.sciencenews.org**

Deprived of any external cues, people go round

Feedback errors accumulate as walkers try to go straight

By Bruce Bower

In one scene of the 1999 movie *The Blair Witch Project*, three film students searching for a legendary creature hike for hours only to end up at the spot where they had started.

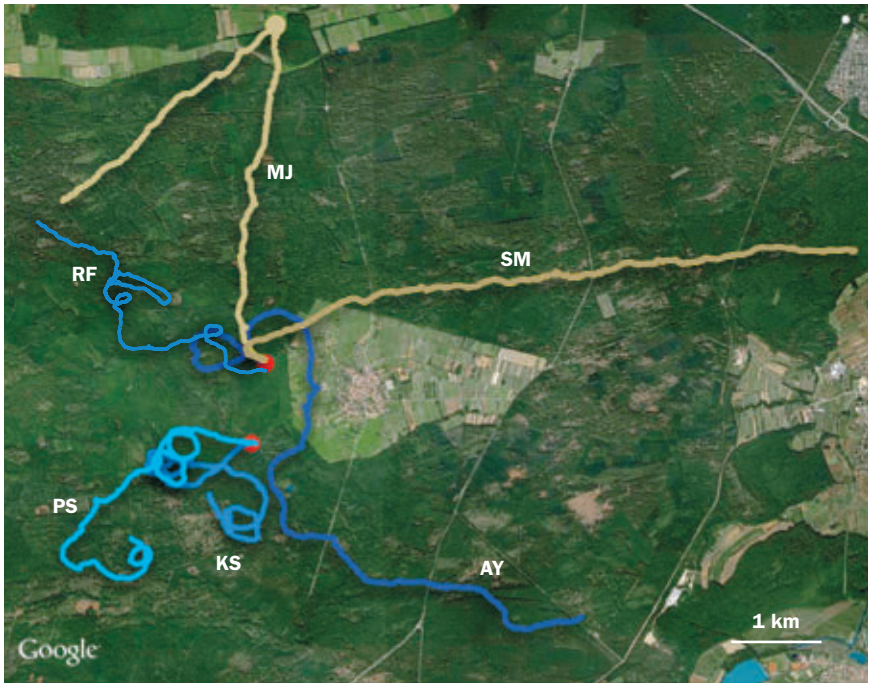
Their misfortune is not just a suspenseful twist in a fictional world, says Jan Souman of the Max Planck Institute for Biological Cybernetics in Tübingen, Germany. Given no external cues to direction, people trying to walk straight over unfamiliar terrain end up doing intermittent loop-de-loops, Souman and colleagues report in a paper published online August 20 in *Current Biology*.

Circular walking occurs when people have to rely solely on bodily cues, such as rotational shifts and joint movements, to estimate the location of "straight ahead," Souman hypothesizes. As random errors in bodily feedback accumulate, a person drifts to one side or the other. A walker dependent on bodily cues may first make a circle to the right, drift back to a straight-ahead direction, start to zigzag and then make a circle to the left.

"You may think that you're walking in a straight line, but in fact the direction you're walking in is drifting more and more away from straight ahead, making you walk in circles," Souman says.

That's "a simple but elegant" proposal for how walking without any external directional signs can lead people in circles, says Roberta Klatzky of Carnegie Mellon University in Pittsburgh.

In these situations, people start to circle after traveling only about the length of a football field, Souman's team finds. Researchers are now trying to mathematically model how random errors in direction can yield systematic movements.



Forest loop-de-loops In a new study, six students walked for four hours in a dense German forest. The paths of the four who walked on an overcast day (blue lines in this satellite view) made circles. The two who walked on a sunny day (tan lines) didn't make loops, possibly because the sun provided an external directional cue. Red dots indicate starting positions, and the tan dot indicates where one of these students (MJ) left the study area and had to be redirected.

Klatzky led an earlier study in which blindfolded adults veered toward the right or left, without circling, while traversing almost half the length of a football field. She initially attributed this finding to a biological tendency to turn in one direction, perhaps because one leg is slightly longer or stronger than the other. In the new study, most individuals circled to both the left and right within the same trial, undermining Klatzky's proposal.

Souman's team first instructed three men to walk straight in part of the Sahara desert. The two men who walked during the day, with the sun visible, veered off course but did not go in circles. After clouds hid the moon, the man walking at night made several sharp turns in the same direction, nearly turning to face the direction from which he came.

In a second experiment, six college students walked for about four hours in a dense German forest where the landscape provides no clear cues to direction. The four volunteers walking on an overcast day traveled in a series of circles. Both students walking on a sunny day followed an almost straight course, except when clouds blocked the sun.

People, like bees and pigeons, may compensate for changes in the sun's position as they move, Souman speculates.

In a third experiment, 15 blindfolded participants tried to stride straight forward in a large, flat field. In a series of five- and 10-minute trials, participants walked in circles often no more than 20 meters wide. Only three veered consistently to the right or left. Souman plans to study people walking on a treadmill in a virtual forest so that he can control visual cues.

In emergency situations, cinematic monster hunters and others may become panicked, disregarding external heading cues and unintentionally ending up where they started, Souman suggests.

J. SOUMAN *ET AL.*/*CURRENT BIOLOGY*

~790,000 years ago | Fire tamed for cooking, warmth and protection

28,000 years ago | Pottery first appeared

5,500 years ago | Metalworking first appeared

Fire engineers of the Stone Age

Africans heated stones for toolmaking 72,000 years ago

By Bruce Bower

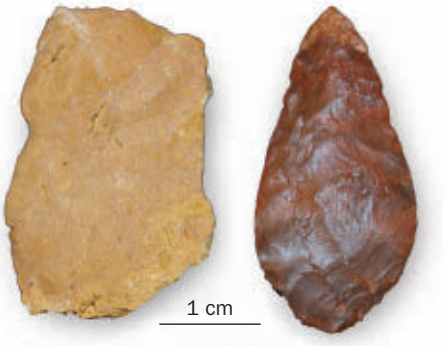
Stone Age toolmakers didn't need motivational speakers to get fired up at work. People living on the southern tip of Africa 72,000 years ago decided on their own to heat stones with controlled fires to make the rock more suitable for tool manufacturing, a new study finds.

Coastal residents of southern Africa may even have heated stones as a first step in toolmaking as early as 164,000 years ago, report Kyle Brown of the University of Cape Town, South Africa, and his colleagues in the Aug. 14 *Science*. Until now, evidence of heat treatment extended back no further than about 25,000 years ago in Europe, Brown notes.

Brown's results "push the antiquity of heat treatment back much earlier than previously supposed," says John Shea of Stony Brook University in New York.

At South Africa's Pinnacle Point cave, the researchers identified magnetic and molecular signatures of intense heating on 26 tools made of a type of stone called silcrete. The tools came from an excavation of sediment layers dating to between 72,000 and 47,000 years ago. The team estimates that the artifacts were heated at maximum temperatures of 300° to 400° Celsius.

High levels of surface gloss further indicated that a majority of 153 stone artifacts from the same and nearby layers had been heated, probably before being made into tools. And gloss levels on 24 Pinnacle Point stone tools with an estimated age of 164,000 years suggested that they too had been heated at high temperatures.



Ancient people may have heated silcrete (left) to make the stone less brittle before shaping it into a tool (right).

K. BROWN/SOUTH AFRICAN COAST PALEOCLIMATE, PALEOENVIRONMENT, PALEOECOLOGY, PALEOANTHROPOLOGY PROJECT

Universal concerns, not cultural values, may shape kids' developing notions of right and wrong

Morality Play

By Bruce Bower
Illustration by Lior Taylor

A 10-year-old Chinese boy listens intently as a visiting researcher tells him a story. It begins pleasantly enough: A boy named Xiaoming goes to a park and meets a child playing with a new ball. But after joining in the fun, Xiaoming decides that he wants to play with the ball alone. So he hits the other child, knocks him down and lunges for the ball. The victim hangs on to the ball and runs home crying.

Meanwhile, Xiaoming's mother witnesses the whole encounter.

Not surprisingly, she is horrified. The researcher describes four possible actions taken by Xiaoming's mother. In one, she reasons with the boy, telling him to remember how it felt to be hit by another child and to imagine how his playmate in the park now feels. In another, she says it's shameful to hit other children and asks why Xiaoming can't behave as well as his friends do. In a third, the mother says that Xiaoming's behavior embarrassed her and makes their family look bad.

For her final go-round, Xiaoming's mother says that she loves him less when he misbehaves. She's so upset about the park incident that she tells the boy to "just go away."

Some of these tactics hit close to home for the real-life Chinese boy. He lives in a mountain village with no computers and few televisions. Adults there teach traditional Chinese values of maintaining harmonious relationships and fulfilling duties to family members. Village parents often talk of the shame that children bring to their families by acting disruptively and of the difficulty in loving a bad son or daughter. Many urban Chinese have gravitated away from these traditional principles over the past 20 years, but not most rural folk.

So it comes as a surprise that the village boy ranks reasoning as the mother's best tactic for setting Xiaoming straight. His explanation: Someone who knocks down other children needs prodding from Mom to realize how it feels to be bullied. That insight will make Xiaoming a better person.

A parent who appeals to family shame, makes unfavorable comparisons with others or threatens to deny love can emotionally burden her child, the boy asserts. In the boy's opinion, Xiaoming "will weep painfully in a corner" after hearing that his mother loves him less for pushing another child. He'll suspect that his mother doesn't really care about him and will be sadder in the future even if he is better behaved.

Culture wars

Other rural Chinese kids, as well as city children in China and Canada, generally agree with the village boy's opinions, says psychologist Charles Helwig of the University of Toronto. His new findings support the idea that universal concerns among children — such as a need to feel in control of one's behavior and disapproval of harming others — shape moral development far more than cultural values do.

"It's remarkable how little cultural variation we have found in developmental patterns of moral reasoning," says Helwig, who presented his results in Park City, Utah, at the recent annual meeting of the Jean Piaget Society.

Helwig and like-minded researchers don't assume that kids' universal responses spring from a biologically innate moral-reasoning capacity. Instead, they say, children gradually devise ways of evaluating core family relationships in different situations. Kids judge the fairness and effectiveness of their parents' approaches to punishing misbehavior, for example. These kinds of relationship

issues are much the same across all cultures, from Helwig's perspective.

Children everywhere stew in the same pot of family conflict, with different cultural seasonings added for flavor, in Helwig's view. When parents restrict behaviors that children regard as personal choices, such as what clothes to wear or which friends to hang out with, disputes inevitably arise. Parental restrictions on behavior that kids view as morally wrong or as a violation of conventional social rules are often accepted, even if grudgingly.

During the teen years, kids in Asian and Western cultures alike gravitate toward a broader class of moral imperatives, including rights to privacy, education and freedom of speech, Helwig and colleagues find in another new study published in the August *Social Development*. Adolescents also appeal to democratic notions, such as majority rule, to justify a preference for representative forms of government — even if they live in a communist or authoritarian society.

Helwig's conclusions trigger skepticism from some psychologists, including Shinobu Kitayama of the University of Michigan in Ann Arbor, who contend that moral reasoning fundamentally differs in Eastern and Western cultures. In Kitayama's view, only individualistic Westerners put a premium on personal freedoms and rights. Asians steeped in responsibilities to family and society guard the moral integrity of their assigned roles and duties.

As Helwig demonstrates in his studies, Chinese children know about autonomy — having a sense of personal control over one's acts — but collective values still dominate their lives, Kitayama contends. "Autonomy is a primary developmental goal in some societies but not others," he says. "It shouldn't be regarded as an inherently superior value."

Grading Mom's discipline

Cultures undeniably differ, Helwig acknowledges. But each culture inspires a mix of cooperation and conflict from its members, he says. Relationships and situations in which some people wield power over others — think parents and children — generate challenges to cultural values from the weaker parties.

"Young children critically evaluate culturally sanctioned parenting practices and sometimes disagree with those that they think have harmful effects," Helwig says.

He and his colleagues interviewed 384 children, teenagers and young adults who had grown up in Toronto, the Chinese city of Nanjing or a farming village in China's Shandong Province. Each participant listened to stories, such as that of Xiaoming and his mother, told in his or her native language.

In line with earlier studies of Chinese families, Chinese city and village children said that their parents most frequently disciplined them by making negative comparisons with someone else, such as "Even your baby brother knows what to do." Reasoning and talk of family shame occurred slightly less often, as did parental threats of withdrawing love.

Canadian children cited reasoning as their parents' number one disciplinary tactic. Negative comparisons and talk of family shame occurred somewhat less often than reasoning, followed by threats of love withdrawal.

Despite different levels of exposure to various forms of discipline, children in each setting evaluated parents' practices similarly, Helwig says. Beginning between ages 7 and 10, participants ranked reasoning as a "very good" disciplinary technique and maintained that conviction until young adulthood.

Children generally accepted shame-based discipline, but increasingly criticized it during adolescence.

Threats of love withdrawal often got panned, especially after age 10.

All children in the study offered detailed descriptions of psychological harms caused by shaming and love-withdrawal techniques. But participants added that the threat of losing a parent's love would work as well as reasoning at changing a child's behavior for the better.

"Children recognized that the threat of losing a parent's love could effectively change their behavior, but they didn't see it as morally acceptable for parents to use such methods," Helwig says.

At this point, he doesn't know whether kids who harshly evaluated certain parental discipline practices will reject or perpetuate those tactics as adults dealing with their own children.

Thinking about kids' right and wrong

Jean Piaget looms over current theories of moral development. In 1932, the late Swiss psychologist proposed that children progress through three stages to construct mature concepts of right and wrong. He believed that kids achieve a sense of autonomy and a critical stance toward parenting practices by late childhood or early adolescence.

Psychologist Lawrence Kohlberg elaborated on Piaget's theory in 1969, arguing that children don't formulate moral concepts such as justice, rights and autonomy until late adolescence.

One alternative to Kohlberg's approach proposes that a morality of care and empathy develops alongside a morality of justice. Other researchers argued that children in non-Western cultures come to think about morality differently than the Western youngsters studied by Piaget and Kohlberg.

Today, a school of thought developed by University of California, Berkeley psychologist Elliot Turiel asserts that moral decisions based on fairness and welfare develop alongside those based on other concerns, such as social rules. He and other researchers posit that children in all cultures think critically about the morality of parents' and others' actions at earlier ages than assumed by Piaget and Kohlberg.

Piaget's suggestion that children form and revise moral concepts based on their social experiences remains influential. Most researchers, though, now reject his idea that moral development proceeds through one-size-fits-all stages. —*B.B.*

Autonomously yours

Kids' widespread endorsement of reasoning techniques that make them active participants in behavioral change suggests to Helwig that children everywhere want control, or autonomy, over what they think of as their personal domains of behavior.

By late childhood, concerns about autonomy provide a framework for rating the fairness of parental rules and punishments, he proposes.

In line with that argument, two new studies find that Chinese and Japanese children believe strongly in resisting their parents when conflicts arise over personal preferences, such as clothes choices. Earlier studies have documented that this type of parent-child conflict frequently occurs in Western nations.

Min Chen, a University of California, Berkeley graduate student, interviewed 85 pairs of Chinese eighth-graders and their mothers. These boys and girls lived either in the city of Wenzhou or in rural farming villages. About half of the 57 city children had no siblings, a situation that some researchers view as promoting a selfish outlook at odds with traditional Chinese values of obedience.

In the two weeks before the interviews, many arguments had arisen over children wanting to hang out with friends versus parents wanting chores to be completed first, Chen found. Most children, not just those living in the city without siblings, felt that coordinating friend visits with household duties fell under their personal discretion. Parents lamented kids' lack of obedience and thought it would undermine school performance.

"Chinese adolescents showed desires for freedom, independence and individuality, much like teenagers of diverse ethnicities in the United States," Chen says.

Similar concerns appeared among 95 Japanese children, ages 6 to 12, who heard hypothetical stories of parent-child conflicts presented by Berkeley education researcher Hiroyuki Yamada. Participants came from middle-class suburbs of Tokyo.

Children reasoned that a parent should respect a child's personal wishes, such as what shoes to buy or when to play with friends.

Most youngsters also accepted a parent's right to determine a son's or daughter's moral behavior, such as ordering a child to return money found on the street to the person who lost it.

Voting rights

Concepts of autonomy and personal rights expand during the teen years, wherever youngsters happen to live, Helwig theorizes. As they get older, both Western and Asian teens increasingly endorse the right of children to pursue their own desires and to make their own choices, whether or not parents and other authorities like it, Helwig and his colleagues report in the August *Social Development*.

The researchers asked 160 teens in China, half of them 13 years old and half 17 years old, to evaluate a series of family and school conflicts. Participants came either from a city or from rural villages.

Teens frequently supported a peer who wanted, say, to quit school in order to work for a local business against his parents' wishes or a girl who aspired to write a story critical of school rules in her school's newspaper despite a teacher's censorship efforts. Such responses were especially common among 17-year-olds.

Chinese girls favored personal rights as much as Chinese boys.

Like their Canadian peers, Chinese teens from either villages or a city also prefer democratic over nondemocratic government, Helwig's team reported in 2007 in *Cognitive Development*. Adolescents assessed the fairness of various forms of government described briefly in writing.

Even in rural China, most 12- to 19-year-olds favored democratic decisions reached by a public vote or the consensus of elected representatives. In all settings, teens said that democratic systems ensure that the people have a "voice," let different segments of society contribute to decisions and give the public a chance to remove unpopular government officials.

Government rule by the wealthiest or most knowledgeable people was generally deemed to be unfair, especially by older adolescents.

Preferences for democratic rule develop everywhere, even if they are most obvious in Western societies, Helwig proposes. "Adolescents reflect on and evaluate forms of political organization in ways that go beyond official cultural ideologies," he says.

Necessary lies

Simply put, from childhood on, many people critically appraise their cultural values, says psychologist Elliot Turiel of UC Berkeley.

Not every individual in a culture shares the same assumptions about what counts as good and bad values, how to act around parents and other key issues, as has traditionally been assumed by anthropologists and psychologists, in Turiel's view. Instead, he argues, members of a culture try to balance sometimes-clashing beliefs about individual rights and social obligations.

Such tensions feed off each culture's tendency to give some groups power over others. Individuals who have limited clout — children relative to parents, wives relative to husbands in many societies, citizens relative to authoritarian rulers — often follow certain cultural practices simply to avoid the dire consequences of dissent, Turiel asserts. Opposition gets expressed in hidden, underground ways.

"Individuals often take the initiative to go against, or attempt to change, existing social conditions on the basis of what they see as morally right and wrong," Turiel says.

In an influential 1994 study, Turiel and a colleague interviewed husbands and wives in a Druze Arab community in Israel. In this male-dominated society, the large majority of wives regarded their unequal standing in marriages as unfair. Wives routinely said that they did their husbands' bidding only to avoid becoming impoverished by abandonment or divorce.

Other investigators have documented undercurrents of resentment about culturally enforced second-class status among women living in Egypt, India and Colombia. Some women reported carrying out elaborate plots to avoid participating in cultural practices that they disapproved of, such as arranged marriages and polygamy.

Honesty may be the best policy in general, but as these women illustrate, people willfully lie to prevent what they perceive as greater harms or to resist injustice, Turiel asserts. In these situations, moral concerns validate dishonesty.

Studies directed by Turiel indicate that U.S. teenagers and married couples label honesty as "good" in principle but see certain types of deception as justified. Most teens said it was OK to lie to get around parents' demands seen as morally unacceptable, such as staying away from peers of another race, or as invasions of a personal domain, such as directives not to date a certain person.

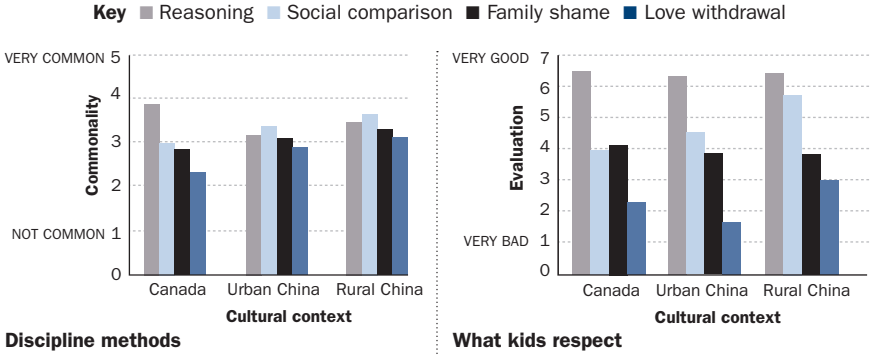
Husbands and wives generally judged it acceptable for either sex to lie in order to further personal welfare, such as a wife lying to her husband about attending an alcoholism support group because he thinks the sessions are useless. Lies about keeping a secret bank account and seeing friends on the sly were rated as more acceptable for wives than husbands, especially by women who worked outside the home. Those women may view such fabrications as necessary to preserve an equal status with their husbands, Turiel speculates.

Successful marriages from Beijing to Boise may thus maintain a delicate balance between morally inspired truth-telling and lying. As in parent-child relationships, spouses' moral decisions about honesty, rights and harm could well vary more from one situation to another than from one culture to another, Turiel concludes.

When it comes to making moral judgments, it may be a small world after all. ■

Cross-cultural values

Some of kids' earliest moral judgments come from interactions with parents. Parents in different nations favor different means of discipline, but kids judge those means similarly.



Discipline methods
Parents in China are more likely than Canadians to use shame or withhold love from kids.

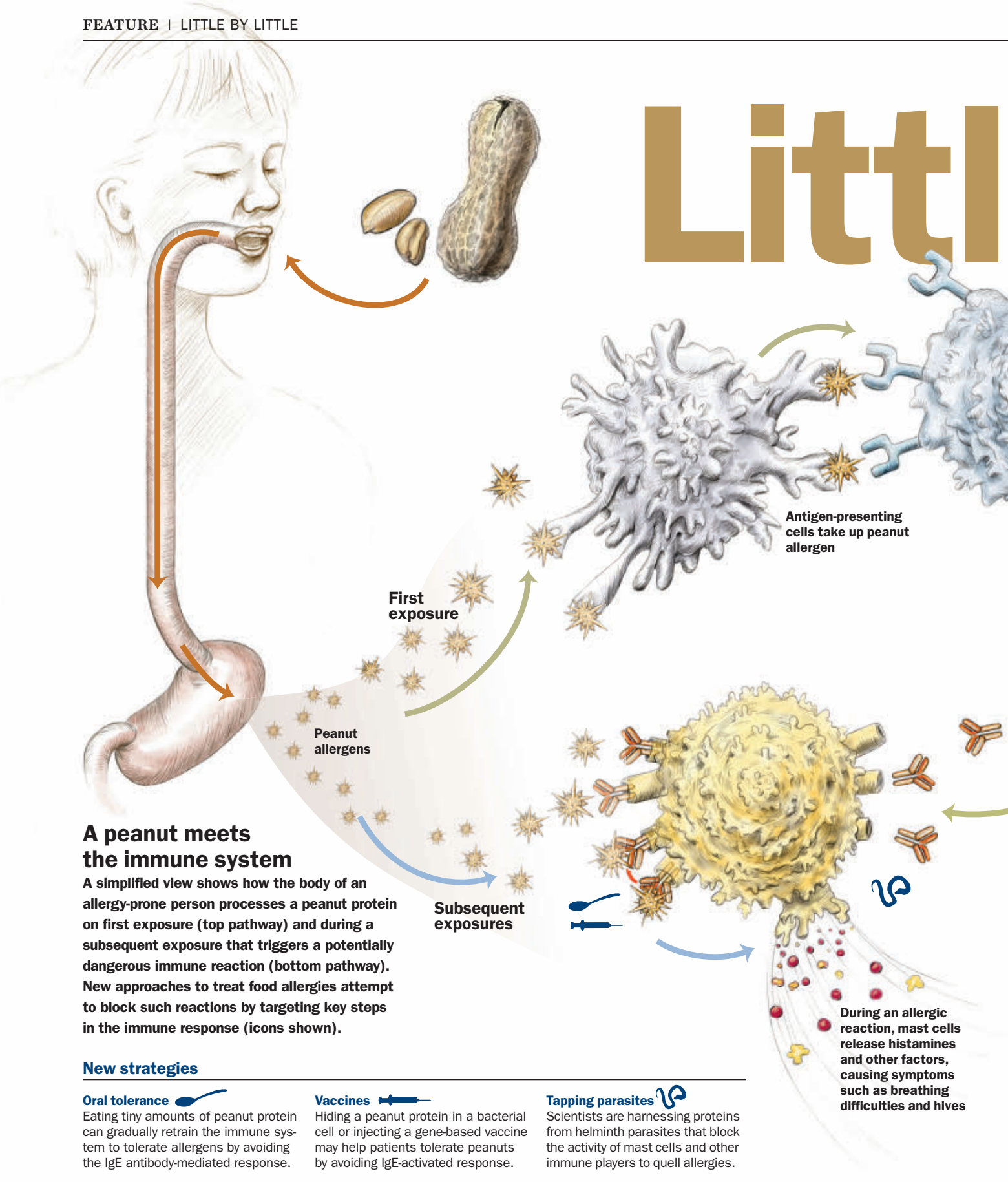
What kids respect
By age 10, kids in both Canada and in China prefer reasoning as the "good" way to parent.

SOURCE: C. HELWIG

Explore more

- Melanie Killen and Judith Smetana, eds. *Handbook of Moral Development*. Lawrence Erlbaum Associates, 2006.

Littl



A peanut meets the immune system

A simplified view shows how the body of an allergy-prone person processes a peanut protein on first exposure (top pathway) and during a subsequent exposure that triggers a potentially dangerous immune reaction (bottom pathway). New approaches to treat food allergies attempt to block such reactions by targeting key steps in the immune response (icons shown).

New strategies

Oral tolerance
Eating tiny amounts of peanut protein can gradually retrain the immune system to tolerate allergens by avoiding the IgE antibody-mediated response.

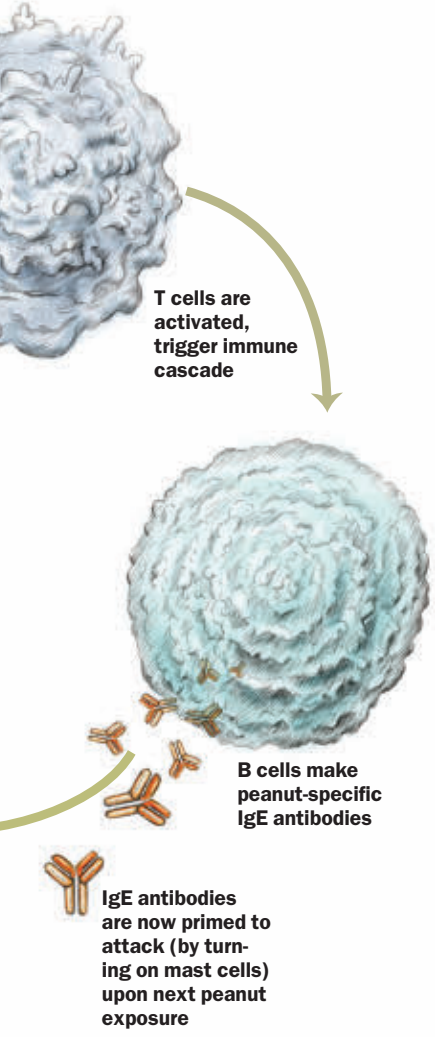
Vaccines
Hiding a peanut protein in a bacterial cell or injecting a gene-based vaccine may help patients tolerate peanuts by avoiding IgE-activated response.

Tapping parasites
Scientists are harnessing proteins from helminth parasites that block the activity of mast cells and other immune players to quell allergies.

e by Little

As food allergies proliferate, new strategies may help patients ingest their way to tolerance

By Laura Beil • Illustration by Nicolle Rager Fuller



Considering that food is full of foreign proteins, it makes sense that the intestine is the immune system's version of Grand Central station. It's the largest organ to regularly sweep up and annihilate molecules that don't belong. And because food comes from outside, it's no surprise that some people have allergies to it. The bigger mystery is why most don't. Somehow during evolution, the immune system and food components developed a secret handshake that allows munchables to pass without a fuss.

Most of the time, that is. Once relatively rare, serious allergies to peanuts, milk, shellfish and other foods appear to be afflicting a growing number of children. The U.S. Centers for Disease Control and Prevention reports that food allergies now affect about 4 percent of American children, almost 20 percent more than a decade ago. Scientists have ideas to explain the increase—from children raised with too few germs exercising their immune cells to modern food processing that alters natural proteins and adds nonfood substances never before consumed in large amounts. Some studies implicate the use of certain vitamins and even childhood obesity.

Despite the growing problem, doctors have had little to offer beyond advising patients to avoid allergic triggers. Recently, though, studies have raised hope that new approaches might one day treat food allergies and perhaps even prevent the next generation from developing them. "I think we're all encouraged that progress has happened relatively quickly," says Robert Wood of Johns Hopkins Children's Center in Baltimore. Nonetheless, he cautions, a true, effective therapy is still years away.

If nothing else, the experiments have shown for the first time that curing food allergies is at least possible, even if the long-term prospects aren't clear. Some children who began studies with immune reactions to even the smallest trace of peanut can now eat up to 13 nuts in one sitting. Similar dramatic gains have been seen for milk and egg allergies. Only a few children have been involved in each study so far, but researchers are cautiously increasing the number of enrollees and are emboldened to try other, more innovative methods.

"It's the beginning," says Andrew Saxon of UCLA's David Geffen School of Medicine. In a field with a history of false starts and disappointment, he says, "it's the *real* beginning this time."

Curing food allergies has been challenging, in part, because there are many ways to go wrong. No body process is simple, but the immune system is so terrifically complex that Nobel laureate Niels Jerne once likened it to a foreign language operating independently of

the brain. Immunity (or allergy, which is essentially immunity run amok) involves legions of cells that not only chatter back and forth at lightning speed each time they encounter something new, but also remember their conversations for a lifetime.

Simply speaking, when an antigen such as peanut protein passes through the digestive tract, it is first greeted by an "antigen-presenting" cell. This cell functions like a maître d', escorting guests to their table and alerting the waiter. The waiters — it's a fancy establishment, so there are more than one — are the T cells, which help the body recognize friend from foe. When food allergy develops, the T cells, instead of welcoming the peanut as the valued customer it is, initiate a process that alerts another type of immune cell, called a B cell. B cells make antibodies — the body's bouncers. In the case of food allergies, B cells start to make IgE antibodies, which when bound to a peanut protein summon mast cells. Mast cells come armed with chemical weapons. Substances released from mast cells, including histamines and cytokines, lead to the most frightening symptoms of food allergies: hives, vomiting and anaphylaxis, which can be deadly. Once the IgE antibodies are on patrol, the peanut protein finds itself on the blacklist, and will be violently ejected by security should it try to return.

Second chance for a first impression

Treatments for pollen, cat dander and other nonfood allergies can slowly refocus the immune system, starting with injections of antigen in amounts too minuscule to provoke IgE antibodies and gradually increasing the dose. In the presence of minute amounts of the antigen, immune responsibility gradually shifts back to the more friendly reception of T cells and antigen-presenting cells. The problem is, attempts in the 1980s to treat food allergies with shots produced severe, even life-threatening side effects. The risks from treatment exceeded the risks from the allergy itself. "With that, we quit trying for a while," says Wesley Burks of Duke University Medical Center in Durham, N.C.

Food Allergy Facts

Serving Size: U.S. Population

Children affected ≤4 years	**6–8%**
People affected ≥10 years	**4%**
Food-induced anaphylactic reactions per year	**30,000**
Percentage of ER visits for anaphylaxis food-allergy related	**34–52%**
Hospital admissions per year, food-allergy related	**2,000**
Deaths per year, food-allergy related	**200**
U.S. children affected ≤5 years by peanut allergy	**1%**
Total U.S. population affected by allergy to peanuts, tree nuts or both	**3 million**

COMMON FOOD ALLERGENS: FISH AND SHELLFISH SUCH AS SHRIMP, CRAYFISH, LOBSTER AND CRAB; EGGS; MILK; SOY; PEANUTS AND TREE NUTS SUCH AS WALNUTS.

RECOMMENDED TREATMENT: AVOIDANCE

HALF OF PEOPLE WITH FOOD ALLERGIES DEVELOP A REACTION AFTER ACCIDENTAL EXPOSURE OVER A 2-YEAR PERIOD

SOURCES: NIH, NIAID, BURKS/*THE LANCET* 2008

But as the number of children with food allergies began to rise, so did renewed interest in research. (The U.S. National Institute of Allergy and Infectious Diseases alone increased funding for food allergy studies from $1.2 million in 2003 to more than $13 million in 2008.) Allergy experts spooked by the results of early experiments began to consider new approaches, among them giving allergy treatment orally rather than by injection.

Burks and others had long thought that the problem with previous treatment attempts was the shots themselves. Research suggested that the immune response to food particles introduced by mouth was safer and more likely to lead to tolerance. In 2003, for example, researchers writing in the *New England Journal of Medicine* noted that British infants were more likely to have peanut allergies if their skin had been exposed to creams containing peanut oil, instead of a first exposure through food. Experts believe that the human body is more inclined to tolerate substances introduced through the mouth, precisely because the digestive system must deal with the large amount of outside proteins in food and with the colonies of bacteria that live peacefully in the gut. "Understanding oral tolerance has been recognized as a key component in developing strategies for preventing and treating food allergies," Burks writes in the August issue of *Current Opinion in Allergy and Clinical Immunology*.

So guardedly, and under intense medical supervision, he and his colleagues began giving children infinitesimally small amounts of peanut powder to swallow (mixed with food), and increasing the dose in halting increments. In the August *Journal of Allergy and Clinical Immunology*, the researchers report that after months of treatment, 27 of 29 severely allergic children were able to eat about 13 peanuts. The most common reactions during the treatment were sneezing, itching and hives. Molecular analysis also revealed clues to explain how oral tolerance therapy might dampen the allergic response. Tests of the immune cells in the treated children found that after the experimental therapy, T cells were more likely to contain genes active in cellular suicide, or apoptosis, a finding that "is novel and may provide insight into the mechanism of oral immunotherapy," the scientists write.

Tolerance to a T

Under the oral tolerance scenario, almost any food antigen could be a candidate for therapy. For example, in October 2008, Wood from Johns Hopkins and his colleagues released results of the first randomized trial using oral tolerance to treat milk allergy — a study of 20 children that 19 completed. At the beginning, no child could drink more than about one-fourth of a teaspoon of cow's milk without a severe immune reaction. Writing in the *Journal of Allergy and Clinical Immunology*, the scientists reported that four months after starting treatment, children were able to tolerate from 2.5 to 8 ounces of milk. A follow-up published online in the journal this August described the experiences of more than a dozen children who were able to continue to gradually increase their intake of milk. While the results are encouraging, the team also noted that

many of the children experienced side effects such as itching and hives that should be better understood before such a treatment becomes widespread.

Oral therapy isn't the only way scientists want to try to reeducate the immune systems of allergic children. For example, studies will soon be underway with a vaccine that encapsulates modified peanut proteins in *E. coli* bacteria. With the protein tucked inside a bacterium, researchers hope to sneak in under the IgE antibody radar, but still alert the nonallergic components of the immune system. "By altering the peanut proteins just a bit, but in very specific ways, it is hoped that the IgE will not as readily see the vaccine," says Scott Sicherer of Mount Sinai School of Medicine's Jaffe Food Allergy Institute in New York City. Other modifications should improve safety and effectiveness, he says.

Meanwhile, the idea of giving food-allergy shots has even been revived. UCLA's Saxon is trying to develop a genetic food-allergy vaccine — injecting not the peanut protein this time, but the gene that codes for it. The idea is to slip the gene into the maître d'/antigen-presenting cells and coax those cells to make the peanut protein. If the antigen-presenting cells produce the peanut protein robustly enough, the responsibility for the immune response might shift away from the IgE antibodies and mast cells.

"The idea of gene vaccines has been around a long time," Saxon says. "The biggest bugaboo is getting it where you want." If the introduced gene doesn't find the correct cell, the protein won't get made, or it won't get made in the right place. However, in July, he and his colleagues described a molecule they believe can deliver the gene straight to the antigen-presenting cells. The idea is still being tested in mice.

Promise from parasites

Other future strategies take lessons from the past, by considering the origin of food allergies. Studies have long suggested that such allergies are a wayward version of the immune reaction to infection with human parasites such as helminths, the worms that cause river blindness, elephantiasis and other diseases. "If you study people in those countries where there are normally multiple parasites, the incidence of allergy is very low," says Marie-Hélène Jouvin of Beth Israel Deaconess Medical Center in Boston. Yet when children are treated for parasites, she says, the tendency for allergy rises.

Parasites survive by manipulating the immune system to grudgingly allow their presence. Since a helminth attaches itself to the inside of the intestine, the parasite's survival depends on creating a tolerant environment inside the body. One tactic was revealed in 2007: A research team led by scientists from the University of Strathclyde in Glasgow reported in *Nature Medicine* that a substance isolated from a helminth was able to disarm mast cells.

Jouvin and her colleagues hope to soon receive approval to study a kind of oral therapy that might mimic the natural protection from food allergies that follows a parasitic infection. Using helminth eggs, researchers hope to test a treatment designed to trick the immune system into reacting as if it were accommodating a parasite (minus the actual worm), and tempering the mast cell response.

The helminth experiments would also be consistent with the "hygiene hypothesis," one of the leading theories to explain the rise in the prevalence of allergies — that children raised in the indoor, antibacterial age lack the exposures to antigens of their ancestors, and so the children's immune systems don't always develop as nature intended. "Children are born with an immune system that is immature," Jouvin says.

Other clues, too, point to food allergies as a consequence of an immune system too bored in early life. Parents are often advised to avoid giving children foods that are particularly prone to causing allergies for about the first year of a child's life. But many studies are questioning that conventional wisdom, including one described late last year in the *Journal of Allergy and Clinical Immunology*. Researchers examined the prevalence of allergies among Jewish children in Israel and Great Britain, finding that the British elementary school children had almost 10 times the risk of peanut allergies (*SN: 12/6/08, p. 8*). The biggest difference in diets? Israeli children are fed peanuts earlier and more frequently than British children. The researchers also note that in the Middle East, Asia and Africa, peanuts are generally consumed in infancy and peanut allergies are uncommon.

"Our findings raise the question of whether early and frequent ingestion of high-dose peanut protein during infancy might prevent the development of peanut allergy," wrote an international research team funded in part by the National Peanut Board. "Paradoxically, past recommendations in the United States and current recommendations in the U.K. and Australia might be promoting the development of peanut allergy." Some countries, such as Sweden, have now abandoned the advice to avoid the introduction of certain foods early in life.

American doctors remain wary about early exposure to allergy-prone foods, believing the information still isn't conclusive enough to change official recommendations. "We will do the same things we've been doing until the ongoing studies have given us better guidance," Burks says. In particular, doctors are awaiting the results of a large study underway in Great Britain, in which children are being randomly assigned to eat peanuts in infancy or avoid them until later (for more information, see www.leapstudy.co.uk). Only when these and other studies conclude will experts know whether the secret weapon against food allergies ultimately lies in the culprit itself. ■

Laura Beil is a freelance science writer in Cedar Hill, Texas.

Explore more

- A. Wesley Burks. "Peanut allergy." *The Lancet*, May 3, 2008.
- S.M. Jones *et al*. "Clinical efficacy and immune regulation with peanut oral immunotherapy." *Journal of Allergy and Clinical Immunology*, August 2009.

the status Quark

Murray Gell-Mann reflects on matter's building blocks and scientists' resistance to new ideas

By Tom Siegfried

When in the course of scientific events it becomes necessary to dissolve allegiances to established beliefs, you can expect to face a lot of flak.

New scientific ideas, the German physicist Max Planck once observed, triumph not because of the power of reason, but because their opponents eventually die. It was perhaps a slight exaggeration. But it certainly reflects the spirit of scientific conservatism infused in the textbooks, journals and academic departments that impose disciplinary consensus on students and their teachers. Science's methods are so powerful, its defenders sometimes contend, that views contrary to current consensus are too likely to be wrong to be taken seriously.

Nobody understands this pressure from the scientific establishment better than Murray Gell-Mann, the Nobel laureate physicist who identified quarks as the ultimate building blocks of most earthly matter. Gell-Mann, who turns 80 on September 15, has witnessed resistance to many groundbreaking advances during his long career, including some of his own.

"Most challenges to scientific orthodoxy are wrong," he emphasizes. "A lot of them are crank. But it happens from time to time that a challenge to scientific orthodoxy is actually right. And the people who make that challenge face a terrible situation."

Take quarks, proposed by Gell-Mann in 1963 as the constituents of protons, neutrons and certain other subatomic particles. "A lot of people thought the quarks were a crank idea," Gell-Mann said in an interview last month during a visit to the Institute for Advanced Study in Princeton, N.J.

As it turned out, though, quarks signified one of the deepest insights into the nature of matter since the prescient reflections of the ancient Greek atomists. Many scientists have tried, but so far none have succeeded in digging more deeply in seeking matter's ultimate constituents. One recent paper, for instance, proposes that quarks and electrons alike are composed of more basic entities named "spinons." Older suggestions invoked "preons." So far neither their names nor the evidence for them matches that of quarks. More than four decades after Gell-Mann conceived them, quarks retain their standing as the indivisible building blocks of every known tangible substance.

Sure, electrons buzz about and orchestrate the curiosities of chemistry, but quarks are responsible for more than 99.9 percent of ordinary matter. No example provides better reason to beware of blind dismissals of novel ideas. And no story better illustrates the power of science to deduce aspects of reality deeply hidden from human senses.

Atomic deconstruction

In the ancient days of science's infancy, great thinkers pondered deep questions about matter—such as how finely it could be sliced and diced. One group of Greeks proclaimed that matter could be cut only so much before reaching a limit they labeled with the alluring term *atomos*—uncuttable.

Millennia later, chemists and physicists built their sciences upon the foundation provided by the idea of "atom." But the triumph of atomism unveiled a confusion. As it developed, the Greek notion of "atom" contained two different concepts. On the one hand, it meant the smallest unit of a substance. On the other, it was supposed to mean unsplittable. But those turned out not to be the same thing. Atoms are indeed the smallest units of the chemical elements, but can (very dramatically) be split.

A century ago, physicists had realized that atoms have parts and were on the verge of figuring out atomic architecture. Ernest Rutherford's assistants had witnessed alpha particles bouncing off a thin sheet of gold foil—as astounding,

Quarks in the news

Science News has reported on the evolution of Murray Gell-Mann's unorthodox proposal for the ultimate building blocks of matter from its earliest days.

1964

Gell-Mann publishes a paper in *Physics Letters* that introduces "quarks" as fundamental particles making up protons, neutrons and various other particles. Gell-Mann identified three quarks labeled u, d and s (for up, down and strange). At about the same time physicist George Zweig independently develops similar ideas, calling the fundamental particles "aces."

Nuclear Zoo Minus 'Quarks'

THE NUCLEAR zoo is missing its "quarks," a California physicist believes.

A quark is not an animal out of Alice in Wonderland or the sound a duck might make. It is a made-up word used by the late James Joyce and now borrowed by a physicist to describe a particle he believes should exist in the nuclear zoo.

Dr. Gell-Mann thought that the truly basic building blocks of the universe might be three closely related particles he calls quarks.

An experiment recently concluded at Brookhaven National Laboratory by physicists from Brookhaven and Yale University has shown that elementary particles with a charge only a fraction as large as an

Partons

One of the ways in which physicists try to discover how protons are constructed is to bombard them with other particles. Experimental evidence now indicates that in some kinds of collisions, the impinging particles interact with only a part of the proton.

Such parts of a proton, called partons, appear to have the characteristics of particles, and the characteristics of the partons are not necessarily those of the whole proton. In other words it seems as if the proton, instead of being a simple particle, is actually more like an atom, being composed of a number of subsidiary entities whose properties add up to make those of the proton.

Since physicists already have a theory in which protons, like all other particles, are made up of ultraelementary objects called quarks, some theorists, says Dr. Emmanuel Paschos of the Stanford Linear Accelerator Center, have applied the quark theory to the parton situation to see whether the partons could be quarks.

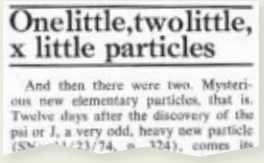
The evidence is still inconclusive, he says, but if partons were quarks, the quark theory would have to be

Late 1960s

Evidence that protons and neutrons contain pointlike particles (later identified as quarks and gluons) emerges from experiments at the Stanford Linear Accelerator Center.

1973

David Gross, Frank Wilczek and independently H. David Politzer develop the concept of "asymptotic freedom," which explains why quarks are unable to escape from within nuclear particles.



One little, two little, x little particles

And then there were two. Mysterious new elementary particles, that is. Twelve days after the discovery of the psi or J, a very odd, heavy new particle (SN: 11/23/74, p. 324), comes its

1974

Discovery of the J/psi particle confirms the predicted existence of a fourth quark, labeled "charm."

SCIENCE NEWS OF THE WEEK

Upsilon and the Fifth Quark: A He

1977

Experiments at Fermilab discover a fifth quark, designated "bottom."

Extra data bolster top quark discovery

1994/1995

Fermilab physicists report evidence favoring the existence of the "top" quark (1994) and confirm its discovery (1995).

Rutherford later said, as tissue paper repelling artillery fire. He soon figured out that the alpha particles had encountered atomic nuclei, the specks in the center of every atom occupying almost none of the space but concentrating almost all of the mass. Scientists spent the next half century tearing the nucleus apart in search of matter's ultimate constituents.

By the 1950s, those efforts had produced perplexity. Atomic nuclei contained two types of particles, or nucleons: the proton and the neutron. Observations of cosmic rays and experiments with atom smashers, though, disclosed numerous other seemingly basic particles, with weird names like pion, lambda, delta and sigma, threatening to exhaust the Greek alphabet. Enrico Fermi famously muttered that he might as well have been a botanist if he had to remember so many odd names.

Amidst that chaos, Gell-Mann saw a pattern. In 1961 he (and independently, Yuval Ne'eman) perceived an analogy between some arcane mathematics and the properties of the known particles. Gell-Mann sorted the particles into tables, reminiscent of the periodic table of the chemical elements devised by the Russian chemist Dmitri Mendeleev almost a century earlier.

Just as Mendeleev had predicted the existence of previously unknown elements based on gaps in his chart, Gell-Mann forecast the discovery of new particles. As certain classes of particles came in groups of eight, he called his system "the eightfold way," although subsequent comparisons to Eastern mysticism annoyed him. "I meant it as a joke," he once proclaimed.

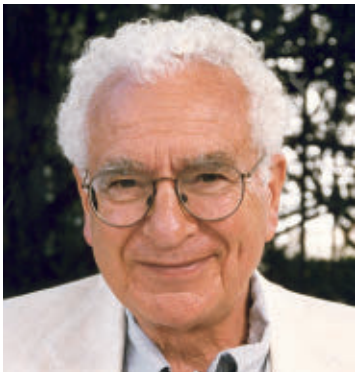
Mendeleev's periodic table accomplished much more than predicting new elements. It also served as an early warning sign that atoms were not indivisible. His table showed that when listed in order by weight, atoms displayed patterns in their properties: columns in the table contained families of similar elements. Such a repetitive pattern of properties suggested that atoms within a column possessed arrangements similar to others in their family—implying that there were some internal parts to arrange. In much the same way, the regularities in Gell-Mann's tables implied deeper structure in nature's basic particles.

At the time, many physicists believed that the proton, neutron and cousin particles might all be equal partners in a conspiracy to create themselves. In other words, no one particle was truly basic—each was a combination of some of the others (perhaps even including itself). This "bootstrap" principle avoided the need to declare any one particle the ultimate chip off the atomic block.

Gell-Mann, though, found what he described in a 1964 paper introducing quarks as a "simpler and more elegant scheme." All the relatives of protons and neutrons in the subatomic zoo, including the proton and neutron themselves, could be explained as composites made from three basic building blocks. Each had its own label: u, d and s, for up, down and strange. He chose the name quark (the squawk of a gull) from a line in James Joyce's *Finnegans Wake*: "Three quarks

for Muster Mark." (Independently, the physicist George Zweig suggested a similar idea, calling the building-block particles "aces." Not quite as catchy a name.)

Quarks challenged orthodox physics on several levels, violating at least three prevailing principles. "One of them was that the neutron and proton were elementary — they were not composed of anything simpler," Gell-Mann said during the Princeton interview. Second, quarks had to be permanently trapped inside observable particles, also defying beliefs held by many physicists. "That was a crazy idea, they thought," he said.



Physicist Murray Gell-Mann, who developed the concept of quarks, turns 80 this month.

Third, quarks possessed the awkward property of fractional electric charge, something never observed (even to this day) for a subatomic particle. All observable charged particles possess some integral multiple of the charge on an electron, the smallest unit of charge that nature offers. "The idea of particles with fractional charges — that was considered to be a crank idea too," Gell-Mann said. "So the quarks had three strikes against them, from these three principles — all wrong, of course."

Quarks proliferate

Over the years, support for the quark idea grew, though, even as Gell-Mann's original elegant picture became somewhat more complicated. A new particle discovered in 1974 implied the existence of a fourth quark, called charm (a sort of partner for the strange quark, just as up partnered with down). Three years later evidence turned up for another quark. This one was called bottom, naturally requiring a sixth quark — the top — not definitively discovered until 1995.

Most experts today doubt there will be any more quarks. But nobody can say for sure that quarks themselves will forever reign as the ultimately unsplittable units of matter.

"So far nothing has pointed in that direction, of another layer of constituents underlying the quarks," Gell-Mann says. "But you can't rule it out completely, of course. We know that the present theory, the standard model, is a low-energy approximation of some kind to a future theory, and who knows what will happen with a future theory?"

Lack of evidence for quark parts doesn't prevent people from investigating the possibility, though. One new scheme, for instance, describes particles that could combine to make not only quarks but also leptons — the electron and its relatives — and bosons, the particles that carry forces governing interactions between other particles.

In a recent paper describing this idea (arxiv.org/abs/0907.2538), Eckart Marsch of the Max Planck Institute for Solar System Research in Germany calls such all-purpose building blocks "spinons." Using mathematical symmetry principles similar to those underlying quarks, he shows how spinons and their antimatter counterparts could combine to create particles resembling the known quarks, leptons and bosons.

Three spinons, for example — two of one kind, one of another — could make particles with electric charge of +2/3, like the up quark, or -1/3, like the down quark. Other combinations of three spinons would reproduce the properties of electrons and their cousins. Unions of two spinons could produce bosons such as the W particles responsible for transmission of the weak nuclear force. One combination of two spinons even reproduces properties expected of the hypothetical Higgs boson, about to be the subject of an intense search at the world's newest atom smasher, the Large Hadron Collider at the CERN laboratory on the outskirts of Geneva (*SN: 7/19/08, p. 16*).

Past suggestions about composite quarks have failed when tested by experiment, and no one would be surprised if the spinon idea also fails to overturn the scientific consensus.

Language barriers

Gell-Mann, meanwhile, remains active in research at the Santa Fe Institute in New Mexico, where he continues to pursue ideas that are sometimes at odds with establishment views. He is particularly interested in linguistics, for instance, and collaborates with researchers at Santa Fe and in Moscow studying distant (in time) relationships among human languages.

"In that collaboration we seem to be finding more and more evidence ... that a very large fraction of the world's languages, although probably not all, are descended from one spoken quite recently ... something like 15,000 to 20,000 years ago," Gell-Mann says.

Language surely originated much earlier than that, he says, but most languages still around today may have descended from this mother of (nearly) all mother tongues, tentatively labeled Borean (as in "the north wind").

Of course, many experts resist the idea.

"For some reason, in this country and in Western Europe, most tenured professors of historical and comparative linguistics hate the idea of distant relationships among human languages, or at least the idea that those can be demonstrated," Gell-Mann says. "They put a tremendous burden of proof on anyone who wants to say that languages are related in this way, by this common descent." And so once again Gell-Mann faces what he calls the "negative principles of the establishment."

"Eventually I think everybody will be convinced that these relationships really exist," he says. "In the meantime, we're fighting one of these battles." And just as there's no evidence of constituents of quarks, there's no evidence that Gell-Mann will stop fighting such battles anytime soon. ■

T. SIEGFRIED

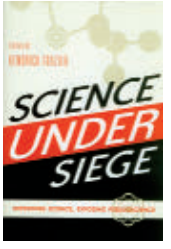
Science Under Siege: Defending Science, Exposing Pseudoscience

Kendrick Frazier, ed.

Scientific literacy has taken a hit. Facts are absent or distorted by spin doctors, leaving people to flounder when interpreting complex issues, writers argue in this new collection of essays. Edited by former *Science News* editor Kendrick Frazier (now editor of *Skeptical Inquirer*), these engaging, insightful and often surprising essays by researchers and journalists describe what science is and is not, and what happens when the facts get twisted.

"Discovering new evidence about nature is what science is all about," Frazier writes, but public discourse rarely involves such evidence. Clear, fact-based evidence should trump emotional, vitriolic attacks concerning flash point issues like the creationism-evolution debate, the antivaccine movement and global warming, the essays argue.

The writings are loosely divided into three sections: science and skepticism, current scientific controversies and examples of pseudoscience. Some pieces breezily poke fun at pseudoscientific breakthroughs, including "electrically activated" oxygen water and healing magnets, both purported to cure just about everything. Other essays describe frightening true scenarios: A piece by former *Scientific American* columnist Martin Gardner describes how errant mental health workers in the 1980s and '90s manipulated children's memories through methods including hypnotism, leading to a slew of false molestation accusations.



Although the essays cover various topics and range from technical to conversational in tone, the overarching message is clear: Any claim, evidence-based or otherwise, must be met with a healthy dose of skepticism that comes only from a scientifically literate perspective. —*Laura Sanders*
Prometheus Books, 2009, 370 p., $21.98.

Spycraft: The Secret History of the CIA's Spytechs, from Communism to Al-Qaeda

Robert Wallace and H. Keith Melton with Henry Robert Schlesinger

Most spy stories star a James Bond–like figure, but the tales of espionage in *Spycraft* feature behind-the-scenes technologists more akin to Q, Bond's gadget guru. The authors describe how CIA scientists and engineers developed technologies that have shaped U.S. intelligence since the late 1950s.

Drawing from interviews with spies and gadget engineers, the story moves from the early Cold War spy technology to the antiterrorism efforts and cyberspies of the 21st century. Along the way, the authors describe spectacular ideas that never got off the ground, such as collapsible rubber airplanes that could lift a man out of a jungle and depilatory cigars to rid Fidel Castro of his "macho" beard.

But there were also triumphs of technology that resulted in intelligence coups, like a fountain pen camera used by a Soviet diplomat to photograph documents for the U.S. government.

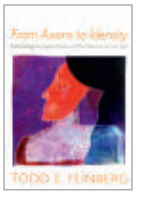
Spycraft also details battles within the CIA over technology's role. At first, many agents did not see the value of investing in technology, the authors explain, but by the late 1960s both engineers and their gadgets had become an integral part of the spy trade.

Historical photographs—some even taken by CIA-designed cameras—and diagrams of devices supplement these exciting stories. Though the topic is technical, the engaging tales make this a fun read for anyone interested in espionage. —*Jenny Lauren Lee*
Plume Books, 2009, 548 p., $18.

Finding the Big Bang

P. James E. Peebles, Lyman A. Page Jr. and R. Bruce Partridge, eds.

A collection of essays details the initial discovery of the cosmic background radiation and the development of cosmology. *Cambridge Univ., 2009, 596 p., $72.*



From Axons to Identity: Neurological Explorations of the Nature of the Self

Todd E. Feinberg

A neuroscientist considers the intimate relationship between the brain and sense of self. *W.W. Norton & Co., 2009, 304 p., $25.95.*

The Spirit of Invention

Julie M. Fenster

A historian explores the role of innovation in American history, illustrated with archival photos and news clippings. *Smithsonian Books/Collins, 2009, 256 p., $29.99.*

Poseidon's Steed: The Story of Seahorse, from Myth to Reality

Helen Scales

A marine biologist distinguishes fact from fiction about these famous and elusive fish. *Gotham Books, 2009, 254 p., $24.*

What Bluebirds Do

Pamela F. Kirby

Young readers can learn basic facts about the life history and ecology of these familiar backyard birds. *Boyds Mill Press, 2009, 48 p., $18.95.*

How to Order To order these books or others, visit www.sciencenews.org/bookshelf. A click on a book's title will transfer you to Amazon.com.

Philosophers strike back

As someone who has taught philosophy of science and history of science for 30 years, I must take exception with Tom Siegfried's editorial, "Philosophers don't know what scientists can't do" (*SN: 7/18/09, p. 2*). Of course, they don't! But neither do scientists! Immanuel Kant and Auguste Comte were just as wrong about many things as their scientific contemporaries were. Categorical claims about the nature of the world and the nature of knowledge are risky and, as we know, often mistaken, but this is not the province of philosophers only.
David Boersema, Forest Grove, Ore.

Science News is my favorite journal of new observations and theories, and your weekly editorial is frequently my first stop. Your editorial, "Philosophers don't know what scientists can't do," was exceptionally provocative. One might argue the subject ad nauseam.

Kant's proclamation *was* disproved (according to current orthodox beliefs), yet Einstein could not have arrived at his conclusions without a philosophical outlook permitting him to think outside the box. Many forget Einstein's struggle to be heard before his star ascended. The orthodox beliefs of the time categorically rejected his theories.

Today we face the same pigheadedness Einstein faced from those who now insist dark matter exists because galaxies would fly apart without its added gravitational attraction. In counterpoint to your editorial I suspect, "Scientists can't progress without philosophers to question their reasoning." Ignorance frequently dismisses empirical evidence, but it can also misinterpret it. Philosophers and scientists need each other, whether they like it or not.
Marc Kramis, Boise, Idaho

As a philosopher and a scientist, we were astonished and then appalled to read "Philosophers don't know what scientists can't do." Leaving aside the gratuitous hostility of the opening sentence ("Among many scientists, philosophers are regarded with suspicion, or even disdain"), the examples Siegfried brings to support his position are misreadings of philosophical tracts.

Kant, for example, when stating that "space must of necessity observe the rules of Euclidean geometry" was not concerned with space independent of human perception. He distinguished between the phenomena (appearances) and the noumena (essentially reality). Kant was making a point about how we perceive the natural world and not a claim about reality itself.

Similarly, Siegfried did not understand Comte's apparent claim that we shall never know the composition of stars. In fact, in the very next sentence Comte wrote, "Whatever knowledge is obtainable by means of the sense of Sight, we may hope to attain with regard to the stars, whether we at present see the method or not." Clearly this covers the later discoveries through spectroscopy and much else. His point was the limit of the senses, not the limits of technology or knowledge.

Too often we forget that foundational questions in science have a philosophical component, and that philosophers of science help create that structure in discourse with scientists. Editorialists in a widely read and respected science magazine should know better than to publish naïve impressions of what philosophers do and how they do it.
Henry B. Kreuzman and
Mark A. Wilson, Wooster, Ohio

We are gratified that some philosophers read Science News *(including the editor's letter) and welcome expressions of other viewpoints. Certainly some philosophers have provided insightful observations about science and scientific methodology, even if much of the value of philosophy is derided by some scientists. As for the ex post facto defenses of Kant and Comte, though, their claims have been widely interpreted to be erroneous. Kant's claim about the necessity of Euclidean space was supposedly an example of synthetic a priori "knowledge" (presumably about reality). I confess that it had not occurred to me to interpret Comte's second sentence as contradicting the previous one, or that he somehow predicted the development of spectroscopy. In any event I first encountered these examples in a philosophy course (taught by a philosopher) as examples of famous philosophical errors. — Tom Siegfried*

Pedantic but curious

I'm not normally this pedantic (OK, yes I am), but a phrase in "The star that ate a Mars" (*SN: 7/18/09, p. 22*) startled me. The planet's remains were said to be bobbing in the "thin but dense" atmosphere of the white dwarf. Is the atmosphere also "hot but cold" or "black but white"?
Gary Crockett, Chevy Chase, Md.

Thin refers in this case to dimension, not degree of density. A white dwarf's gravity pulls its atmosphere into a very thin layer on its surface — some say if Earth-type skyscrapers could exist there, they would stick through the layer into the near-vacuum of space. But the atmosphere is very dense. Another way to think of it: No matter how thin you pound a lump of lead with a hammer, it is still lead — and dense. — Charles Petit

Correction

The article "Shaky forecasts" (SN: 8/29/09, p. 26) begins with a description of Jeff McGuire's work predicting an earthquake on the floor of the Pacific Ocean. The phrasing that the quake happened within 30 kilometers of a predicted location was misleading. The center of the quake occurred within 10 kilometers of the predicted location. The seismometers were deployed along 30 kilometers of the fault. — Kristina Bartlett Brody

Send communications to:
Editor, Science News
1719 N Street, NW
Washington, D.C. 20036
or **editors@sciencenews.org**
All letters subject to editing.

Murray Gell-Mann

For more Comment, visit COLUMNS at **www.sciencenews.org**

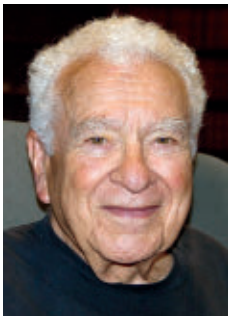
A place removed from 'the pressure of received ideas'

Murray Gell-Mann, winner of the 1969 Nobel Prize in physics for his work on elementary particles (see Page 24 in this issue), was one of the originators of the Santa Fe Institute, an interdisciplinary research center in New Mexico that is celebrating its 25th anniversary this year. Gell-Mann recently addressed a group of about 150 high school students gathered at the Institute for Advanced Study in Princeton, N.J., for Adventures of the Mind, a biennial summit for academically outstanding 15- to 18-year-olds. Gell-Mann described the origins of and philosophy behind the Santa Fe Institute's approach to science. Tom Siegfried, Science News' *editor in chief, excerpted Gell-Mann's remarks.*

A group of us who were connected with the government lab at Los Alamos, either as consultants or employees, 27 or 28 years ago, used to meet and talk about starting a theoretical institute. The place we wanted it to be was Santa Fe.... We thought it would be an ideal location. People sometimes ask why we didn't set it up across the street from Harvard or Stanford or Berkeley, and I think actually it was a good idea not to do that. Because of the pressure of received ideas. If you say something new at Harvard, you will get a lot of discouraging responses: "I already did that and decided it was wrong." "That's been considered carefully by lots of people and it doesn't show any promise." ...

This pressure of received ideas at standard places is very severe. We [at Santa Fe] are free of that. Also, we get the same wonderful, brilliant visiting lecturers that they do, only in our case they talk to 15 people instead of 3,000. That makes it a much more intimate experience.

We fixed on certain principles in starting the Santa Fe Institute. One of them was that we would do mainly or entirely theoretical work.... We would try to aim for important subjects, interesting results. In fact, ideally we would be working toward a grand synthesis, like the grand synthesis represented by the genesis of the chemical elements in stars in the early universe, by the biological synthesis of genetics and evolution, or the other remarkable unifications like, for example, the standard model of elementary particle physics.... In geology you had plate tectonics, which represents a very general similar example. We were looking for something like that, but we didn't know where to look. We didn't know exactly how to set it up even.



We fixed on certain principles in starting the Santa Fe Institute.... ideally we would be working toward a grand synthesis.

We thought first of having our own graduate students, but then we decided that was probably not a good idea, because in order to get recognition for our degrees we would have to get teachers to teach a lot of standing courses, and pretty soon we'd be back in the university. So we decided not to do that. But we had graduate students, lots of them, and we've even had undergraduates from time to time, but they're not ours, they're other people's....

What do we work on? Well, mostly it turns out from our founding seminar, 25 years ago, that an interesting set of subjects that might lead to a grand synthesis are those connected with simplicity and complexity, regularity and randomness. Evolution, learning, adaptation. All of these things form a kind of universe of problems that may indeed someday lead to a grand synthesis.

The way we operate is to be completely transdisciplinary. Problems are worked on without any regard for what field they originally come from. It doesn't matter what they started out being. That's quite different from what happens at most universities, where you have departments and textbooks and professional societies and sections of granting agencies all dividing people up into special compartments. We didn't have any of that. The research is done by voluntary associations of people. They come together and decide that there's something interesting that they can all contribute to. One of them, at least, should know something about the subject. But it's not necessary that they all do. They can contribute their own expertise and their own ways of thinking and their own models. And it seems to work very well. It's also a delight to be there. It's so exciting to watch these ideas bubbling up from the bottom, not being imposed from the top....

We have no objection to the existence of all the specialized departments and publications and societies and so on. Specialization in science and even in the humanities is something that's necessary, desirable and keeps going on, with subspecialization and sub-sub-subspecialization and so forth. And it's all good. It needs to be supplemented, by other kinds of association. And we have one example at the Santa Fe Institute. ■

T. SIEGFRIED

© Andrew Gunners/Digital Vision/Getty Images.

Understand Islam and Its History

How familiar are you with the world's second-largest and fastest-growing religion? Many people in the West know little about Islam—with its more than 1.2 billion adherents worldwide—and are familiar only with the actions of a minority of radical extremists. **Great World Religions: Islam** helps you better understand Islam as both a religion and a way of life.

In 12 illuminating lectures, award-winning professor, international consultant, and expert Islamic scholar John L. Esposito of Georgetown University takes you through Islamic history from the 7th to the 21st centuries. You explore Muslim beliefs and practices in the context of its impact on Muslim life and society through the ages, as well as world events today. You also examine how and why Muslims came to Europe and America; the issues of faith, identity, and integration that face Muslims in their homelands; and how this great world religion grapples with these challenges.

This course is one of The Great Courses®, a noncredit, recorded college lecture series from The Teaching Company®. Award-winning professors of a wide array of subjects in the sciences and the liberal arts have made more than 300 college-level courses that are available now on our website.

Great World Religions: Islam

Taught by Professor John L. Esposito, Georgetown University

Lecture Titles

1. Islam Yesterday, Today, and Tomorrow
2. The Five Pillars of Islam
3. Muhammad—Prophet and Statesman
4. God's Word—the Quranic Worldview
5. The Muslim Community—Faith and Politics
6. Paths to God—Islamic Law and Mysticism
7. Islamic Revivalism—Renewal and Reform
8. The Contemporary Resurgence of Islam
9. Islam at the Crossroads
10. Women and Change in Islam
11. Islam in the West
12. The Future of Islam

Order Today!
Offer expires Wednesday, November 11, 2009

Great World Religions: Islam
Course No. 6102
12 lectures (30 minutes/lecture)

DVDs ~~$199.95~~ **NOW $39.95**
+ $5 Shipping, Processing, and Lifetime Satisfaction Guarantee

Audio CD ~~$134.95~~ **NOW $24.95**
+ $5 Shipping, Processing, and Lifetime Satisfaction Guarantee

Special price for shipping, processing, and lifetime satisfaction guarantee for this offer only.

Priority Code: 33333

ACT NOW!

1-800-TEACH-12
www.TEACH12.com/9sn

The Teaching Company®
The Joy of Lifelong Learning Every Day™
Great Professors, Great Courses, Great Value Guaranteed.™

VOL. CLVII....No. 20,000 **The Springfield Ledger** "It's About Time"

Recently Discovered....

150-Year-Old Mystery of the Lincoln Watch Solved

The secret close to Abe Lincoln's heart is now part of history.

High drama at the Smithsonian. With a screwdriver in his talented hands, wearing a pair of jeweler's goggles, master watchmaker George Thomas puts a historical mystery to rest after almost 150 years: Did a watch repairman really engrave a secret message on Abraham Lincoln's pocket watch on the day the Civil War began? Abraham Lincoln stowed this watch in his vest pocket, close to his heart. Now at the Smithsonian Museum, it has been rumored to carry a secret message, allegedly written by Jonathan Dillon in 1861. With cameras from NBC's *Today Show* rolling, George Thomas, finally opened the back to reveal the underside of the watch movement.

"The moment of truth has come," he said. *"Is there or is there not an inscription?"*

George hands the watch to the great-great grandson of Jonathan Dillon to do the honors. The inscription read, *"Jonathan Dillon April 13 -1861 Fort Sumter was attacked by the rebels on the above date J Dillon April 13-1861 Washington thank God we have a government Jonth Dillon."*

As seen in... NY Times, CNN, USA Today and the Washington Post

The **George W. Chatterton™ Watch Company** today announces the release of the ***Lincoln Watch*** to bring history's mystery to life. The design of the ceramic dial is painstakingly recreated in detail and even the replication of the mysterious engraving on the back of the movement is included for your inspection. The design of the historic hands is especially rare. The movement employs vintage-styled manual winding with 20 jewels and the case is 14k gold-fused and matches the color of the original exactly.

The original has been in the safe custody of the Smithsonian Institution since 1958, but you can own your own Lincoln watch made by George Chatterton with the secret inscription from history.

Limited edition on history. America's fascination with Lincoln is exceedingly high in 2009, the 200th anniversary of his birth. To celebrate, we're offering the ***Lincoln Watch*** with a 30-day purchase price back guarantee. **The George W. Chatterton™ Watch Company** has set a strict limited edition and Stauer is the only place that you can find this piece of history.

WATCH SPECS:
- 14k gold-fused case with manual wind movement
- Hunter's back with inside inscription
- Croc-embossed leather strap
- Water resistant to 3 ATM - Fits a $6\frac{3}{4}$"–$8\frac{3}{4}$" wrist

The Chatterton *Lincoln-Dillon* Watch
MSRP ~~$499~~ ***Now $199*** +S&P ***Save $300***
Call now to take advantage of this limited offer.

1-888-324-1886

Promotional Code LNW140-01
Please mention this code when you call.

Stauer
14101 Southcross Drive W.,
Dept. LNW140-01
Burnsville, Minnesota 55337
www.stauer.com