



Infoteca's E-Journal



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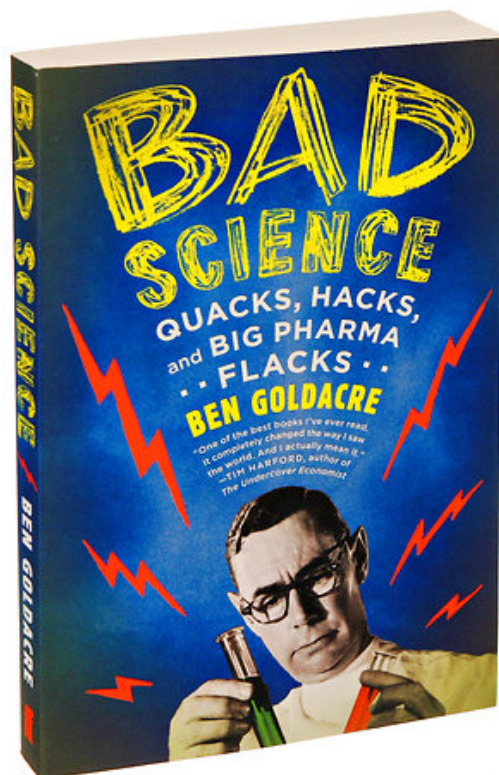
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Wrapped in Data and Diplomas, It's Still Snake Oil

By KATHERINE BOUTON



Ben Goldacre is exasperated. He's not exactly angry — that would be much less fun to read — except in certain circumstances. He is irked, vexed, bugged, ticked off at the sometimes inadvertent (because of stupidity) but more often deliberate deceptions perpetrated in the name of science. And he wants you, the reader, to share his feelings.

His initial targets are benign. Health spas and beauty salons offer detox footbaths for \$30 and up, or you can buy your own machine online for \$149.99. You put your feet in salt water through which an electrical charge runs. The water turns brown, the result of electrolysis, and you're supposedly detoxed. Dr. Goldacre describes how one could produce the same effect with a Barbie doll, two nails, salt, warm water and a car battery charger, thus apparently detoxing Barbie. The method is dangerous, however, because of the chance of getting a nasty shock, and he wisely warns readers not to try his experiment themselves. As for homeopathy, he says that it may indeed work but it's not because of the ingredients in those pills. You can pay for Valmont Cellular DNA Complex (made from "specially treated salmon roe DNA"), but Vaseline works just as well as a moisturizer.

There's more here than just debunking nonsense. The appearance of "scienciness": the diagrams and graphs, the experiments (where exactly was that study published?) that prove their efficacy are all superficially plausible, with enough of a "hassle barrier" to deter a closer look. Dr. Goldacre (a very boyish-looking 36-year-old British physician and author of the popular weekly "Bad Science" column in *The Guardian*) shows us why that closer look is necessary and how to do it.

You'll get a good grounding in the importance of evidence-based medicine (the dearth of which is a "gaping" hole in our culture). You'll learn how to weigh the results of competing trials using a funnel plot, the value of

meta-analysis and the Cochrane Collaboration. He points out common methodological flaws: failure to blind the researchers to what is being tested and who is in a control group, misunderstanding randomization, ignoring the natural process of regression to the mean, the bias toward positive results in publication. “Studies show” is not good enough, he writes: “The plural of ‘anecdote’ is not data.”

Dr. Goldacre has his favorite nemeses, one of the most prominent being the popular British TV nutritionist Gillian McKeith, whose books and diet supplements are wildly successful. According to her Web site, “Gillian McKeith earned a Doctorate (PhD) in Holistic Nutrition from the American Holistic College of Nutrition, which is now known as the Clayton College of Natural Health.” (The college closed in July of this year.) Clayton was not accredited, and offered a correspondence course to get a Ph.D. that cost \$6,400. She is also a “certified professional member” of the American Association of Nutritional Consultants, where, Dr. Goldacre writes, he managed to get certification for Hettie, his dead cat, for \$60. Ms. McKeith has agreed not to call herself “Dr.” anymore.

There’s nothing wrong, he says, with the substance of her diet (“anyone who tells you to eat more fresh fruits and vegetables is all right by me”) any more than with diets that advise drinking plenty of water and moderate alcohol intake and exercise. What he does object to is the “proprietaryization of common sense.” Adding sciency flourishes and a big price tag to the advice may enhance the placebo effect, “but you might also wonder whether the primary goal is something much more cynical and lucrative: to make common sense copyrightable, unique, patented and *owned*.”

Sometimes bad science is downright harmful, and in the chapter titled “The Doctor Will Sue You Now,” the usually affable Dr. Goldacre is indeed angry, and rightly so. The chapter did not appear in the original British edition of the book because the doctor in question, Dr. Matthias Rath, a vitamin pill entrepreneur, was suing The Guardian and Dr. Goldacre personally on a libel complaint. He dropped the case (after the Guardian had amassed \$770,000 in legal expenses) paying \$365,000 in court costs. Dr. Rath, formerly head of cardiovascular research at the Linus Pauling Institute in Menlo Park, Calif., and founder of the nonprofit Dr. Rath Research Institute, is, according to his Web site, “the founder of Cellular Medicine, the groundbreaking new health concept that identifies nutritional deficiencies at the cellular level as the root cause of many chronic diseases.”

Dr. Rath’s ads in Britain for his high-dose vitamins have claimed that “90 percent of patients receiving chemotherapy for cancer die with months of starting treatment” and suggested that three million lives could be saved if people stopped being treated with “poisonous compounds.” He took his campaign to South Africa, where AIDS was killing 300,000 people a year, and in newspaper ads proclaimed that “the answer to the AIDS epidemic is here.” The ads asked, “Why should South Africans continue to be poisoned with AZT? There is a natural answer to AIDS.” That answer was multivitamin supplements, which he said “cut the risk of developing AIDS in half.”

“Tragically,” as Dr. Goldacre writes, Dr. Rath found a willing ear in Thabo Mbeki. Despite condemnation by the United Nations, the Harvard School of Public Health and numerous South African health organizations, Dr. Rath’s influence was pervasive. Various studies have estimated that had the South African government used antiretroviral drugs for prevention and treatment, more than 300,000 unnecessary deaths could have been prevented.

You don’t have to buy the book to read the whole sorry story, which is readily available online. Dr. Goldacre believes in the widest possible dissemination of information. But if you do buy the book, you’ll find it illustrated with lucid charts and graphs, footnoted (I’d have liked more of these), indexed and far more serious than it looks. Depending on your point of view, you’ll find it downright snarky or wittily readable.

BAD SCIENCE Quacks, Hacks, and Big Pharma Flacks. By Ben Goldacre. Faber and Faber. 288pages. \$15.

<http://www.nytimes.com/2010/11/02/science/02scibks.html?ref=science>



A Second Comet to Visit, With a Look-but-Don't-Touch Mission

By **KENNETH CHANG**

Five years after NASA set off interplanetary fireworks by slamming an 800-pound bullet into a comet, the same spacecraft that fired that bullet will be visiting a second comet on Thursday, this time without the collision.

Traveling 27,000 miles per hour, the spacecraft, left over from the Deep Impact mission, will come within 435 miles of Comet Hartley 2 on Thursday at 9:50 a.m. Eastern time. Hartley 2 will be only the fifth comet to be photographed close up, and the event will make the spacecraft the first to have visited two comets.

“This is going to give us the most extensive observation of a comet to date,” said Timothy W. Larson, the project manager for the mission.

The primary mission of Deep Impact, launched in January 2005, was to visit Comet Tempel 1. As the spacecraft neared, it separated into two pieces — the main spacecraft, about the size of a subcompact car, and the 800-pound impactor, which crashed into the comet on July 4, 2005. From a spray of ice and dust gouged from the comet, scientists were able to identify some of the minerals beneath its surface.

Comets are of particular interest to planetary scientists because they contain almost pristine ingredients from the formation of the solar system 4.5 billion years ago.

After the crash, the part of Deep Impact that did not slam into the Tempel 1 still had plenty of propellant left. “The spacecraft was still in good shape, willing to do more work,” Dr. Larson said. “It just needed a new reason for living.”

NASA approved a new mission called Epoxi. The name is a combination of two acronyms: Epoch, or Extrasolar Planet Observation and Characterization, which has been using one of the spacecraft’s cameras to look at stars known to have planets, and Dixi, or Deep Impact Extended Investigation, for the second comet flyby.

The spacecraft was sent on a looping path to intersect Comet Boethin in 2008. Boethin, a mile-wide comet with a 11.8-year orbit, had been visible during its previous passes into the inner solar system, most recently in 1986. But when astronomers looked for it in late 2007, it was nowhere to be seen. Boethin had apparently broken into smaller pieces.

Not wanting to send Epoxi to visit a comet that no longer existed, the mission team shifted to Hartley 2, which required an additional two years to reach.

The spacecraft has taken 2,000 pictures a day of Hartley 2 as it approaches. The spacecraft cannot keep its high-speed antenna pointed at Earth and its cameras pointed at the comet at the same time. So during its closest approach, the spacecraft will focus on the comet for 18 consecutive hours before turning back to Earth to radio the data. Michael F. A’Hearn, a professor of astronomy at the University of Maryland and the mission’s principal investigator, said Hartley 2 would help scientists understand whether what they learned at Tempel 1 was common among comets or peculiar to that comet.

About three-quarters of a mile wide, Hartley 2 is much smaller than the four-mile-wide Tempel 1.

“Despite that, it puts out more gas,” Dr. A’Hearn said. “This says it’s a real active nucleus for its size.”

Meanwhile, NASA’s other comet spacecraft, Stardust, which flew by Comet Wild 2 in 2006 and caught some grains of dust that it later parachuted to Earth for scientists to study, is also being recycled for another comet encounter. On Feb. 14 next year, it will fly by Tempel 1, the comet that Deep Impact bombarded.

<http://www.nytimes.com/2010/11/02/science/space/02comet.html?ref=science>

An 80-Year Run for Nuclear Reactors?

By MATTHEW L. WALD



Constellation Energy Constellation sees its Nine Mile Point 1 reactor in Scriba, N.Y., as a candidate for a second permit extension. It is one of the oldest nuclear reactors operating in the United States.

With the so-called “nuclear renaissance” looking smaller and slower than predicted, some in the nuclear industry are focusing on running existing plants longer — not only for their initial 40-year licensing period and the 20-year extension already allowed, but for a second 20-year extension as well.

“If you would have looked five years ago at the number of plants people were intending to construct and then you look today, it’s clear with the economic conditions we face in our nation, they’re pushing the builds out there,” said Maria Korsnick, the chief nuclear officer with Constellation Energy Group. (In industry-speak, that means delaying construction.)

In fact, her own company dropped out of a partnership to build a third reactor at its Calvert Cliffs site, 50 miles south of Washington, last month.

But in a conference call this week with reporters, Ms. Korsnick warned, “If you let these current units retire, you’re going to end up with a gap before you’ll be able to build the new nuclear plants to take their place.” The two reactors now running at Calvert Cliffs were test cases for plants around the nation seeking to win license extensions beyond 40 years. Since then, about half of the plants have applied for 20-year extensions and had them approved.

Constellation views two other reactors that it owns, the Nine Mile Point 1 and Robert E. Ginna reactors in upstate New York, as candidates for a second 20-year extension.

Both plants recently received 20-year extensions of their licenses and would file for the second one early, about 10 years now, Ms. Korsnick said.

The Electric Power Research Institute, a utility consortium based in Palo Alto, Calif., views those plants as test cases for its own research.



The institute is focusing on deterioration of nuclear reactors' steel and concrete. Steel is known to get brittle as it is subjected to radiation; that raises the possibility that a vessel could crack when a mishap triggers the reactor's emergency core cooling system and it pumps cold water into the vessel at high pressure. And concrete can get crumbly with age, researchers suggest.

But the institute's researchers said that while such phenomena pose concerns, they have not observed them to a worrisome degree in existing plants and doubt that either would be a "life-limiting" problem for reactors. Ronaldo Szilard, a member of the research institute and the director of nuclear science and engineering in the Idaho National Laboratory's nuclear program, said researchers would look into installing digital control systems of the kind common to younger industrial plants on old reactors. They will also research fuel components that would resist melting in an accident more ably than existing materials do.

The institute group is not studying the aging problem that has most bedeviled reactors so far, leaks from underground pipes.

And the institute's view on extending reactors' life is not universally shared. The Union of Concerned Scientists argues that reactors are now entering their "wear-out phase."

<http://green.blogs.nytimes.com/2010/11/02/an-80-year-run-for-nuclear-reactors/?ref=earth>

Rising Seas and the Groundwater Equation

By *FELICITY BARRINGER*



Luis J. Jimenez for The New York Times A government employee in Mexico City filled barrels for families who do not have tap water piped into their homes. The city has faced water shortages as groundwater runs out from overpumping.

Worldwide overpumping of groundwater, particularly in northern India, Iran, Mexico, northeastern China and the American West, more than doubled between 1960 and 2000 and is responsible for about 25 percent of the current rise in sea level, according to estimates in a new [study](#) by a team of Dutch researchers published in [Geophysical Review Letters](#).

The general idea that groundwater used for irrigation is running off into ocean-bound rivers or evaporating into the clouds, only to end up raining into the ocean, has been around for two decades or so; it was a focus of [a 2005 paper](#) in The Journal of Hydrogeology. But Peter H. Gleick, a leading expert on water issues, said the new paper offers a fresh way of quantifying the phenomenon.

Mr. Gleick, president of the Oakland-based [Pacific Institute](#), said that experts on groundwater issues “have known for a long time that that water ultimately ends up in the oceans and contributes to sea level rise. What we haven’t known is the magnitude and severity of the problem.”

This study, by a team of researchers based at the University of Utrecht and the [International Groundwater Resources Assessment Center](#) in Utrecht in the Netherlands, suggests that, in Dr. Gleick’s words, “both the magnitude and the severity of the phenomenon are severe”: it estimates that groundwater depletion worldwide went from about 99.7 million acre-feet (29.5 cubic miles) in 1960 to 229.4 million acre-feet (55 cubic miles) in 2000.

That volume is almost as much as the combined annual flows of the Ohio and Susquehanna Rivers, as measured by the United States Geological Survey. Put another way, it is 15 times the amount of water used annually by all the users of the Colorado River in the United States, from the cities of Los Angeles, Phoenix and Las Vegas to the farms of the California and Arizona deserts, which produce most of this country’s winter fruit and vegetables.

Barton H. Thompson Jr., a Stanford law professor who is co-director of the university's Woods Institute for the Environment, said the Dutch study could help broaden the lens through which groundwater problems are examined.

"There has been growing recognition that it is not simply a local issue but at least a regional issue," he said. "If you are living in an area where maybe you're not depleting your groundwater but other people nearby are depleting theirs, eventually they are going to have to find other water. They may have to find it nearby, and that may be your water."

What the new study suggests, he added, "is that groundwater depletion is a global problem. Now we have to worry that it's also contributing to sea level rise. It changes the scale of the problem in a way that perhaps we haven't thought about before."

Both Dr. Gleick and Dr. Thompson emphasized the extent to which large agricultural regions in arid or semi-arid areas, from California's San Joaquin Valley to the Ogallala Aquifer under the Great Plains the Yuncheng Basin in northern China, have become dependent on groundwater to grow the crops that sustain both livestock and people.

This dependence may make it hard to change current practices that lead to depletion, Dr. Gleick suggests.

"I do think there's growing awareness of the seriousness of the groundwater overpumping problem, but I think it's going to take more than this wake-up call to change policy, because we're hugely dependent on this unsustainable source of water," he said, adding, "Forty percent of our groundwater withdrawals are coming from unsustainable sources of water."

"By definition, unsustainable means it can't continue forever. This water provides a lot of our food. And we're basically drawing down the bank account."

Groundwater's contribution to sea-level rise will probably diminish, he added, because as groundwater basins are depleted, there won't be as much water left to send through rain clouds to the oceans.

<http://green.blogs.nytimes.com/2010/11/02/rising-seas-and-the-groundwater-equation/?ref=earth>

Killer of Aspen Slows, but Worries About a Beloved Tree Remain

By **KIRK JOHNSON**



Benjamin Rasmussen for The New York Times

VULNERABLE A stand of aspen in Colorado. Researchers say sudden aspen decline has stabilized.

GUNNISON, Colo. — Aspen trees, with their quivering, delicate foliage and the warm glow of color they spread across the high country of the Rocky Mountains this time of year, have an emotional appeal that their stolid, prickly evergreen cousins do not.

So tree lovers and scientists alike felt the impact when the aspen in the West started dying around 2004 — withering away in a broad band from here in southwest Colorado through the mountains of Utah, Arizona, and New Mexico and into Wyoming.

“There’s definitely something powerful about these trees,” said James Worrall, a forest pathologist for the United States Forest Service, gazing at a brilliant yellow swath of healthy aspen in a stand in the mountains here, about four hours southeast of Denver.

“It’s partly, I think, an emotional impression,” he said. “Partly a very real impression that the aspen is very important in our forests — hydrologically, biologically, to wildlife, every kind of way you can imagine.”

The good news is that the phenomenon known as sudden aspen decline, or SAD, appears to have stabilized, Dr. Worrall and other researchers say. Individual trees are still dying, since the process can take years to unfold, but many stands of trees are holding their ground against any new onset.

A sudden severe drought and heat wave early in the decade set off the decline, according to a paper co-authored by Dr. Worrall this year in the journal *Forest Ecology and Management*. Wetter, cooler seasons since then — more to the aspen’s liking — have halted SAD’s spread. Other evidence supports the weather as the cause. Although the aspen is the most widely distributed tree species in North America, the die-off struck



mostly in the Southwest, where the drought beginning in 2002 was most severe. And lower elevations were affected more than upper ones, which tend to be cooler and wetter.

“It was a really large stressor to the trees, and that made them more susceptible to other things — there’s pretty good comfort among scientists that that was what was going on,” said Dan Binkley, a professor of forest ecology at [Colorado State University](#), who was not involved in Dr. Worrall’s paper.

The new research delivers some bad news as well. It has shown how profoundly vulnerable aspen are to environmental events outside their niche. In keeping with their delicate image, they do not like sudden weather shifts.

And the 2002 drought was a doozy. The winter was dry, with snowpack about half the long-term average in much of the aspen heartland here in Colorado. Early heat then melted what snow there was weeks ahead of average, and June arrived with searing temperatures about six degrees above average, which fried the already weakened trees.

Long-term climate projections, Dr. Worrall and other scientists say, all point to more curveballs ahead — wider, more severe fluctuations and variations of hot, dry, wet and cold.

Gerald Rehfeldt and others at the forest service’s Rocky Mountain Research Station in Moscow, Idaho, using three climate models and carbon-dioxide projections, concluded that stable aspen climate could be lost in at least two-thirds of the tree’s habitat area in Colorado and southern Wyoming alone by 2060.

“It’s the extremes of variation that gets the aspen — not the average,” Dr. Worrall said.

The aspen is, of course, not the only tree affected by changes in weather and climate. But different species respond in different ways. Millions of lodgepole pines have also died in the West in recent years, killed by beetles that are natural predators and control agents for the trees — but which have gone out of control, many ecologists say, because the cold winters that once kept beetle populations in check have not been happening the way they used to. In other words, lodgepoles have always been killed by beetles; climate patterns simply tilted the relationship out of whack.

In contrast, aspen die-off of the magnitude and pace seen in the last few years had never been recorded, Dr. Worrall and others said. The weakened trees became vulnerable to a fungus and a tiny beetle that had in the past mostly fed on dead or dying aspen and had not posed a serious threat.

Because aspen are relatively short-lived by tree standards — 100 years is long in the tooth, 300 is Methuselah — tree ring studies that might show how the species fared in some of the devastating droughts in the past 1,000 years or so in the West are hard to come by.

But the West’s perennial anxiety over water makes the research into that question — the aspen’s response to drought — more crucial than ever.

Colorado has more aspen than any other state in the West, and it is also the fountainhead for major river systems that tens of millions of people depend on, including the Rio Grande, the Colorado and the Arkansas. Water generated in Colorado’s high mountains travels through 17 states and Mexico.

Aspen stands, acting like sponges or underground reservoirs, hold much of those headwaters in place, growing where things are wettest and coolest, and adding greatly to the water storage capacity of the mountains.

Aspen stands are also centers of biodiversity in a forest. Many insects and plants have evolved in conjunction with trees, which provide shelter for elk and other animals in the most severe winter weather.

But there is hope for the species — and perhaps an indicator that it has dealt with setbacks before and recovered — in the peculiar properties and strengths of its reproductive system.

Aspen, unlike evergreens, do not usually grow from seeds, but rather by vegetative reproduction, sending up suckers from a mother tree. (Aspen seeds — tiny and nutrient-poor — can become established only under unusual conditions.) For a tree solely dependent on seed reproduction, recovery from an event like SAD would be a much slower road.

In perhaps the oddest twist of all, aspen are in some places colonizing areas of the Rockies where they did not exist in recent years, filling in spaces with their quick-shot sucker system that were once home to hardier-looking lodgepoles, killed off by beetle attack.

<http://www.nytimes.com/2010/10/19/science/19aspen.html>

In Kansas, Climate Skeptics Embrace Cleaner Energy

By **LESLIE KAUFMAN**



Steve Hebert for The New York Times

A family eats by candlelight at a restaurant in Salina, Kan., part of an effort to conserve power.

SALINA, Kan. — Residents of this deeply conservative city do not put much stock in scientific predictions of climate change.

“Don’t mention global warming,” warned Nancy Jackson, chairwoman of the Climate and Energy Project, a small nonprofit group that aims to get people to rein in the fossil fuel emissions that contribute to climate change. “And don’t mention Al Gore. People out here just hate him.”

Saving energy, though, is another matter.

Last Halloween, schoolchildren here searched for “vampire” electric loads, or appliances that sap energy even when they seem to be off. Energy-efficient LED lights twinkled on the town’s Christmas tree. On Valentine’s Day, local restaurants left their dining room lights off and served meals by candlelight.

The fever for reducing dependence on fossil fuels has spread beyond this city of red-brick Eisenhower-era buildings to other towns on the Kansas plains. A Lutheran church in nearby Lindsborg was inspired to install geothermal heating. The principal of Mount Hope’s elementary school dressed up as an energy bandit at a student assembly on home-energy conservation. Hutchinson won a contract to become home to a \$50 million wind turbine factory.

Town managers attribute the new resolve mostly to a yearlong competition sponsored by the Climate and Energy Project, which set out to extricate energy issues from the charged arena of climate politics.

Attempts by the Obama administration to regulate greenhouse gases are highly unpopular here because of opposition to large-scale government intervention. Some are skeptical that humans might fundamentally alter a world that was created by God.

If the heartland is to seriously reduce its dependence on coal and oil, Ms. Jackson and others decided, the issues must be separated. So the project ran an experiment to see if by focusing on thrift, patriotism, spiritual

conviction and economic prosperity, it could rally residents of six Kansas towns to take meaningful steps to conserve energy and consider renewable fuels.

Think of it as a green variation on “What’s the Matter with Kansas?” Ms. Jackson suggested, referring to the 2004 book by Thomas Frank that contended that Republicans had come to dominate the state’s elections by exploiting social values.

The project’s strategy seems to have worked. In the course of the program, which ended last spring, energy use in the towns declined as much as 5 percent relative to other areas — a giant step in the world of energy conservation, where a program that yields a 1.5 percent decline is considered successful.

The towns were featured as a case study on changing behavior by the Department of Energy’s Lawrence Berkeley National Laboratory. And the Climate and Energy Project just received a grant from the Kansas Energy Office to coordinate a competition among 16 Kansas cities to cut energy use in 2011.

The energy experiment started as a kitchen-table challenge three years ago.

Over dinner, Wes Jackson, the president of the Land Institute, which promotes environmentally sustainable agriculture, complained to Ms. Jackson, his daughter-in-law, that even though many local farmers would suffer from climate change, few believed that it was happening or were willing to take steps to avoid it. Why did the conversation have to be about climate change? Ms. Jackson countered. If the goal was to persuade people to reduce their use of fossil fuels, why not identify issues that motivated them instead of getting stuck on something that did not?

Only 48 percent of people in the Midwest agree with the statement that there is “solid evidence that the average temperature on earth has been getting warmer,” a poll conducted in the fall of 2009 by the Pew Research Center for the People and the Press showed — far fewer than in other regions of the country. The Jacksons already knew firsthand that such skepticism was not just broad, but also deep. Like opposition to abortion or affirmations of religious faith, they felt, it was becoming a cultural marker that helped some Kansans define themselves.

Nevertheless, Ms. Jackson felt so strongly that this opposition could be overcome that she left a job as development director at the University of Kansas in Lawrence to start the Climate and Energy Project with a one-time grant from the Land Institute. (The project is now independent.)

At the outset she commissioned focus groups of independents and Republicans around Wichita and Kansas City to get a sense of where they stood. Many participants suggested that global warming could be explained mostly by natural earth cycles, and a vocal minority even asserted that it was a cynical hoax perpetrated by climate scientists who were greedy for grants.

Yet Ms. Jackson found plenty of openings. Many lamented the nation’s dependence on foreign oil. Some articulated an amorphous desire, often based in religious values, to protect the earth. Some even spoke of changes in the natural world — birds arriving weeks earlier in the spring than they had before — leading her to wonder whether, deep down, they might suspect that climate change was afoot.

Ms. Jackson settled on a three-pronged strategy. Invoking the notion of thrift, she set out to persuade towns to compete with one another to become more energy-efficient. She worked with civic leaders to embrace green jobs as a way of shoring up or rescuing their communities. And she spoke with local ministers about “creation care,” the obligation of Christians to act as stewards of the world that God gave them, even creating a sermon bank with talking points they could download.

Relatively little was said about climate.

“I don’t recall us being recruited under a climate change label at all,” said Stacy Huff, an executive for the Coronado Area Council of the Boy Scouts of America, which was enlisted to help the project. Mr. Huff describes himself as “somewhat skeptical” about global warming.

Mr. Huff said the project workers emphasized conservation for future generations when they recruited his group. The message resonated, and the scouts went door to door in low-income neighborhoods to deliver and install weatherization kits.

“It is in our DNA to leave a place better than we found it,” he said.

Elliot Lahn, a community development planner for Merriam, a city that reduced its energy use by 5 percent, said that when public meetings were held on the six-town competition to save energy, some residents offered their view that global warming was a hoax.

But they were very eager to hear about saving money, Mr. Lahn said. “That’s what really motivated them.” Jerry Clasen, a grain farmer in Reno County, south of Salina, said he largely discounted global warming. “I believe we are going through a cycle and it is not a big deal,” he said. But his ears pricked up when project workers came to town to talk about harnessing wind power. “There is no sense in our dependency on foreign oil,” he said, “especially since we have got this resource here.”

Mr. Clasen helped organize a group of local leaders to lobby the electronics and energy giant Siemens to build a wind turbine factory in the area. When the company signed a deal in 2009 promising to create as many as 400 local jobs, it stirred a wave of excitement about the future of wind power.

Now, farmers expect to lease some of their land for turbines and rely on wind power as a stable source of income, he said, and land prices are rising as result.

“Whether or not the earth is getting warmer,” he said, “it feels good to be part of something that works for Kansas and for the nation.”

<http://www.nytimes.com/2010/10/19/science/earth/19fossil.html?ref=earth>



Daniel Phoenix Singh brings Anna Sokolow's dances to life again

By Sarah Kaufman
 Washington Post Staff Writer
 Sunday, October 31, 2010; E02

It is a deceptively simple picture: Daniel Phoenix Singh sits in a wooden chair, hands on his lap, staring straight ahead. He's one of nine dancers in this studio at Silver Spring's Maryland Youth Ballet, all of them seated the same rigid way, as if they have been plotted on graph paper and are captive to an unyielding calculus.

Slowly, on the same silent count, Singh and the others lean forward, making a focused appeal to the wall they're facing.

The dancers are members of Singh's company, Dakshina. Karen Bernstein, one of two rehearsal directors watching their run-through of the opening moments of Anna Sokolow's "Rooms," stops them. In this 1955 work that distills the alienation of apartment-dwellers, that forward pitch in their posture is a pleading gesture to the audience, Bernstein tells them, "like, 'Help me -- *I have something important to say.*' " The dancers scooch back against their chairs and repeat their mute entreaty, making it a little gentler around the eyes, a little more poignant.

Simple enough. Though for Singh, 38, getting to this point has been anything but easy. To this soft-spoken man whose Indian birth certificate is stamped "backward class" as a signifier of his low caste, to this onetime misfit who would be trapped in techie geekdom if he hadn't discovered dance at the University of Maryland -- to Singh, this studio, these chairs, the specificity of Sokolow's work: This is what freedom looks like.

After a few years of dancing works by Sokolow, a pioneer in American modern dance who died in 2000, Dakshina/Daniel Phoenix Singh will perform two all-Sokolow programs -- including "Rooms," her most famous piece, with each chair representing an isolated flat; "Dreams," a searing meditation on the Holocaust; and reconstructions of her little-known "Frida," based on the life of painter Frida Kahlo, and the love duet "September Sonnet." Performances are Thursday and Friday at the University of Maryland's Clarice Smith Performing Arts Center.

These shows won't be the end of Singh's Sokolow obsession. With the help of Lorry May, one of Sokolow's leading dancers, who now licenses her choreography (mostly to colleges and small regional groups), Singh hopes to acquire Sokolow's existing catalogue, some 30 works.

As it is, Singh's two rehearsal directors, Bernstein and Harriet Moncure Williams, are compiling written notations of the Sokolow works that May has taught the company -- a remarkable act of preservation.

Why is Singh taking this on? How did this Indian immigrant become enmeshed in the biting social commentary of a leftist Jewish woman? As a founding member of the Actors Studio, Sokolow taught movement to such stage and screen stars as Julie Harris and Eli Wallach. But in the centennial of her birth, her dances can be seen only spottily. (As an example of how prominent Sokolow once was in the New York arts scene, she was the original choreographer for the 1967 off-Broadway run of "Hair" -- the showcase that launched the anthemic musical into enduring popularity, as witnessed by its current sojourn at the Kennedy Center. But that kind of success was not to be Sokolow's. She was fired just before the show opened.) Singh first saw one of Sokolow's pieces at Dance Place 12 years ago -- it was her 1945 solo "Kaddish," performed by Risa Steinberg, a veteran interpreter of Sokolow's work. At just five minutes long, it is a sustained gasp of mourning, in which the dancer wraps herself in her arms, beats her chest and plunges to the floor, then drifts away into the shadows. Brief as it was, it spoke to Singh.

"It's all about the hands," he says, spooning stewed lentils over a mound of rice at Heritage India near Dupont Circle. He demonstrates a few gestures from the solo, reaching across the table with long fingers, then cradling his face in his palms. "It was kind of a cultural trigger for me. I don't know what it was about it, but I felt this powerful longing and pain in her."

And there was something else. "I have seen my mother beat her chest in mourning," he says. "It's an Indian thing, a really physical slap. It's an image you don't forget easily; it still makes me lose my breath when I think about it. To see it from a different cultural perspective -- it triggered something."

But there is more than sentimentality behind the story of Singh's connection with the volatile expressionism of this pre- "Mad Men"-era artist. There is something pure about it. This is the story of art bridging cultural divides, time and mortality. And--at the risk of sounding like another type of chest-beater--it could only happen here.

* * *

Anna Sokolow grew up on New York's Lower East Side, the daughter of Russian immigrants. She danced with Martha Graham in the 1930s before making her own works that expressed human pain and fortitude in powerful new ways -- often with screams, explosive agitation and frozen moments of watchfulness. She drew inspiration from city life, its energy as well as its confinement; she channeled the agonies of the Holocaust and the arts of Mexico, where she frequently worked. Companies as diverse as the Joffrey Ballet, Alvin Ailey American Dance Theater and Israel's Batsheva Dance Company have performed her work.

Yet even before her death at 90, Sokolow had been steadily fading from public view. An influential teacher who inspired such choreographers as Jerome Robbins and Martha Clarke, she had never founded a dance school or maintained a studio, and there was little funding to keep her on-again, off-again troupe, the Players' Project, in business.

Meanwhile, on the other side of the planet, dance held a secret fascination for Singh, but it had to remain just that -- a secret. The youngest of three children, he was raised in Mumbai and Chennai in a financially strapped, strict Methodist family near the bottom of India's rigid social structure. Daniel, his brother, David, and sister, Tara, attended religious schools and were kept away from things considered non-Christian. That included classical Indian dance forms such as bharatanatyam, the sensual, highly theatrical form grounded in Hindu mythology, which Singh knew about only from Bollywood films.

His life had one thrust, drilled into him by his parents, who saw a high-tech career as the only way to a better life: "I have to succeed, I have to succeed, I have to succeed." Recalling the mantra now, Singh grips his head in his hands.

After Singh's sister married an Indian American and moved to Maryland, she brought her parents over, and they, in turn, brought over Singh and his brother in 1990. A few years later, as Singh was nearing graduation from the University of Maryland, Baltimore County, as a computer science major, he realized he lacked a physical education credit. He signed up for a ballet class. And discovered and lost his heart in almost the same moment.

The physicality was a rush. In India, he says with a shy smile, "I was nerdy." (Nerrier than the other techie kids? He considers. Well, he says, "I wasn't out there playing cricket.") With his lean athletic build, Singh looks far from nerdy now. He's fashionably urbane, wearing a crisp deep purple shirt and dark trousers, his black hair neatly parted and slicked straight. A few curls have sprung free, charmingly, around his ears. Through dance, Singh says, "I found comfort in my body. I didn't have to articulate in words."

And he couldn't get enough of it. He studied the modern-dance techniques of Graham, Merce Cunningham and Jose Limon. He was working as a janitor at Rockville High School when one night there was a bharatanatyam concert in the auditorium, by a Gaithersburg-based troupe called Nrityanjali. For the first time, Singh saw a live performance of one of the oldest dances of his homeland. Soon after, he persuaded Nrityanjali director Meena Telikacherla to take him on as a student.

"I had to really start from scratch," Telikacherla says. "But his wanting to learn -- that impressed me. And he had the discipline to come on a regular basis."

Singh wanted to crack the code of this complicated dance form, whose clarity "was breathtaking to watch," he says. But he could hardly have chosen a more difficult art to begin at the late age of 23. In bharatanatyam, the dancer must be deeply expressive -- communicating a story and emotions with the body as well as the face -- while moving to highly complex rhythms: The hands, fingers and even the eyes respond to specific musical counts as the feet pound out a beat of their own.

Singh's family wasn't pleased by this cultural connection, he says. As Christians, they were appalled that he was throwing himself into a form of dance with origins in Hindu temple rituals. Then came another shock: Having found a supportive community of artists here, and having rejected his fundamentalist upbringing, Singh came out as a gay man.

Since then, neither his brother, a Methodist minister, nor his sister has had much contact with him. His mother, Singh says, tried "to pray me straight." She fasted. She lamented that it was all her fault, that if only his father, who had recently died, were still alive "this wouldn't have happened."

* * *

It was around this time that Singh saw Sokolow's "Kaddish."

The title refers to the Hebrew prayer of mourning. Sokolow had created it in 1945, with the Holocaust and her father's death on her mind. When Singh saw it, after losing his father, to whom he'd never been able to reveal what was truest about himself -- his homosexuality, his love of dance -- the performance unleashed the grief he'd been keeping inside. In Sokolow's work, he realized, the dancer is not merely form or motion, as she is in so much of contemporary dance. She is a person, a real person with feelings like his.

Discovering the living humanity in Sokolow's work, created half a century before and a world away from Singh, was like finding the last piece of a puzzle. Now he knew what he wanted to do with his life: run a dance company that brought together modern dance -- particularly Sokolow's brand -- and bharatanatyam. "Dance helped me put all these pieces of myself -- being Indian and being gay and being an immigrant -- together," Singh says. "It's a place where you can be all of yourself and not divide yourself."

Luckily, his nerdy side meant that Singh was better equipped to float this improbable dream than most. For the past 13 years he has worked for the Association of American Colleges and Universities, where he is director of information systems. He owns a house. He has job security.

"Yeah, if I don't get outsourced -- to India," he cracks.

He founded Dakshina, which means "offering" in Sanskrit, in 2004, after getting a master's in fine arts from the University of Maryland in College Park in dance, performance and choreography.

In some ways, he's more stereotypically Indian now than he was when he was growing up in India. He has become a vegetarian, and he teaches yoga. His choreography for Dakshina fuses bharatanatyam with modern dance. And once a year he hosts an Indian dance festival at the Lincoln Theatre, bringing over prominent dancers from India. Among them is Mallika Sarabhai, a dancer so celebrated that when I had lunch with her and Singh at an Indian restaurant here some time ago, the wait staff asked to pose with her for photos.

"He's genuinely trying to find a new language, and doing it with a mixed company and doing it in a way that I find really interesting and not just superficial," says Sarabhai, who performed at this year's festival on Oct. 8.

"I think it comes out of very deep thought." As for Singh's interest in Sokolow, Sarabhai reasons that "the raw emotion is something that is very Indian. None of the Indian arts is stony-faced and abstract, in that sense."

Working with a modest annual budget of less than \$250,000, Singh has built Dakshina into a busy operation with a growing presence both here and internationally. He has taken Sokolow's work to Bangladesh and India. He has performances booked around here through July, including at the Kennedy Center's Maximum India festival in March. Next month, he takes his company to Argentina for the Queer Tango Festival in Buenos Aires.

He performs every year at Dance Place, where he had his Sokolow epiphany.

And he calls his mother every day, even though she doesn't come to his performances.

His analytical background gives him a realistic view of his future; he is prepared to run Dakshina at a loss for several more years. "I have a lot of dance friends who quit their day jobs and moved to New York, and now they're waiting tables," he says. "So I'm holding on to my job."

But Singh says he'll never give up dancing. Like the characters in Sokolow's "Rooms," he has something important to say.

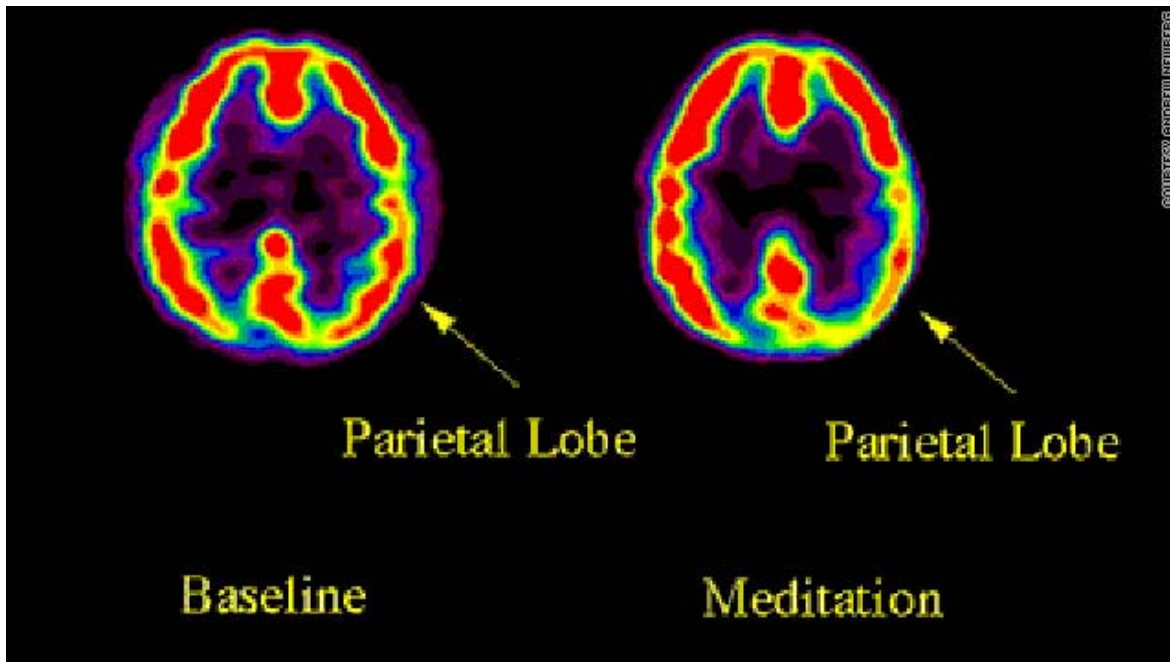
"It's a big journey," he says. "I feel like I've just started."

An Evening of Anna Sokolow

performed by Dakshina/Daniel Phoenix Singh. Nov. 4 and 5 at 8 p.m. at Clarice Smith Performing Arts Center, University of Maryland. Tickets \$30.

http://www.washingtonpost.com/wp-dyn/content/article/2010/10/29/AR2010102900002_pf.html

Can meditation change your brain? Contemplative neuroscientists believe it can



October 26th, 2010

From CNN's Dan Gilgoff:

Can people strengthen the brain circuits associated with happiness and positive behavior, just as we're able to strengthen muscles with exercise?

Richard Davidson, who for decades has practiced Buddhist-style meditation— a form of mental exercise, he says — insists that we can.

And Davidson, who has been meditating since visiting India as a Harvard grad student in the 1970s, has credibility on the subject beyond his own experience.

A trained psychologist based at the University of Wisconsin, Madison, he has become the leader of a relatively new field called contemplative neuroscience - the brain science of meditation.

Over the last decade, Davidson and his colleagues have produced scientific evidence for the theory that meditation - the ancient eastern practice of sitting, usually accompanied by focusing on certain objects - permanently changes the brain for the better.

"We all know that if you engage in certain kinds of exercise on a regular basis you can strengthen certain muscle groups in predictable ways," Davidson says in his office at the University of Wisconsin, where his research team has hosted scores of Buddhist monks and other meditators for brain scans.

"Strengthening neural systems is not fundamentally different," he says. "It's basically replacing certain habits of mind with other habits."

Contemplative neuroscientists say that making a habit of meditation can strengthen brain circuits responsible for maintaining concentration and generating empathy.

One recent study by Davidson's team found that novice meditators stimulated their limbic systems - the brain's emotional network - during the practice of compassion meditation, an ancient Tibetan Buddhist practice.

That's no great surprise, given that compassion meditation aims to produce a specific emotional state of intense empathy, sometimes call "lovingkindness."

But the study also found that expert meditators - monks with more than 10,000 hours of practice - showed significantly greater activation of their limbic systems. The monks appeared to have permanently changed their brains to be more empathetic.

An earlier study by some of the same researchers found that committed meditators experienced sustained changes in baseline brain function, meaning that they had changed the way their brains operated even outside of meditation.

These changes included ramped-up activation of a brain region thought to be responsible for generating positive emotions, called the left-sided anterior region. The researchers found this change in novice meditators who'd enrolled in a course in mindfulness meditation - a technique that borrows heavily from Buddhism - that lasted just eight weeks.

But most brain research around meditation is still preliminary, waiting to be corroborated by other scientists. Meditation's psychological benefits and its use in treatments for conditions as diverse as depression and chronic pain are more widely acknowledged.

Serious brain science around meditation has emerged only in about the last decade, since the birth of functional MRI allowed scientists to begin watching the brain and monitoring its changes in relatively real time.

Beginning in the late 1990s, a University of Pennsylvania-based researcher named Andrew Newberg said that his brain scans of experienced meditators showed the prefrontal cortex - the area of the brain that houses attention - surging into overdrive during meditation while the brain region governing our orientation in time and space, called the superior parietal lobe, went dark. (One of his scans is pictured, above.)

Newberg said his findings explained why meditators are able to cultivate intense concentration while also describing feelings of transcendence during meditation.

But some scientists said Newberg was over-interpreting his brain scans. Others said he failed to specify the kind of meditation he was studying, making his studies impossible to reproduce. His popular books, like *Why God Won't Go Away*, caused more eye-rolling among neuroscientists, who said he hyped his findings to goose sales.

"It caused mainstream scientists to say that the only work that has been done in the field is of terrible quality," says Alasdair Coles, a lecturer in neurology at England's University of Cambridge.

Newberg, now at Thomas Jefferson University and Hospital in Philadelphia, stands by his research.

And contemplative neuroscience had gained more credibility in the scientific community since his early scans.

One sign of that is increased funding from the National Institutes of Health, which has helped establish new contemplative science research centers at Stanford University, Emory University, and the University of Wisconsin, where the world's first brain imaging lab with a meditation room next door is now under construction.

The NIH could not provide numbers on how much it gives specifically to meditation brain research but its grants in complementary and alternative medicine - which encompass many meditation studies - have risen from around \$300 million in 2007 to an estimated \$541 million in 2011.

"The original investigations by people like Davidson in the 1990s were seen as intriguing, but it took some time to be convinced that brain processes were really changing during meditation," says Josephine Briggs, Director of the NIH's National Center for Complementary and Alternative Medicine.

Most studies so far have examined so-called focused-attention meditation, in which the practitioner concentrates on a particular subject, such as the breath. The meditator monitors the quality of attention and, when it drifts, returns attention to the object.

Over time, practitioners are supposed to find it easier to sustain attention during and outside of meditation.

In a 2007 study, Davidson compared the attentional abilities of novice meditators to experts in the Tibetan Buddhist tradition. Participants in both groups were asked to practice focused-attention meditation on a fixed dot on a screen while researchers ran fMRI scans of their brains.

To challenge the participants' attentional abilities, the scientists interrupted the meditations with distracting sounds.

The brain scans found that both experienced and novice meditators activated a network of attention-related regions of the brain during meditation. But the experienced meditators showed more activation in some of those regions.

The inexperienced meditators, meanwhile, showed increased activation in brain regions that have been shown to negatively correlate with sustaining attention. Experienced meditators were better able to activate their attentional networks to maintain concentration on the dot. They had, the study suggested, changed their brains.

The fMRI scans also showed that experienced meditators had less neural response to the distracting noises that interrupted the meditation.

In fact, the more hours of experience a meditator had, the scans found, the less active his or her emotional networks were during the distracting sounds, which meant the easier it was to focus.

More recently, contemplative neuroscience has turned toward compassion meditation, which involves generating empathy through objectless awareness; practitioners call it non-referential compassion meditation. New neuroscientific interest in the practice comes largely at the urging of the Dalai Lama, the spiritual and political leader of Tibetan Buddhists, for whom compassion meditation is a time-worn tradition.

The Dalai Lama has arranged for Tibetan monks to travel to American universities for brain scans and has spoken at the annual meeting of the Society for Neuroscience, the world's largest gathering of brain scientists. A religious leader, the Dalai Lama has said he supports contemplative neuroscience even though scientists are stripping meditation of its Buddhist roots, treating it purely as a mental exercise that more or less anyone can do.

"This is not a project about religion," says Davidson. "Meditation is mental activity that could be understood in secular terms."

Still, the nascent field faces challenges. Scientists have scanned just a few hundred brains on meditation to date, which makes for a pretty small research sample. And some scientists say researchers are over eager to use brain science to prove that meditation "works."

"This is a field that has been populated by true believers," says Emory University scientist Charles Raison, who has studied meditation's effect on the immune system. "Many of the people doing this research are trying to prove scientifically what they already know from experience, which is a major flaw."

But Davidson says that other types of scientists also have deep personal interest in what they're studying. And he argues that that's a good thing.

"There's a cadre of grad students and post docs who've found personal value in meditation and have been inspired to study it scientifically," Davidson says. "These are people at the very best universities and they want to do this for a career."

"In ten years," he says, "we'll find that meditation research has become mainstream."

<http://religion.blogs.cnn.com/2010/10/26/can-meditation-change-your-brain-contemplative-neuroscientists-believe-it-can/>

Take the ultimate intelligence test

- 18:00 27 October 2010 by [Adrian M Owen](#)
-



How quick off the mark are you? (Image: Paul Burns/Getty)

You might think it's obvious that one person is smarter than another.

But there are few more controversial areas of science than the study of intelligence and, in reality, there's not even agreement among researchers about what this word actually means.

Unlike weight and height, which are unambiguous, there is no absolute measure of intelligence, just as there are no absolute measures of honesty or physical fitness.

Nonetheless, over the decades, legions of scientists have devised tests that can show that one person is smarter than another just as surely as Olympic events can shed light on how much you can lift or how far you can jump.

Now my team at the UK Medical Research Council's Cognition and Brain Sciences Unit in Cambridge has come up with the ultimate test of intelligence.

Like many researchers before us, we began by looking for the smallest number of tests that could cover the broadest range of cognitive skills that are believed to contribute to intelligence, from memory to planning. But we went one step further. Thanks to recent work with brain scanners, we could make sure that the tests involved as much of the brain as possible – from the outer layers, responsible for higher thought, to deeper-lying structures such as the hippocampus, which is involved in memory. [Here's a longer explanation of the theory and evidence that we used when devising the tests.](#)

The result is a set of tests that probe what might be called your 12 pillars of wisdom. In all, they take about half an hour to complete. Now we've teamed up with *New Scientist* and [the Discovery Channel](#) to give you the chance to take the test for yourself.

Do take part! You can see how sturdy your pillars are. And you will help us to place the concept of intelligence on a firmer footing.

[Click here to take the 12 Pillars of Wisdom Test](#)

[Find out more about the Anatomy of the Brain on Discovery](#)

[Find out more about how the test was devised](#)

Adrian Owen is a senior scientist at the Medical Research Council Cognition and Brain Sciences Unit in Cambridge, UK

<http://www.newscientist.com/article/dn19592-take-the-ultimate-intelligence-test.html>

a short history of the space station

- 17:49 02 November 2010 by Henry Spencer



The space station's crew snapped this picture of the northern coast of the Gulf of Mexico from an altitude of 350 kilometres on 29 October (Image: NASA)

Today is the 10th anniversary of the start of permanent occupation of the International Space Station (ISS). For those whose memories have grown dim, here are some highlights from the station's first 10 years.

29 July 1970

NASA abandons all hope of further production of its mammoth Saturn V rockets, which launched Apollo astronauts to the moon. As a result, it cancels the *big* space station it had planned to build as a successor to Skylab. With Skylab itself nearly finished, space station work enters a long hiatus.

25 Jan 1984

In his state of the union address to Congress, President Ronald Reagan announces: "Tonight, I am directing NASA to develop a permanently manned space station and to do it within a decade." With contributions from Europe, Japan, and Canada, this becomes Space Station Freedom. Unfortunately, it is repeatedly redesigned, getting further and further behind schedule and over budget. By 1993 it is clearly headed for cancellation.

Sept 1993

With the Cold War over, a US-Russian agreement combines Space Station Freedom and Russia's planned Mir 2 station to produce ISS.

20 Nov 1998

Zarya, the first ISS module, is launched from Baikonur, Kazakhstan.

6 Dec 1998

Unity, the first US module, is docked to Zarya by space shuttle Endeavour. This flight also marks the first crew visit to the station and includes the first station spacewalks. An 18-month hiatus follows, due to funding problems with Russian modules and technical problems with US modules.

21 May 2000

Space shuttle Atlantis visits, preparing the station for resumption of assembly.

26 July 2000

Zvezda – a.k.a. the Service Module, originally built as the core module of Mir 2 – joins the station.

2 Nov 2000

The "Expedition One" crew arrives by Soyuz. Permanent occupation of the station begins.

10 Feb 2001

The Destiny lab module arrives. ISS internal volume now exceeds that of Mir.

23 March 2001

The Russians reluctantly de-orbit Mir, removing ISS's only competitor.

23 April 2001

Canadarm 2, the station's manipulator arm, arrives on the shuttle Endeavour. This is the first non-US/Russian station component, added relatively early because it's needed for later assembly work.

30 April 2001

Dennis Tito becomes the first space tourist to visit ISS, over NASA's strenuous protests.

15 July 2001

The Quest Joint airlock module, a pressurised module that serves as an entryway and exit for spacewalks, arrives. ISS is now heavier than Mir was.

21 July 2001

First spacewalk done from the station itself, using the Quest airlock.

4 Feb 2002

The first significant station emergency occurs when control over the station's orientation, or attitude, is lost for several hours, endangering both power generation and temperature control. Rapid response from the crew and ground controllers resolves the problem before any damage is done.

1 Feb 2003

Space shuttle Columbia is lost during atmospheric re-entry from a non-ISS flight. The shuttle fleet is grounded, making the station entirely dependent on Russian Soyuz and Progress spaceships for crew and cargo deliveries. The resident crew is cut to two, with activities largely limited to maintenance.

6 April 2003

An old rocket component makes a close approach, causing the station crew to briefly retreat to their Soyuz lifeboat in case of collision.

28 July 2005

Discovery makes the first shuttle visit since the loss of Columbia. (The next doesn't happen until a year later, due to continuing problems with foam shedding from the shuttle's external fuel tank during launch.)

26 Nov 2006

A rendezvous antenna aboard a Progress M-58 cargo ship becomes tangled with the end of the station's Zvezda module during docking. It is eventually freed by spacewalkers with cutting tools on 22 February.

11 Feb 2008

The Columbus module – the main European ISS component – arrives. Designed as a lab for biology, physiology, fluid physics and other experiments, it is roomy enough for three crew members to work in at once.

3 April 2008



The European Space Agency's "Jules Verne" ATV supply ship arrives. It is the first non-US, non-Russian vehicle to visit.

4 June 2008

The first part of Japan's bus-sized Kibo lab arrives on shuttle Discovery.

29 May 2009

At long last, the permanent crew is enlarged to the intended six (requiring two Soyuz lifeboats docked to the station at all times), and substantial science work can start.

17 July 2009

With the shuttle Endeavour visiting, there are 13 people aboard, a new record for ISS and for any single spacecraft (and a tie for the all-time record for the number of people in space simultaneously).

17 Sept 2009

HTV-1, the first Japanese supply ship, arrives.

10 Feb 2010

Five vehicles are docked, a "full house": two Soyuz capsules, two Progress freighters, and the shuttle Endeavour.

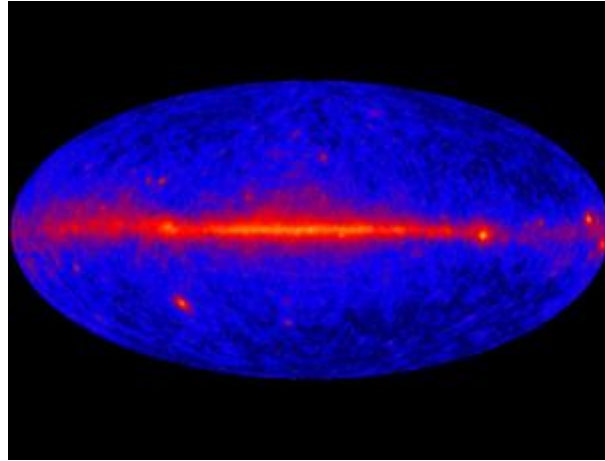
31 July 2010

A pump failure in the cooling system for the power equipment temporarily limits available power and badly curtails operations. Fixed, after several spacewalks and some unexpected difficulties, on 17 Aug.

<http://www.newscientist.com/article/dn19668-high-life-a-short-history-of-the-space-station.html?full=true&print=true>

Hints of lightweight dark matter particle found in space

- 20:51 28 October 2010 by Rachel Courtland



Cannibalistic dark matter particles may be creating gamma rays at the centre of the Milky Way (Image: NASA/DOE/International LAT Team)

Hints of a lightweight dark matter particle have been found in the gamma-ray glow at the Milky Way's heart. The particle's apparent mass lines up with tentative signals of dark matter in two direct-detection experiments on Earth, but other researchers caution that conventional sources – such as pulsars – may be responsible for the gamma-ray light instead.

The Milky Way is thought to be awash in dark matter, an as-yet-unidentified substance that makes up more than 80 per cent of the matter in the universe. Although dark matter has been detected by its gravitational tug on stars and galaxies, many of its fundamental properties are still unknown.

One way to study dark matter is to look for the gamma-ray light produced when dark matter particles meet and annihilate one another, producing a cascade of other particles and radiation. Since dark matter particles rarely interact, the best place to look for this light is at the centres of galaxies, where concentrations of dark matter particles are densest.

The Milky Way's centre seems to be aglow with the light from dark matter annihilation, say Dan Hooper of the Fermi National Accelerator Laboratory in Batavia, Illinois, and Lisa Goodenough of New York University in New York City.

Too bright

In a new analysis of two years of data collected by NASA's orbiting Fermi telescope, the team has found evidence of excess gamma-ray light emitted from the inner 100 light years of the galaxy.

They say the light is too bright, energetic, and confined to be explained by known gamma-ray sources. "We're at a point where we have a clear signal of what we think could be dark matter, without any alternative explanation," Hooper says.

This is not the first time gamma-ray light has been attributed to dark matter. Europe's INTEGRAL satellite, which launched in 2002, also revealed unexpectedly bright gamma-ray radiation coming from the galactic centre.

The excess gamma rays had an energy of 511 keV. That suggested they were produced by annihilations between electrons and their antimatter counterparts, positrons, which in turn may have sprung up in dark matter annihilations. But the glow has proven difficult to interpret, and conventional astrophysical sources such as stellar explosions and gluttonous neutron stars are still likely culprits.

The gamma rays in the purported Fermi excess are 10,000 times more energetic, and may result from the decay of short-lived particles, such as tau leptons, produced in dark matter annihilations. Hooper says the Fermi signal is much harder to explain with astronomical sources: "Other than dark matter, we don't know any mechanism to create this signal."

Direct detection experiments

By analysing the spectrum of gamma rays produced at the galactic centre, the team estimates the light is being produced by dark matter particles that have a mass between 7.3 and 9.2 gigaelectronvolts, roughly 8 times the mass of a proton.

This mass is on the light end of predicted values for WIMPs, the leading dark matter candidate. The particles must be between roughly 10 and 1000 GeV to have been created in sufficient quantities in the early universe to explain the abundance we see today, Hooper says.

Curiously, this mass matches up well with hints of dark matter detections from experiments that hunt for collisions of the particles on Earth. Earlier this year, the Coherent Germanium Neutrino Technology (CoGeNT) experiment, based in the Soudan iron mine in Minnesota, released data showing particle strikes that are best explained by a dark matter particle with a mass between 7 and 11 GeV.

A dark matter particle in a similar range could also be responsible for the signal registered by DAMA, a dark matter experiment buried beneath a mountain at Italy's Gran Sasso mountain. For years, DAMA has registered an annual signal that is stronger in June than in December, consistent with the signal physicists would expect if the solar system were moving through a cloud of dark matter particles.

Garden-variety sources

Do these lines of evidence all point to dark matter? Fermi team member Simona Murgia of Stanford University in California says it is too early to say. The official Fermi collaboration has also reported tentative evidence of excess gamma-ray radiation toward the center of the galaxy, but says the source is unclear.

To determine whether the Milky Way is glowing with the light created when dark matter particles annihilate, astrophysicists must first subtract all known sources of gamma-ray light to see if there is any extra, unaccounted-for radiation.

But estimating the contribution from conventional astrophysical sources is difficult. The inner galaxy is the brightest gamma-ray region in the sky, says Stefano Profumo of the University of California, Santa Cruz. Abundant charged particles that slam into photons and interstellar gas produce a strong, diffuse gamma-ray glow. Individual sources, such as pulsars and supernova remnants, can also shine brightly in gamma rays. "We are far from the point where dark matter annihilation is the only explanation," Profumo says. "The burden of proof to claim new physics should always be set very, very high, and this is no exception."

'Last man standing'

Hooper concedes that the signal cannot be taken as a definitive detection of dark matter. "What we would like now is for experts in various astrophysical processes to explain the signal," he told *New Scientist*. "If they can't, then the only man left standing will be the dark matter interpretation."

But it may take more to declare a true detection. "For a truly compelling case, what we need are signals from a number of independent, but related, experiments that all point to a common solution," says theorist Jonathan Feng of the University of California, Irvine. "I don't think we're there yet, but given the expected experimental progress in the coming months and years, these are exciting times for dark matter."

For hunters of lightweight dark matter, eyes are on the CoGeNT collaboration, which will release its first year of data around December. The accumulated data will have enough sensitivity to register tentative evidence of a seasonal variation like DAMA's, if it exists. "Evidence for a modulation compatible with galactic dark matter is not the same as evidence for dark matter, but it would definitely make the plot thicken," says CoGeNT team member Juan Collar at the University of Chicago.

Journal reference: arxiv.org/abs/1010.2752

<http://www.newscientist.com/article/dn19655-hints-of-lightweight-dark-matter-particle-found-in-space.html>

Superhero suit to strengthen astronauts' bones

- 28 October 2010 by **Rachel Courtland**, Boston
- Magazine issue 2784



Feel the pull in zero g (Image: James Waldie)

WITH its stitching clearly visible and reference lines drawn in marker pen, the stretchy superhero-blue suit at the Massachusetts Institute of Technology's Man Vehicle Laboratory doesn't look like much. But if it works as planned it could offer orbiting astronauts a replacement for something they are sorely missing: gravity.

The microgravity of orbital flight is tough on the bones. Even with regular exercise, an astronaut can lose 1.5 per cent of the mass of some bones in the hips and lower back in just one month. That is similar to the bone loss experienced by a post-menopausal woman in a year.

To combat the problem, Russian cosmonauts on the International Space Station wear space suits designed to mimic gravity. Bungee cords on the suit's arms and legs exert a force that simulates the body's weight. But these suits are difficult to wear for long periods, and it is not clear how effective they are in preventing bone loss.

The team at MIT, led by engineer James Waldie, now based in Melbourne, Australia, has designed a suit that should be more comfortable. Made of an elastic material, the suit is deliberately cut too short for the wearer, and has stirrups that wrap around the feet so that it stretches when the wearer puts it on. The elasticity of the stretched material then pulls the wearer's shoulders towards their feet just as gravity would.

In normal gravity a person's legs bear more weight than the torso. The suit mimics this using vertical ribbons of inelastic material, each stitched into the suit in a series of caterpillar-like loops. The size of the loops limits how far the suit's elastic material can stretch. The more it stretches, the greater the force it exerts, so by allowing the suit's legs to stretch more than its torso the wearer's legs are subjected to the strongest force.



In 2009, prototypes of the suit were tested by three volunteers on a plane that creates brief periods of weightlessness by following a roller-coaster-like flight path (see photo). The suits were easy to move around in, and replicated the tug of gravity on the torso and thighs, but did not provide enough force on the lower legs. The team is now refining the design (*Acta Astronautica*, DOI: 10.1016/j.actaastro.2010.07.022). Members of the design team are now planning to see what happens when they wear the suits overnight.

The spine elongates when it is not compressed - both when people are lying down and when they are in microgravity. The team reasons that if the compressive force of the stretchy suit prevents sleepers' spines from elongating while they are lying flat, it should also help astronauts in space. Lack of gravity has been found to cause astronauts' spines to stretch by as much as 7 centimetres.

Could the suit stop bone loss entirely? Jean Sibonga, a bone specialist at NASA's Johnson Space Center in Houston, Texas, thinks not. While the body's weight does play a part in maintaining bone density, she says impacts and muscle activity play a bigger role in bone health.

<http://www.newscientist.com/article/mg20827843.700-superhero-suit-to-strengthen-astronauts-bones.html?full=true&print=true>

Aircraft bomb finds may spell end for in-flight Wi-Fi

- 18:01 02 November 2010 by **Paul Marks**

The long-awaited ability to use a cellphone or Wi-Fi connection on an aircraft might become a casualty of the latest aviation security threat.

It was revealed on 29 October that parcels containing a powdered explosive packed in laser printer cartridges had travelled undetected on aircraft to the UK and to Dubai in the UAE. A cellphone connected to a detonation circuit could have allowed a terrorist to trigger an explosion by calling or texting the phone. This comes as the aviation industry is gearing up to provide broadband in-flight entertainment systems that feature both cellphone and Wi-Fi connections for passengers. These systems would mean that passengers would no longer need to illicitly use their cellphones when they come into range of ground masts at low altitudes near airports – a potentially dangerous activity that could interfere with the aircraft's avionics.

Growing market

In-flight communications is a fast-growing market at the moment. Market researcher InStat of Scottsdale, Arizona, says that 2000 passenger aircraft are expected to have this kind of satellite broadband communications technology by the end of this year, compared with just "a couple of dozen" in 2008. Last week's discoveries cast doubt on the wisdom of in-flight communications, says Roland Alford, managing director of Alford Technologies, an explosives consultancy in Chippenham, Wiltshire, UK. He says he expects the technology to be scrutinised in the security reviews being undertaken by the UK government and US Department of Homeland Security in the wake of the discovery of the printer bombs.

The UK Department of Transport would not confirm whether the issue would in fact be on its agenda.

Cellphone trigger

It is not yet known whether the cellphones in the printer bombs were intended to be triggered remotely. They may have been intended simply as timers, as in the 2004 Madrid train bombings. But future devices could take advantage of wireless communication.

In-flight Wi-Fi "gives a bomber lots of options for contacting a device on an aircraft", Alford says. Even if ordinary cellphone connections are blocked, it would allow a voice-over-internet connection to reach a handset.

"If it were to be possible to transmit directly from the ground to a plane over the sea, that would be scary," says Alford's colleague, company founder Sidney Alford. "Or if a passenger could use a cellphone to transmit to the hold of the aeroplane he is in, he could become a very effective suicide bomber."

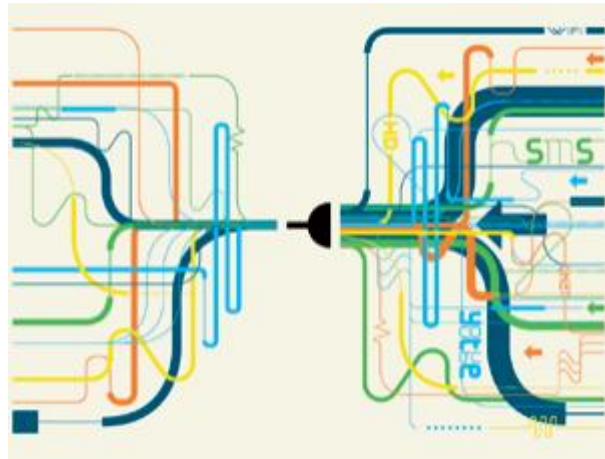
Manufacturers of the technologies will not welcome this fresh security concern, having finally gained airworthiness approval for their in-flight cellphone and Wi-Fi systems by proving that their microwave transmissions do not interfere with avionics.

"There are many ways of coordinating an attack without using a mobile phone," says Aurélie Branchereau-Giles of OnAir, a company based in Geneva, Switzerland, that Airbus is backing as a maker of in-flight cellphone and Wi-Fi systems. "The position of our security experts is that the use of mobile phones on planes does not constitute any additional security threat."

<http://www.newscientist.com/article/dn19665-aircraft-bomb-finds-may-spell-end-for-inflight-wifi.html>

Traffic jam: the coming cellphone crunch

- 02 November 2010 by **Jim Giles**
- Magazine issue 2784.



Its crunch time (Image: [Leandro Castelao](#))

Smartphone users beware – the days of all-you-can-eat wireless data may be numbered

YOUR connection to YouTube might be the first to go, with increasingly choppy videos that one day just fail to download. In your impatience, you decide to scout out the latest posts in the Twittersphere, except that, too, is temporarily down. Your email's stalled, and even a simple text is now too arduous, as the world's phone networks come crashing down. In the following months, it's almost impossible to get a lasting connection - even for a voice call. Welcome to 2013, and the first mobile meltdown.

Although this is the worst-case scenario, some kind of collapse in the near future is a real possibility. Cellular networks are already showing signs of strain: your phone may temporarily cut out in large crowds or at a sporting event or music gig, and if you live in New York, San Francisco or London, you may have found it increasingly difficult to make calls in your home city. And things have the potential to get a lot worse. Data-gobbling smartphones are, of course, the source of the problem, as they overload networks with requests for web pages, email and video streaming 24/7. If the use of these devices grows as expected, cellphone networks across the world could grind to a halt by 2013 - and since many core services depend on wireless communication, the results could be devastating. The only solution will be an overhaul of the way mobile communications are delivered.

Think of it as a road traffic problem. Governments in Europe and the US currently allocate a handful of 5-megahertz chunks of the electromagnetic spectrum to each operator's network, which the operator uses at each of its transmitters. The chunks of spectrum correspond to the lanes of a highway, carrying data either to or from the transmitter. Many operators are given just two 5 MHz chunks - one lane either way - though some may have as many as five pairs.

Like any road, these highways can only hold so much traffic. Current 3G technologies can send roughly 1 bit of data - a one or a zero - per second over each 1 Hz of spectrum that the operator owns. That means a cell tower using one pair of 5 MHz chunks of spectrum can transmit just 5 megabytes of data per second - a handful of streamed videos at most.

Cellphone congestion seemed like a distant prospect a decade ago, when the 3G network was rolled out. At that time, pretty much the only smartphone users were business execs on their BlackBerrys, leaving the 3G network massively underused.

Not any more. Wireless modems - the "dongles" that plug into USB drives - added traffic when they emerged around five years ago. Then, in 2007, Apple launched the iPhone; it has now sold 50 million of the devices.



Suddenly, lots of new people were on the highway, each taking up huge amounts of road space. A single streaming video occupies as much bandwidth as around 100 phone calls, for example. As a result, the 3G highway is now overcrowded, especially in cities where lots of people use smartphones, triggering waves of complaints in New York and San Francisco.

Congestion is likely to be a common problem as enthusiasm for smartphones continues to rise at an extraordinary rate. More than 1.5 million iPhone 4s, the latest version of the device, were sold in the first week after its June launch. And phones based on Google's Android operating system are rapidly gaining popularity. If the growth continues in this vein, mobile traffic will more than double every year for the next four years, according to predictions by the computing company Cisco. Which means that the occasional congestion of today will become gridlock tomorrow, especially in big crowds in sporting events like the Olympics (see "Olympic demand").

In the past, cellphone companies used innovative engineering to increase capacity. By making the jump from 2G to 3G (see "Networks explained"), for example, engineers were able to squeeze 5 to 10 times as many bits per second into each hertz of spectrum, says Simon Saunders of Real Wireless, a consultancy based in Pulborough, West Sussex, UK. This meant more data could rush down the highway without hold-ups.

Could a similar technique stave off the wireless crunch? Internet traffic is often what Saunders describes as "snacky": it comes in bursts as users click on a page, read, then click again. 3G networks struggle with this kind of traffic, but their successors - Long Term Evolution (LTE) and WiMAX - should do better.

These technologies have spent years in development, yet they will only let operators cram roughly 50 per cent more data into the chunks of spectrum before hold-ups will start happening again - a mere drop in the ocean when faced with the rise and rise of the iPhone. If LTE were the only solution in the pipeline, demand might well trump supply in only a couple of years (see graph), according to a recent report commissioned by Research In Motion (RIM), maker of the BlackBerry.

Worse still, any successors to LTE will be unlikely to provide the improvements in data transfer rates that would be necessary to avoid the crunch. "LTE is so advanced and complex that it has required the global output of the entire industry to produce," says Peter Rysavy, a wireless industry consultant based in Hood River, Oregon, who produced RIM's report. "If there was an alternative that worked a lot better they would have found it."

Many cellular operators are optimistic about option number two: widening the road. "If the number of cars on a highway quadrupled without additional lanes then everything would slow down," says Christopher Guttman-McCabe, a vice-president at CTIA - The Wireless Association in Washington DC. "We need more lanes." That would mean dishing out a few more pairs of 5 MHz chunks of spectrum to mobile operators to use on their transmitters.

Before this can happen, governments will have to go through the messy political business of persuading existing owners to part with underused chunks. That is because much of the spectrum in the 400 MHz and 3 gigahertz range that wireless operators use is already spoken for by the military, TV broadcasters and satellite communication. But now is a good time to be bargaining for bandwidth, as the switch from analogue to digital television is freeing up space. The US and UK militaries, which use large swathes of spectrum, will also have slices prised away from them. In the US, the Federal Communications Commission says that these factors, together with reallocations from other owners, will free 500 MHz for cellphones. The UK's communications regulator, Ofcom, has plans to reallocate close to 300 MHz that could be parcelled off to the various networks.

Unfortunately, there may be a wait: William Webb, head of R&D at Ofcom, says the UK's auction may take place next year, but progress is bogged down by arguments between industry and government about who should be able to bid for the additional spectrum. And in the US, it may take 10 years to move all of the 500 MHz over to cellular networks.

Even once that extra spectrum does become available, it will soon be eaten up by smartphone users and their data-hungry apps. "Freeing up spectrum would be helpful," says Stirling Essex of CRFS, a UK company based in Cambridge that sells spectrum-monitoring and management tools. "But even if you double the amount available you'll have a problem in a few years. The demand is insatiable."

Even if you double the available spectrum, you'll have trouble in a few years. The demand is insatiable

Clearly these two routes are not going to allow us to stave off the wireless crunch for long. Might the only solution be to tax the road hogs who are bogging down the networks? iPhone owners are used to paying a flat fee for unlimited internet access through their 3G connection, but charging them for the amount they download would surely rein in their usage. "Economists will tell you that when you make something free people will use a lot of it," says David Cleevely, chairman of Cambridge Wireless in the UK. "We'll see capping on data plans. The operators have to get the genie back in the bottle."

Might the only solution be to tax the road hogs who are bogging down the networks?

AT&T, which provides internet access to iPhone users in the US, has already implicitly admitted as much. This June, the company announced new price plans for the iPhone that come with monthly caps - 200 megabytes and 2 gigabytes for \$15 and \$25, respectively. The move hasn't troubled the majority of iPhone owners, since they can save money by switching from their original \$30 unlimited data plan and, in most cases, will not be bothered by the 2 GB limit, which is equivalent to watching more than 100 2-minute videos in a month. Yet AT&T is quietly letting users know that they cannot expect the days of unlimited browsing to continue forever. These caps may not be onerous, but unpalatable ones could follow unless other ways of dealing with demand are found.

Fortunately, there may be a fourth way that would still leave the door open for cheap and extensive internet use: install a cellphone transmitter in every home and office. These transmitters, dubbed femtocells, look like wireless routers and would plug into broadband connections. By shifting the traffic onto the internet, they would bypass larger conventional cellphone transmitters, which would still serve users when they're out. Femtocells wouldn't be too much of a burden on the home's broadband connection, since the constraints of cell towers have forced engineers to create smartphones that use data far more efficiently than traditional desktops and laptops. Saunders estimates that the technology could boost capacity by a factor of tens or even hundreds.

As an added bonus, it would also make mobile communication more energy efficient. Existing cell towers lose 90 per cent of their energy when the signal passes through an external wall. "Trying to service the need for better indoor coverage with the outdoor network alone is the equivalent of trying to improve the experience of reading in bed by making lamp posts outside brighter instead of installing a bedside lamp," says Saunders.

Sound too good to be true? There are certainly some questions to be answered. Health risks are an easy one to deal with. Despite fears over cell towers, there is no evidence to suggest that radiation from the towers is dangerous. Home transmitters will run at a much lower power, as will the phones that connect to them. So there is no reason to think that femtocells pose a health hazard.

A bigger question is whether femtocells will interfere with each other when packed into urban neighbourhoods. Interference is a problem for all transmitters, and engineers routinely monitor transmissions in areas where signals overlap and tweak the output of towers accordingly. As transmitters have got smaller and too numerous to adjust manually, engineers have developed technology that listens to signals from other sources and makes the necessary changes automatically. So far, these systems have coped. But femtocells will add another layer of complexity, and no one knows whether the automated systems are up to the job.

We will soon find out, however, as the first commercial femtocells arrived in the past year. Vodafone's Sure Signal system, which launched in July 2009 and is essentially a tiny 3G cell tower, is priced at between £40 and £120, depending on the contract that the phone owner has with Vodafone. This March, AT&T rolled out a similar system for \$150. That pricing will probably only attract people who live in areas of bad reception, but demand will rise as prices fall. One operator - Japan's Softbank - has already started giving femtocells to subscribers free of charge.

It will be a rocky road ahead as the operators roll out these possible solutions and jump the inevitable technical hurdles, so we'll have to keep our fingers crossed that all is in place before the crunch hits. But there's no doubting the effort will be worth the struggle: now that we've tasted the wonders of ubiquitous internet, could we ever live without it?

Olympic demand



Cellphone reception is often patchy at big concerts and sporting events, where crowds can number 100,000. But that's nothing compared to the challenge facing the organisers of the 2012 London Olympic Games. The number of athletes, media and volunteers alone will top 100,000, and that's before you factor in spectators. It won't just be phones that they will be using. Journalists will come with wireless microphones and cameras. The emergency services will all need clear chunks of spectrum in the event of trouble. All in all, it's a headache for organisers.

To head off problems, Ofcom, the UK's communications regulator, has already published its plans for managing the spectrum. The organising committee for the London Olympics is building dedicated radio networks, which will take care of the first responders. Spectrum cleared by the switch-over from analogue to digital television will be used for wireless microphones, while the Ministry of Defence and the Civil Aviation Authority will lend the organisers the spectrum needed by wireless TV cameras.

The best laid plans can, of course, be derailed by human error. Ofcom says that equipment operating at the wrong frequency will be the most likely cause of problems, so it may build a network of sensors to pinpoint offending sources.

Networks explained

2G was the first digital network and the technology that sparked widespread use of cellphones. In Europe, the 5 MHz chunks allocated to individual operators are divided into 200 kHz slices of spectrum, each of which handles up to eight calls. Although mainly used for voice calls, it can also transmit data, albeit slowly. On European 3G networks, multiple calls, internet data and other traffic are spread across all of an operator's 5 MHz. By devoting a greater range of frequencies to each user, their data is transferred more quickly - meaning each user's connection should be faster. Congestion can occur, however, if too many people want to use the service at any one time.

The latest networks, WiMAX and LTE, are in some sense a throwback to 2G, since in both cases each operator's 5 MHz allocation is again divided into discrete 200 kHz slices. Unlike 2G, however, data from one conversation or call can be placed in different 200 kHz slices. This on-the-fly allocation helps operators to handle the stop-start signals characteristic of internet traffic and make the most of the available spectrum.

Jim Giles is a correspondent for New Scientist based in San Francisco

<http://www.newscientist.com/article/mg20827841.400-traffic-jam-the-coming-cellphone-crunch.html>

Machine intelligence put to test in alien world

- 01 November 2010 by [MacGregor Campbell](#), Stanford
- Magazine issue [2784](#).



The machines will soon come for us (Image: Jae C. Hong/AP/PA)

Computers that can beat chess grandmasters? Ho-hum. The new challenge for artificial intelligence is a strategy game called StarCraft

A SQUADRON of tanks sits patiently on a bridge. Smaller reconnaissance vehicles inch nervously ahead, probing for signs of the enemy. Suddenly, two allied spaceships zoom overhead. They illuminate a horde of hidden alien spider-robots. The aliens' cover blown, they attack. The battlefield erupts into chaos.

Called *StarCraft*, this space-war strategy game is played in real time. It's normally played by humans, but this particular match is different. The commanders in charge of each side are sophisticated artificially intelligent "bots" competing in the first ever *StarCraft* AI tournament, the finals of which were held earlier this month at Stanford University in California. The game is emerging as the next arena to put machine intelligence to the test - and could even provide the inspiration for the next big advance in AI.

Games and AI have a history. As far back as the 1950s, computers were programmed to play chess. It wasn't until the late 1980s, however, that they started beating human grandmasters. Since then, other games, such as poker, go, and even the [quiz game Jeopardy](#), have attracted the interest of AI researchers.

"Chess is hard because you need to look very far into the future. Poker's hard because it's a game of imperfect information. Other games are hard because you have to make decisions very quickly. *StarCraft* is hard in all of these ways," explains [Dan Klein](#), an AI researcher at the University of California, Berkeley, and adviser to one of the tournament teams.

The allure of *StarCraft* for AI researchers lies in the game's extreme complexity. Players compete to harvest resources, build an army, and battle each other in realms filled with bottlenecks, alleys and strategic high ground. Armies can be as large as 200 independently controlled units, each with different strengths, weaknesses and special abilities, such as invisibility cloaking, flying or teleportation. Unlike chess, units aren't confined to squares, but rather are in constant motion - a couple of second's distraction can be the difference between victory and defeat.

"An AI bot has to interact, reason about multiple goals concurrently, act in real time, deal with imperfect information - a lot of the properties of building robust intelligence are there," says tournament organiser [Ben Weber](#), a graduate student at the [Expressive Intelligence Studio](#) at the University of California, Santa Cruz.

An AI bot has to interact, reason about many goals and act in real time with imperfect information

What's more, while chess AIs traditionally use software that searches for all the permutations of moves and counter-moves, it is infeasible to write such a program for a game as expansive as *StarCraft*, says David Burkett, a member of a team entered by Berkeley.

One reason for that is that players don't take turns: military units are constantly being built, moving, scouting for advantageous positions and, of course, fighting. And in general, opponents cannot see what the enemy is up to until the fighting begins.

The 28 competitors in the AI tournament coped with this complexity in a variety of ways. The most basic is scripting, where a programmer writes a set script for the bot to follow, independent of what is happening in the game. Weber describes this approach as "rock, paper, scissors", in that the bot may win if it happens to be executing the right script for what the opponent is doing, but if not, it cannot adapt and react.

A more sophisticated approach is the finite state machine (FSM), a technique that designers of videogame AI have long used to give the illusion of intelligence. In this approach, a bot has discrete behaviours from which it can choose, depending on the inputs given to it. The ghosts in *Pac-Man* are a classic example, toggling between "chase" and "evade", depending on whether or not the eponymous yellow gobbler has eaten a power pill. In *StarCraft*, FSMs can be used both to control individual unit tactics on the battlefield, and at higher strategic levels of deciding which units to produce and when.

FSMs are limited, says Klein, in that a human usually needs to define how and when to transition between behaviours, meaning the bot can fail if it encounters a situation that it wasn't explicitly programmed to handle. A third approach relies on machine learning. Bots are trained on thousands of hours of game replays to find which strategies and tactics are statistically most likely to be successful, given the current game conditions. This approach can be combined with learning from trial and error, much as a human player might train. The bot learns from its mistakes and from the mistakes of others. Most competitors relied on a mixture of techniques.

The tournament itself was broken up into four categories, designed to make the complexity of the game more manageable for the bots, which are still not as skilled as an expert human player. The first two categories pitted small fixed-size armies against one another on simple terrain. An FSM-based bot won both categories by choosing better attack formations than its opponents.

In the third category, bots had to harvest resources, select from a limited set of buildings and military units, and fight. But unlike the full game, they were allowed to see their opponents preparing. The winning bot used a mimicking strategy, copying its opponent's build order while throwing in a few scripted tricks to gain the upper hand.

The final category of the tournament pitted bots against each other in "best-of-five" rounds on different maps, with access to the full functionality of the game. The winner, the Berkeley team's "Overmind" bot, used a mix of FSMs, machine learning, and a limited form of chess-style prediction, to control swarms of flying units which aimed to constantly harass the opponent.

Burkett says that tournaments like this can help advance the field of AI. Simple problems in *StarCraft*, like finding a path across a map, can be handled by traditional AI. But solving many problems simultaneously and quickly will require new ideas.

"There are a lot of good AI research problems involved in getting this thing to work," says Burkett. His team plans to submit details of the approach employed with Overmind for publication in a journal.

For now, however, human players remain the champions of *StarCraft*. In an exhibition match at the tournament, Oriol Vinyals, a former world-class player and member of the Berkeley team, took on one of the top-ranking bots. After a brief struggle, he easily defeated his AI opponent. He doubts this will always be the case.

"In 2 to 3 years, I would expect bots to be in the top 5 per cent of players," he says. "Beating the best human player doesn't seem out of the question."

A beginner's guide to starcraft

In *StarCraft*, players battle as one of three space-faring races, each geared towards a different style of play. The stoic Protoss favour strong, but expensive, warriors. The Zerg tend to overrun opponents with sheer numbers. Terrans prefer a mixed approach and can adapt. All races must harvest resources, build bases, make units, scout and fight.



In this image from the *StarCraft* AI tournament, flying blue Zerg are attacking yellow Terrans on the ground. The annotations give a glimpse of the thinking of the AI bot playing as Zerg. In the top left of the map, the bot has chosen to target an undefended Terran worker, circled in green. The red lines show planned movement; the white lines link Terran soldiers it has identified as threats.

The game has sold over 9.5 million copies since it was released in 1998 and is particularly popular in South Korea, where some players play professionally and matches are broadcast on TV. Top pros can earn hundreds of thousands of dollars per year through tournament winnings and endorsement deals.

Much like chess, there are a canon of known effective strategies. One player might opt for slow-to-develop but versatile flying units, for example, while another employs an "all or nothing" rush strategy, with cheap, but weak, attack units.

StarCraftIII was released in July.

<http://www.newscientist.com/article/mg20827845.400-machine-intelligence-put-to-test-in-alien-world.html>



Captcha adverts capture your attention

- 30 October 2010
- Magazine issue 2784.

IT IS an online advertiser's dream. Some ads on the websites you visit could soon be impossible to ignore, as they will be integrated into the "captchas" used to check whether site visitors are human.

With many web users using tools to block online adverts, companies must find new ways to get their message across. Software firm NuCaptcha, based in Vancouver, Canada, believes the answer lies in captchas, as they require a user's full attention to solve.

The firm has created NuCaptcha Engage to exploit this. Instead of the traditional squiggly word that users have to decipher, the new system shows them a video advert with a short message scrolling across it. The user has to identify and retype part of the message to proceed. Companies including Electronic Arts, Wrigley and Disney have already signed up.

<http://www.newscientist.com/article/mg20827845.200-captcha-adverts-capture-your-attention.html?full=true&print=true>

Will we cope if the rare earths live up to their name?

- 29 October 2010 by **Katharine Comisso**
- Magazine issue 2784.

China has control of most rare earth extraction
(Image: Nelson Ching/Bloomberg/Getty)

FOR decades, the world has been busy incorporating the so-called rare earth elements into all manner of high-tech devices, including disc drives, wind turbines and hybrid cars. The messy business of mining the ore and extracting the elements was left to China, and few people in the west cared that the nation controlled 97 per cent of world supply.

"Rare earth" is an alternative name for the lanthanides - elements 57 to 71 - plus yttrium and scandium, and despite the name most of them were not considered rare at all. The elements hit the headlines a few weeks ago, when China appeared to be blocking exports to Japan and the US. The Chinese government, which has also been tightening its export quotas, claims that it needs to clean up mining procedures and support its own growing demand for rare earths.

So what can the rest of the world do about it? The most obvious course of action is to open mines elsewhere, since China accounts for little more than a third of known reserves. The biggest importer, Japan, is hoping to open a mine in Vietnam. And in the US, Molycorp Minerals plans to reopen its Mountain Pass mine in California, which has not been active since radioactive waste leaked from a pipe there in 2002.

However, facilities to refine rare earths cannot be created overnight, and few US scientists know how to do it anyway. "Even if Molycorp can get material mined and concentrated right now... it would have to send that material to China to get it refined," says Gareth Hatch of Technology Metals Research, a consultancy firm in Carpentersville, Illinois.

Recycling is another option, but impurities sneak in during the process, so recycled materials are not always as good as the freshly refined equivalent. The neodymium magnets used in hybrid cars, for example, work less well at high temperatures when recycled neodymium is used.

Some items containing rare earths are reusable. The neodymium magnets in computer disc drives, for example, usually outlast the computer they are in, but disc drive manufacturers have till now found it cheaper to use new magnets than to reuse old ones.

The scarcity issue is being tackled in a different way by Kazuhiro Hono of Japan's National Institute for Materials Science in Tsukuba. Dysprosium is one of the rarer rare earth elements, so Hono is reducing the amount of the element in the permanent magnets used in hybrid cars.

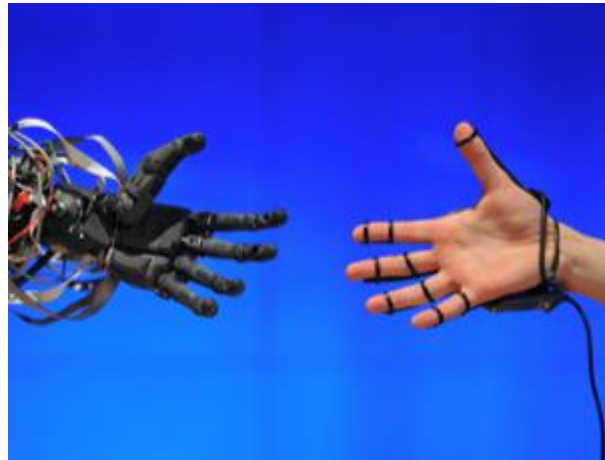
Hono hopes the crisis will encourage more scientists into the field. "The important thing is to recognise the importance worldwide," he says. With efforts focused on innovation, he adds, "the solution to this problem will come out in the future".

<http://www.newscientist.com/article/mg20827843.900-will-we-cope-if-the-rare-earths-live-up-to-their-name.html?full=true&print=true>



Better hands may help robots grasp meaning

- 10:25 29 October 2010 by Helen Knight



New research could be handy for robots (Image: Nils Jorgensen/Rex Features)

Two recent studies show that roboticists are applying some fresh thinking to the building and operation of robot hands, and a third suggests why the work is so important – it could be vital for domestic robots learning how to be useful around the home.

Silicon Valley start-up Willow Garage put its PR2 robot on the market earlier this year. It sports two gripper-equipped arms and has demonstrated its ability to use them to fetch a cold beer or fold a towel. But it relies on sophisticated sensors and extensive pre-programming to know how best to grasp an object and how hard to squeeze to maintain a firm grip without causing damage.

Siddhartha Srinivasa at Intel Labs in Pittsburgh, Pennsylvania, and colleagues think they have found a way to do it without the pre-programming. At last week's International Conference on Intelligent Robots and Systems in Taipei, Taiwan, his team discussed using Amazon's Mechanical Turk to help robots pick things up. AMT is an online service that uses a human workforce to carry out tasks that are simple for people but difficult for computers and robots to complete unaided. It's already been used to help lost robots find their bearings, but Srinivasa's team used it to ask people to annotate images of objects the robot comes across. By adding outlines of objects, and grouping objects, the humans helped the robot to pick up a range of objects including a milk carton and a box of Pop-Tarts.

Too smart?

This may be applying more intelligence to the task than is really needed. Eric Brown at the University of Chicago and colleagues have just developed a "dumb" robot gripper that can pick up a range of unfamiliar and even delicate objects with no prior knowledge of them.

"Our gripper is simpler because it does not need tactile sensing, a computer, or precise vision, other than the need to know the general location of the object," says Brown, who developed the device with a team from robot manufacturer iRobot, based in Bedford, Massachusetts, and the Pentagon's Defense Advanced Research Projects Agency.

The "hand" is simply a rubber bag filled with small glass spheres that flows around the object to be picked up. A pump then creates a vacuum in the bag, jamming the spheres in place and hardening the robot gripper around the object. Because the gripper moulds itself around the object before hardening, its force is

distributed evenly across a large surface area, meaning it can pick up even delicate objects like raw eggs without crushing them, says Brown.

Ikea test

Robert Platt of the Computer Science and Artificial Intelligence Laboratory at the Massachusetts Institute of Technology says the robot gripper would be great for picking up difficult objects like small nuts and bolts on an assembly line, for example, or turning a door knob in your home – but he doubts whether a dextrous hand alone will lead to more intelligent robots. "It wouldn't be able to put together a piece of Ikea furniture," he says.

The members of a Europe-wide project called Paco-Plus might disagree. Co-ordinator of the project Tamim Asfour at the Karlsruhe Institute of Technology in Germany says picking up and handling objects is central to robot learning. The strategy should sound familiar – such manual exploration is used by babies to learn about their bodies, the objects around them and their environment.

"Our robots are able to explore the environment and learn about objects and the actions they can apply to them," he says. One of the project's robots – Armar III – has now gleaned enough knowledge from its kitchen-like environment to learn how to open a dishwasher door, pick up a cup, turn it upside down and put it into the machine.

<http://www.newscientist.com/article/dn19656-innovation-better-hands-may-help-robots-grasp-meaning.html?full=true&print=true>

Brain link lets people choose images by thought alone

- 28 October 2010 by **Jessica Hamzelou**
- Magazine issue 2784.

IMAGINE being able to manipulate images on a screen by thought alone. That's the tantalising prospect raised by a brain-machine interface that lets you control which of two competing images you can see on a screen.

Moran Cerf at the California Institute of Technology, Pasadena, and colleagues recruited 12 volunteers who had electrodes implanted in their brains to record epileptic seizures. That meant the team could record activity in the normally inaccessible medial temporal lobe. The MTL houses the hippocampus and amygdala, which are involved in memory and emotions.

Cerf first talked to each person about their interests and recent experiences - the concepts making up their recent memories.

His team then created a database of images to correspond to those concepts, such as a picture of the Eiffel Tower for a person who recently visited Paris, France. Next each person had their brain activity recorded as they looked at 100 of those pictures six times. The team could then identify the individual neurons that fired in response to each image.

The team then chose two images for each person that caused firing in different individual neurons. The two pictures were superimposed, and the person asked to control the strength of each image by focusing on the concepts related to each picture. A brain-machine interface translated the neural activity related to an image so that it was portrayed more or less vividly on the screen. In 70 per cent of tests, volunteers were able to bring one image to the fore (*Nature*, DOI: 10.1038/nature09510).

Although humans and monkeys can already control the movement of a robotic arm via the brain's motor cortex, this is the first time anyone has been able to tap into the neurons associated with individual concepts. Fabien Lotte at the Institute for Infocomm Research in Singapore says the findings could be useful clinically. "A paralysed person could increase the activity in a neuron that corresponds to the person they want to call, for example," Lotte says.

A paralysed person could increase the activity in a neuron that corresponds to who they want to call

<http://www.newscientist.com/article/mg20827843.800-brain-link-lets-people-choose-images-by-thought-alone.html>

Professional climate change deniers' crusade continues

- 02 November 2010 by **Michael Mann**
- Magazine issue 2784.



watch out, deniers about (Image: Steve Fricker)

*In the media and the courts, the battle to undermine climate science and its researchers hasn't let up, warns climatologist **Michael Mann***

I'D LIKE to say I was surprised when news broke a year ago that emails from the Climatic Research Unit at the University of East Anglia, UK, had been hacked into and leaked, and that scientists' personal emails were being quoted out of context to disingenuously imply impropriety on their part. But I wasn't.

Books such as *Merchants of Doubt* by science historians Naomi Oreskes and Erik Conway have detailed how front groups for the fossil-fuel industry have been waging an orchestrated, well-funded campaign against climate science and climate scientists for more than two decades. Hacking into the CRU's email was simply the latest skirmish in this war against science, timed to forestall any progress towards lowering carbon emissions at the Copenhagen climate conference being held about a month later.

In January this year, the state of Virginia swore in Ken Cuccinelli as its attorney general. Cuccinelli was already known to have a radical agenda that included trying to end protection of the rights of gay college students. This agenda soon proved to extend in other directions, too.

In February, Cuccinelli filed a request with the US Environmental Protection Agency (EPA) about its findings that greenhouse gases endanger public health. He said that he was also looking for judicial review in the federal court. As his press statement explained, he took issue with "unelected bureaucrats with political agendas", who, he alleged, were using "falsified" data to regulate US industry and destroy the economy.

A few weeks later, on 1 April, Cuccinelli announced - and despite the date, he wasn't joking - that he planned to challenge the March 2010 standards on fuel efficiency for cars and trucks that had been finalised by the Obama administration and the EPA. He also issued a civil subpoena to my former employer, the University of Virginia, demanding that they hand over 10 years' worth of emails and documents of mine, including correspondence with more than 30 other leading climate scientists.

The intent was clear: in my view, it was to uncover yet more emails that climate change deniers hoped would further embarrass climate scientists.

So why the ongoing attacks against me by Cuccinelli and other groups and individuals doing the bidding of the fossil fuel industry? Undoubtedly, it is because of the prominent role our now decade-old "hockey stick" reconstruction of past temperature trends has played in public discourse on climate change. The graphic, which I helped to create while I was a postdoctoral researcher at the University of Massachusetts, tells a simple story: that the warming of recent decades is unprecedented in at least a millennium. This has made it a compelling icon in the climate change debate. It has also made the graphic a compelling target for climate change deniers, who believe that they can discredit all climate science by undermining the credibility of this one graphic.

The problem for them, however, is that dozens of groups, using different statistical methods, different data sources, and so on, have all come to the same conclusion as our study: recent warming is anomalous in a long-term context. In fact, the Intergovernmental Panel on Climate Change (IPCC) in its 2007 report extended the period of warming back even further to at least the past 1300 years.

Moreover, the case for human influence on climate change hardly rests on our palaeoclimate research, or even on the entire field of palaeoclimatology. It is based, instead, on multiple lines of evidence and, in particular, the match between modern observations and the predictions of simulations using climate models.

The case for human influence on climate change rests on multiple lines of evidence

In August, Judge Paul M. Peatross ruled in Virginia's Albermarle county circuit court that the attorney general had not demonstrated any wrongdoing on my part, and set aside Cuccinelli's subpoena. That was a good day for my colleagues and me, the university, and for science. The decision was celebrated by scientific, academic and civil liberty organisations across the country.

Sadly, on 4 October, Cuccinelli returned to the fray with another civil subpoena going over similar ground. He targeted a single internal University of Virginia research grant. The grant in question had nothing to do with the "hockey stick" work, or even climate change; it was for the investigation of interactions between land, atmosphere and vegetation in the African savannah. That Cuccinelli would try to argue that the funding of this grant allows him to go on a fishing expedition to trawl through 10 years' worth of email in an effort to discredit the hockey stick work speaks to the strength of his beliefs.

Fortunately, individuals and organisations of conscience have spoken up. *The Washington Post* blasted Cuccinelli's latest actions as an "embarrassment" to the great state of Virginia, and quoted Rachel Levinson, senior counsel with the American Association of University Professors, as saying that Cuccinelli's request had "echoes of McCarthyism".

Cuccinelli's actions also underscore the remarkable disconnect between the rhetoric of climate change denialism and reality. While professional climate change deniers continue their crusade against climate science, this year is likely to go down as either the warmest or the second warmest on record.

Michael Mann is director of the Earth System Science Center at Pennsylvania State University

<http://www.newscientist.com/article/mg20827840.100-professional-climate-change-deniers-crusade-continues.html>

Clearing tropical forests is a lose-lose

- 19:00 01 November 2010 by **Michael Marshall**
-

Clearing tropical forests for farmland is bad for the climate – no surprises there. But now we've learned that it's also an inefficient way to feed people.

Paul West of the University of Wisconsin-Madison and colleagues worked out the potential yields of 175 different crops if they were planted in different parts of the world.

Then they estimated how much carbon would be released into the atmosphere by clearing these areas of wild plants.

"In the tropics, clearing a hectare of land releases twice as much carbon as in the temperate zones, and only produces half as much food," says West.

"If we want to balance increasing food production and decreasing carbon emissions, we should emphasise increasing crop production on existing lands."

Trouble in the tropics

"Continued expansion of croplands into tropical forests results in a lose-lose situation for growers and our climate system," agrees Gregory Asner of Stanford University in California, who was not involved in the study.

However, he warns that boosting yields on existing lands can cause other problems, such as nitrogen pollution from fertiliser run-off. "We need to take such unintended consequences into consideration as well," he says.

Journal reference: *Proceedings of the National Academy of Sciences*, DOI: 10.1073/pnas.1011078107

<http://www.newscientist.com/article/dn19662-clearing-tropical-forests-is-a-lose-lose.html?full=true&print=true>

Why western science conquered the world

- 01 November 2010 by **Ian Morris**
- Magazine issue 2784.



Unlocking the secrets of the universe (Image: Geoffrey Robinson/Rex Features)

*History boils down to biology, and geography can be unfair, says **Ian Morris**: but the advantages they confer may not last forever*

Trinity College, Cambridge, 1669

ISAAC NEWTON rubbed his eyes. He was tired but excited after another long day polishing lenses in the Chinese Astrocalendrical Bureau, where he worked as a lab assistant. The bureau was abuzz about a new mathematical technique that its young director, Mei Wending, had just brought back from Beijing. Using this new method, Mei claimed he could calculate the laws of motion of the celestial bodies, which the emperor back in Beijing hoped would so impress Europe's backward rulers with the superiority of Confucian wisdom that they would welcome the expansion of China's global trade.

Mei and his master were to be disappointed. King Charles II's courtiers in London cared more for superstitious quarrels than for finding truth, and eventually expelled the Chinese scientists. Newton, inspired by the beauty of Mei's calculus, devoted his life to showing that its fluxions and fluents unlocked the secrets of the universe - but to no avail. In 1704, Mei went back to Beijing, to spearhead scientific and industrial revolutions that were to give China global mastery. Newton stayed in chilly Cambridge, frustrated and forgotten...

Of course, things didn't happen that way. Newton and Mei are real enough, but China did not bring advanced techniques to 17th-century Europe. Instead, European astronomers took their techniques to China. Charles II didn't throw out Chinese scientists, but China's Emperor Kangxi did expel the Europeans. And, most importantly, Chinese science didn't deliver global domination to the east: European science delivered it to the west.

So how did we end up with a world where Newton, not Mei, founded classical physics? Where Britain, not China, had the first industrial revolution? And where American atomic bombs levelled Hiroshima and Nagasaki, rather than Japanese bombs obliterating Chicago and New York?

Why, in short, has science been western?

There are countless theories. Are westerners just smarter than the rest? Is it the influence of the ancient Greeks' logic? Despite appearances, does western religion leave more room for science? Could it be luck? After all, China, North Korea, Pakistan and India now all boast nuclear weapons, Chinese astronauts have

walked in space, and robotics is as advanced in Japan and South Korea as anywhere on earth. Western domination of science may have been a phase, which will end soon.

Testing these theories against history would mean going back to humanity's beginnings - and ranging over the planet. Not surprisingly, historians balk at working on such a scale. To answer this manageably, they need to take the advice evolutionary biologist Jared Diamond and political scientist James Robinson offered in *New Scientist* earlier this year (1 May, p 24), and act more like natural scientists. We might even go further and argue that history has become a sub-field of biology, focusing on the behaviour of one animal, *Homo sapiens*. History has become a sub-field of biology, focusing on one animal, *Homo sapiens*

To show this, we need to step back from the details. Three big things become immediately clear: first, wherever we find them, people are much the same; second, thanks to shared biology, history has unfolded along more or less the same lines worldwide; third, history has not unfolded at the same pace globally.

This third observation tells us why science has been western - and why it may not remain so much longer. The reasons have nothing to do with race, culture, religion or great men. Nor do they have much to do with luck. But they have everything to do with a force that is also fundamental in biology: geography.

If we look back 12,000 years to when the world warmed up after the last spasm of the Ice Age, we see that geography is unfair, driving different places at different speeds. In the so-called "lucky latitudes", a band stretching from China to the Mediterranean in the Old World, and from Peru to Mexico in the New World, climate, topography and ecology conspired 12,000 years ago to allow the evolution of unusually high numbers of plants and animals that could be domesticated.

This vastly increased the food supply for humans, and because people are much the same wherever we find them, it was in these latitudes that humans first domesticated plants and animals. Fuelled by such resources, they would also be the places where over the next 10,000 years people would create the world's first cities, states and empires.

People in Australia, Siberia or sub-Saharan Africa stuck with hunting and gathering not because they were lazier, more stupid or better attuned to nature than the others, but because geography endowed their homelands with fewer resources, so domestication took longer.

Nor was geography even-handed within the lucky latitudes. The area archaeologists call the "hilly flanks" around the Euphrates, Tigris and Jordan valleys in south-west Asia had especially dense concentrations of plants and animals fit for domestication. Here, around 9500 BC, people turned into the world's first farmers; then they became urbanites around 3500 BC, and imperialists around 750 BC.

By 500 BC, they had also developed the first forms of what we might reasonably call science. As populations grew, the agricultural centres in western Eurasia expanded, carrying farming, cities, states, empires and proto-science across Europe - ultimately becoming the civilisation we label "the west".

Lagging behind

China, Pakistan's Indus valley, Mexico and Peru all emerged from the Ice Age with rather less dense concentrations of domesticable plants and animals than the hilly flanks. In each case, farming developed a couple of millennia later (after 7500 BC), with cities, states and empires following further time-lags. Some 2000 years ago, a continuous band of agrarian empires ran across the lucky latitudes from Rome to Han-dynasty China; in the Americas, Teotihuacan, the Maya and the Moche were following the same path. Rome, the heir of the oldest centre at the western end of Eurasia, remained the biggest and richest region, and home to the strongest scientific culture of all. So is this why science is considered to be a western artefact? Do we honour Newton rather than Mei simply because the west hung on to a 2000-year lead geography gave it at the end of the Ice Age?

The reality is rather more complicated. Consider this: from AD 500 to 1500, Chinese science led the world, with Muslim science lagging far behind and European further still. The role of geography here is complex, driving history, but not straightforwardly. While geography dictates the speed at which different parts of the world develop, the speed of development simultaneously dictates geography's meaning.

To illustrate this, look at western Europe, sticking out into the cold waters of the north Atlantic. Five thousand years ago, geography placed the land mass at a huge disadvantage. It was far from the centres of action in Egypt and Mesopotamia, where people were building the world's first cities, writing down its first epics, and waging its first organised wars. Geography was making western Europe backward.

But fast-forward to 500 years ago, and the same geography was making western Europe rich and powerful. While Germanic, Arabic, and Turkish invaders fought over the ruins of Rome, a new medieval empire had reunited China, sparking centuries of scientific advances. Not least among those advances were two 13th-century inventions: ships that could cross oceans, and guns that could shoot the people the sailors met on the other side. Everyone found the new tools useful, and they spread rapidly across Eurasia. But as they did, they changed the meanings of geography.

Suddenly, the disadvantage of sticking out into the Atlantic became a huge plus. Western European sailors had to sail half as far as the Chinese to reach the Americas. Before ocean-going ships, that was of no importance, but once the ships existed it became crucial. Since all people are much the same, geography now dictated it would be west Europeans rather than the early modern world's greatest sailors, the Chinese, who discovered, colonised and plundered the Americas. Chinese sailors were just as daring, their settlers just as intrepid, but geography had now stacked the deck in favour of the west.

So it was the Europeans rather than the Chinese who created a new kind of maritime market economy, exploiting comparative advantages between continents, and it was the Europeans rather than the Chinese who saw the benefits in explaining how winds and tides worked. A chain of intellectual breakthroughs followed, generating better ways of measuring and counting, and cracking the codes of physics, chemistry and biology. This fuelled a scientific revolution in Europe, not China. By 1800, science and the market economy were creating incentives and opportunities for western entrepreneurs to mechanise production and tap the huge power of fossil fuels. Once again, it was the west (Britain) and not China or Japan that had an industrial revolution and learned how to project power globally.

The back-and-forth between geography and social development reveals why science has been such a western activity, and it may also give us clues about what will happen next, as the engine of geography, biology and social development continues to roll. By 1900 a British-dominated global economy had drawn in the vast resources of North America, converting the US from a backwater into a global centre. By the 20th century, a US-dominated global economy had in turn drawn in Asia's resources, turning Japan, the "Asian tigers" and China and India into global centres.

In my book *Why the West Rules - For Now*, I have tried to quantify the history of social development, which suggests that if change continues through the 21st century at the same speed as it did in the 20th, the east will catch up with the west - in 2103, to be implausibly precise. But if the rate of change continues to accelerate as it has done since the 15th century, we can expect global dominance, and the world's scientific centre of gravity, to migrate to east Asia as soon as 2050.

So far, so clear - but for one niggling detail. The past shows that while geography shapes the development of societies, development also shapes what geography means, and in the 21st century the meanings of geography seem to be changing faster than ever. If current technological trends continue, exponential growth in computing and interconnection may rob geography of its meanings altogether, flattening and shrinking the world so as to strip "east" and "west" of all significance. But current trends in global problems such as nuclear proliferation, climate change, mass migration, pandemics, and food and water supply may mean that they spiral out of control even faster.

The 21st century will be a race between worldwide transformation (a singularity of some sort) and worldwide catastrophe (what, following science-fiction writer Isaac Asimov, I call nightfall) - each on an unimaginable scale. Whichever wins, the next 100 years are likely to bring more change than the previous 100,000. Perhaps the real lesson of history is that by the time the east overtakes the west, it will no longer matter much that Newton, and not Mei, was the father of classical physics.

The next 100 years are likely to bring more change than the past 100,000

Profile

Ian Morris is a historian, archaeologist and classicist at Stanford University, California.

This essay is based on ideas from his latest book, *Why the West Rules - For Now: The patterns of history and what they reveal about the future* (Profile, 2010)

<http://www.newscientist.com/article/mg20827841.100-why-western-science-conquered-the-world.html>

Arctic narwhals reveal climate-model errors

- Updated 17:04 01 November 2010 by [Gaia Vince](#)



Just going about their business, but that suits researchers just fine (Image: Flip Nicklin/Getty) Narwhals diving nearly 2 kilometres below polar ice have revealed that climatology models used for the Baffin bay region – which links the Atlantic and Arctic oceans – underestimate winter ocean temperatures there by as much as 1 °C.

The new data gathered from narwhals tagged with a temperature-depth gauge and satellite transmitter - a package around the size of a deck of cards - show that earlier warming between Greenland and the Baffin Islands of Canada has continued over the last decade.

They provide the best winter temperature measurements yet for this biologically important part of the Arctic Ocean, and add to a body of data showing that ocean temperatures around the world are warming.

The Arctic mammals, known as "sea unicorns" thanks to their single long tusks, also transmitted measurements for the winter layer of surface water that shields sea ice from the warmer waters below. On average The thickness of this layer of water, or isotherm, varies throughout the region, but the narwhal data show it to be 50 to 80 metres thinner than the climatology models, according to [Kristin Laidre](#) of the Polar Science Center at Washington University in Seattle, and her colleagues, who carried out the study.

A thinner isotherm allows faster turnover of warmer waters from below, which speeds ice-melt. The process is self-perpetuating: as ice melts, the ocean absorbs more heat and melts more ice, and so on.

Ice-free summers

"Their findings indicate that the transfer of atmospheric heat into the oceans may be higher than we thought," says climatologist [Walt Meier](#) of the National Snow and Ice Data Center at the University of Colorado at Boulder, who was not involved in the study.

Baffin bay is an unusually abundant zone of the Arctic Ocean, rich in fish and aquatic mammal species that are considered vulnerable to climate change, but the waters there remain poorly sampled with almost no measurements during winter when it is difficult and expensive to navigate. As a result, climatology models for the region have been based on summer data and are unreliable.

Now, data from three winters of narwhal-gathered measurements in December to March of 2005, 2006 and 2007 finds that the models are out by a whole degree on average. However, the narwhal measurements do correlate well with one-shot samples taken by winter helicopter surveys. The warmest temperatures recorded by the whale oceanographers was 4.6 °C at depths of 380 to 580 metres.

"One degree Celcius above the climate model is significantly warmer and shows that the models may not be sensitive enough to be useful," Meier says.

Ideal researchers

Laidre's team began taking measurements in 2005, by capturing 14 narwhals (*Monodon monoceros*) in nets and attaching the electronic gear to the animals' dorsal fins.

Narwhals frequently dive to deep waters – the deepest recorded in this study was 1773 metres. They return regularly to the surface (when the data is sent via polar-orbiting satellites) and are untroubled by surface ice. The animals are "highly efficient and cost-effective", Laidre says, and they always return to the same wintering ground, so there is a geographical consistency in the data they record. And they don't require feeding or payment. In short, they are perfect accomplices.

Journal reference: *Journal of Geophysical Research*, DOI: [10.1029/2009JC005820](https://doi.org/10.1029/2009JC005820)

<http://www.newscientist.com/article/dn19658-arctic-narwhals-reveal-climatemodel-errors.html>

Are we having another food crisis?

- 13:04 28 October 2010 by **Debora MacKenzie**



Under water is a rotten place for maize (Image: David Greedy/Getty)

The world food price index is at its highest since 2008, when food prices rocketed and millions of people suffered. This year the crisis seems to be happening again. Prices for the staple grains that underpin the world's food supply soared after forecasts for the US and Chinese maize harvests fell in October, Pakistan lost its wheat to floods, and crop losses to drought and wildfire led Russia to ban grain exports until 2011. Food prices have soared in India, Egypt and elsewhere and are being blamed for riots in Mozambique. Are we having another food crisis? *New Scientist* investigates.

Is this another crisis like the one we had in 2008?

Not quite. Maximo Torero of the International Food Policy Research Institute (IFPRI) in Washington DC notes that oil, the real driver of food prices and of the 2008 crisis, is relatively cheap, at around \$75 a barrel, not over \$100 as it was in 2008.

In 2008, both immediate grain prices, and the prices offered for future grain purchases in commodities markets, climbed steadily for months, whereas now they are spiking and dipping more unpredictably, which economists call volatility.

"The market fundamentals – supply and demand – do not warrant the price increases we have seen," says Torero. Not all harvests have been bad, and after 2008 countries rebuilt grain stocks. "There are enough stocks in the US alone to cover the expected losses in Russia."

The food riots in Mozambique were not due to world grain prices, he says, but because Mozambique devalued its currency, making imported food more expensive.

So what has been happening this year?

Markets are responding nervously to incomplete information. First there was a series of shocks: Russia's export ban, lower maize forecasts, then, days later, a US ruling to allow more bioethanol in fuel which seemed likely to further reduce the maize – the main source of bioethanol – available for food. Meanwhile there was no reliable information about grain stocks, which is strategic information that most countries keep secret.

The result was nervous bidding and sporadically surging prices in commodity markets. And that attracted the real problem: investors wielding gargantuan sums of speculative capital and hoping to make a killing. When speculation exacerbated the price crisis of 2008, Joachim von Braun of the University of Bonn, Germany,

then head of IFPRI, predicted that it would continue causing problems. "We saw that one coming and it came," he says. "Food markets have new design flaws, with their inter-linkages to financial markets." Volatility also makes it harder to solve the long-term, underlying problem – inadequate food production – by making farmers and banks reluctant to invest in improved agricultural technology as they are unsure of what returns they will get. "Investment in more production alone will not solve the problem," says von Braun. As long as extreme speculation causes constant price bubbles and crashes, either farmers will not get good enough returns to continue investing in production, or consumers will not be able to afford the food. "Without action to curb excessive speculation, we will see further increases in these volatilities," he says.

What can we do?

This is where technology comes in. All the major producers already use remote sensing technology to watch each other's fields. If countries would reveal just once what stocks they hold, says Torero, the satellite images can be used to calculate whether those stocks have risen or fallen, as growing conditions change. "All we need to know is the baseline," he says. Reliable information about stocks could offset unwarranted jitters about crop failures, such as the ones that are contributing to the current market volatility.

Von Braun goes farther: he says there should be a global technical organisation that keeps track of world grain stocks and production, and which decides, using complex computerised models of world food markets, what range of grain prices are actually warranted by real supply and demand. Then if speculation starts to drive prices up out of this band, countries could intervene on markets, buying and selling just enough to counter speculative pressure. "This doesn't stop speculation, just extreme speculation," he says.

He thinks it would take a fund of \$20-\$30 billion to do the trick. In September the World Bank extended a \$2 billion fund to respond to food price crises, but that is aimed at helping the poorest survive price spikes rather than intervening to stop them happening.

Even if we stop the volatility, don't we still need to grow more food?

Yes. As well as stable markets we also need more research into increasing yields that will produce enough grain to sell, plus investment in getting research products into farmers' hands, and the roads, markets and communications technology the farmers need to get it to market.

The more farmers are selling into the world market, says von Braun, the more stable it will be, as when one country falls short, another will have extra.

<http://www.newscientist.com/article/dn19653-are-we-having-another-food-crisis.html?full=true&print=true>

Stress tests show where bone strength comes from

- 11:19 01 November 2010 by **Nic Fleming**

Bone is extraordinarily tough considering how lightweight and porous it is – something materials scientists have struggled to explain. Now they have discovered that bone gets its strength from a combination of tiny fibres that either get stiffer or more malleable when stretched – a finding that could lead to better treatment for osteoporosis.

Around 70 per cent of bone is made up of crystals of the chalk-like mineral hydroxyapatite. These form around tough collagen fibres known as fibrils that make up most of the rest of bone.

To better understand what makes these fibres so strong, Asa Barber and Fei Hang at Queen Mary, University of London, used a new technique to directly measure the mechanical properties of individual fibrils for the first time.

Barber and Hang used scanning electron microscopy (SEM) to image the fibrils, which measure less than 100 nanometres across – over 1000 times as thin as a human hair. They used antler bone because it is a good model of human bone but more suitable for imaging because of its low water content.

The pair combined SEM with atomic force microscopy, which stretches the fibrils with a specific force. They measured the stress-strain response of six fibrils by plotting how much they stretched when a gradually increasing force was applied. At first the fibres all stretched by the same amount under the same force.

However, at a certain point their responses diverged: as more force was applied, some fibres lost their shape at a quicker rate.

Stretched stiff

Others became stiffer, withstanding a force of around 1000 nanonewtons before they broke. This is roughly equivalent to the force that would be applied by the weight of one-hundredth of a grain of rice. The more malleable fibres broke at a force around 500 nanonewtons.

"The presence of collagen fibres with different mechanical properties within bone helps to increase its ability to absorb energy, and makes it such an effective and tough material," says Barber.

The researchers next used spectroscopy to investigate the chemical make-up of the samples. Their findings suggest stronger fibres have greater mineral content.

Barber said their findings could provide a better understanding of how osteoporosis and related conditions affect the mechanical properties of bone.

Jim Gallagher at the University of Liverpool, UK, wonders whether the different types of fibres exist throughout the bone: "It's interesting data, but I would like to see it repeated with more samples from different anatomical sites," he says.

Journal reference: *Journal of the Royal Society Interface*, DOI: 10.1098/rsif.2010.0413

<http://www.newscientist.com/article/dn19632-stress-tests-show-where-bone-strength-comes-from.html>

Brain scans show more than buyers bargained for

- 14:33 02 November 2010 by [Miriam Frankel](#)

Putting on a convincing poker face might not depend on skill alone; it could also be down to the wiring of your brain.

Successful poker players and effective bargainers are good at bluffing: in other words, they can manipulate how other people see them. Until now the brain processes behind this ability have been poorly understood, but a new study has identified patterns of brain activity in talented bluffers.

"One of the most important things we do in life is to build models of other people in our minds that we can act upon," says [Read Montague](#) at the Baylor College of Medicine in Houston, Texas.

So why can some people put on a winning poker face while others can't help giving themselves away? To investigate, Montague scanned the brains of 76 volunteers while they acted as buyers in a bargaining game.

The price isn't right

The aim of the game was to trick another player into selling a hypothetical item for less than its true value. In each round, the buyers were told the item's true value, and would suggest a price to the seller, but sellers would decide on the final selling price. The catch was that the sale would only count if the seller unwittingly agreed to a price lower than the real value. Neither buyer nor seller knew during the game whether a sale had counted or not.

The study revealed three types of buyer. Some honest participants just offered the true value, and others hid it, always suggesting a low price. But a third group – dubbed "strategists" – successfully bluffed to trick their opponents.

The strategists realised that if they constantly suggested a low price, the sellers would become suspicious. Instead, they consistently suggested prices opposite to the actual value: they offered low prices when the value was high, but would offer to pay over the odds for a low-value item. Offering to pay more than the cheap items were worth earned the trust of the seller, and the strategists also made the most profit overall: they sacrificed comparatively little on cheap deals and paid a pittance for expensive objects.

Telltale brain

Brain scans showed strategists had higher activation in the rostral prefrontal cortex, which is thought to play a role in understanding other people's beliefs.

These neural differences may help understand and diagnose people with disorders such as autism, says Montague.

However, just because some people didn't bluff, it doesn't mean they can't, says [Steve Fleming](#) at University College London: "It's interesting to think about whether non-deceptive players have the same capacity to bluff, but choose not to."

Journal reference: *Proceedings of the National Academy of Sciences*, DOI: [10.1073/pnas.1009625107](https://doi.org/10.1073/pnas.1009625107)

<http://www.newscientist.com/article/dn19664-brain-scans-show-more-than-buyers-bargained-for.html>

Putting your intelligence to the ultimate test

- 01 November 2010 by **Adrian Owen** and **Roger Highfield**
- Magazine issue 2784.



Pillars of intelligence (Image: Eric Anthony Johnson/Getty)

*What makes you smart? Neuroscientist **Adrian Owen** reveals the 12 pillars of wisdom – and **New Scientist** invites you to take the ultimate intelligence test*

THERE are few more controversial areas of science than the study of intelligence. Its history is littered with disreputable ideas, from phrenology and other pseudoscientific ways of measuring it to flawed attempts to link it to race. Today intelligence remains contentious, not least because there is still no agreement on precisely what the word means.

With no agreed definition, measuring intelligence is fraught with problems. Unlike weight and height, which are unambiguous, there is no absolute measure of intelligence, just as there are no absolute measures of integrity, honesty or physical fitness. But just as it is apparent that some people are physically fitter than others, some people are also smarter than others. And just as there are tests that capture individual differences in physical fitness, we can devise tests that capture differences between individuals' cognitive abilities. Most intelligence tests are based on performance at an assortment of different types of mental tasks. The most widely used is the intelligence quotient (IQ), now commonly measured using the Wechsler Adult Intelligence Scale. In this test, results from a 90-minute battery of tests of comprehension, vocabulary and arithmetic are combined to derive a final IQ score.

This measure of intelligence does seem to correlate with performance at school and work, so to this extent at least, IQ reflects how smart a person is.

IQ does seem to correlate with performance at school and work

Since the original Weschler test was published in 1955, there have been a number of attempts to systematically break down intelligence to see whether it is best captured by a combination of many independent cognitive abilities, or whether there might be one over-arching performance factor called "generalised intelligence".

The concept of generalised intelligence emerged from the observation that people who do well on one particular mental task, such as mathematical dexterity, tend to do well on other tasks too, such as remembering strings of numbers. In fact they generally get high scores across the board. In 1904, psychologist Charles Spearman suggested that various cognitive tasks are underpinned by a general mental faculty now known as Spearman's factor, or "g".

People who do well at one particular mental task tend to do well on others too

Research on generalised intelligence suggests that it depends on the use of reasoning strategies to go beyond baseline cognitive performance. For example, in a test of short-term memory based on recalling strings of numbers, smart people often "chunk" the numbers into related groups such as 2,4,6 and 5,7,9. Such strategies do nothing to increase the size of short-term memory but they improve the efficiency with which the contents of memory are organised.

The same goes for visuospatial working memory, the ability that allows you to temporarily hold and manipulate information about objects and places. For example, a chunking strategy enables chess masters to memorise up to 100,000 configurations of chess pieces, and to remember each one much more accurately than non-expert players.

Yet more than a century after Spearman, generalised intelligence remains contentious, with some psychologists maintaining there is no clear correlation between the ability to carry out different mental tasks. Now a team at the UK Medical Research Council's Cognition and Brain Sciences Unit in Cambridge, led by one of us (Adrian Owen), wants to probe the question further.

Drawing on 20 years' research, we wanted to find the smallest number of tests to cover the broadest range of cognitive skills that are believed to contribute to intelligence, from memory to planning. We also wanted to explore as much of the brain's anatomy as possible, from the major structures of the cerebral cortex - the outer layer of the brain responsible for higher processes - such as the frontal, temporal and parietal lobes (see diagram), to deeper-lying structures.

The result is a set of tests that probe what might be called "the 12 pillars of wisdom". These 12 pillars are outlined on the pages that follow.

As well as laying bare the building blocks of intelligence, there is also a practical aim. Although our approach will never solve the problem of what intelligence is, it could give us fresh insights into generalised intelligence by showing whether there is a correlation between the performance on the 12 tests.

You too can participate in this experiment. Below, you will find details of how you can measure your own pillars of wisdom, and get involved in what might be called the ultimate intelligence test.

1: Visuospatial working memory

When you navigate your way around an unfamiliar environment, you rely on visuospatial working memory. This component of intelligence contributes to many everyday feats, such as judging the trajectory of other vehicles while you are driving and remembering where you parked your car. It relies on storing information about the position of objects in your environment in working (or "short-term") memory and then retrieving it when you need it.

Its importance can be appreciated by imagining what life would be like if you didn't have it. Similar abilities helped our ancestors store and retrieve food, revisit a fruit tree or return to their cave.

Brain region: When people undertake tasks involving visuospatial working memory there is activity in the ventrolateral frontal cortex a few centimetres behind the eyes, particularly in the right hemisphere, and the parietal lobe at the back and on top of the brain.

2: Spatial working memory

Imagine you are hunting for a pot of gold that you know is hidden in one room in a block of 100 apartments. What's the best strategy?

One option would be to search randomly, but that imposes a huge load on working memory because you would have to remember each apartment you have visited. A far smarter plan would be to organise your search, covering all the rooms in one apartment before moving on to the next, and covering all the apartments on one floor before moving on to the next. That way you can always keep track of where you are in the overall search without having to remember each and every apartment that you have already checked.

Brain region: People with frontal-lobe damage find even easy versions of this task taxing. Even if their memory is not impaired, their ability to organise the contents of memory is, suggesting that the frontal lobe is responsible for how we optimise our memory. The posterior parietal lobe is also engaged.

3: Focused attention

Read a word and you will automatically hear it pop into your head. This is an example of what is known as an overlearned or prepotent response. It is such a basic reaction that it is hard to inhibit. Doing so takes concentration and attention, which together form the foundations of this pillar of wisdom.

The ability to inhibit prepotent responses can be measured by what is called the Stroop effect. In a typical Stroop test, the reflex is confused by showing, for example, the word "green" written in red ink. The subject then has to name the colour of the ink rather than read out the word.

To measure this pillar of wisdom accurately requires a doubly hard version of the Stroop test in which the subject not only has to name the coloured word but also distinguish between two possible answers: for example, the word "red" written in green ink and the word "green" written in red ink ([see diagram](#)).

Brain region: This is a complex task that recruits different regions that are simultaneously involved in focused and sustained attention. It is known to involve the right frontal cortex, as people with an injury to this area have problems maintaining attention while performing these tasks. Damage to this area is thought to be responsible for poor concentration in people who have suffered a traumatic brain injury.

4: Mental rotation

When you read a map while navigating, do you need to physically turn it to make sense of your direction or are you able to "mentally rotate" it in your head? This pillar of wisdom is linked to navigation and our ability to see things from a different perspective. It underlies many everyday activities, from finding your way home to recognising familiar objects placed in unusual positions or orientations.

(Try a mental rotation task)

Brain region: Known to depend crucially on the superior parietal cortex, at the back and top of the brain.

5: Visuospatial working memory + strategy

The game called concentration (also known as pairs) begins with a standard pack of playing cards laid face down. On each player's turn, they choose two cards and flip them face-up. If the two cards are of the same value and colour the player wins that pair. If they don't match, the cards are flipped back. The aim of the game is to win as many pairs as possible.

Activities like this, including an online version devised by the MRC Cognition and Brain Sciences Unit team called Monkey Ladder, require not only visuospatial working memory but also an ability to devise and deploy strategies that keep track of cards you have seen.

Brain region: Essentially the same as for pillar 1, but as the demand for more complex storage increases, along with the need to use strategies, broader regions of the frontal and parietal lobes become active - in particular, the large area behind the temples known as the dorsolateral frontal cortex.

6: Paired associate learning

Every day we have to link memories, such as a person with their telephone number. Psychologists call this paired associate learning, as you are required to pair two items in memory. This is essential in many aspects of everyday life, for example when learning a new word, which requires pairing the memory of how it sounds (or what it looks like when written down) with what it means. In short, it enables you to learn the connections between related concepts.

Brain region: Pairings that involve spatial or visual information activate two "streams" or networks of brain regions. The parietal lobes deal with spatial information (the "where" stream) and the outer region of the temporal lobes deals with perception and memory for objects (the "what" stream).

7: Deductive reasoning

Determining which one of a series of shapes is the odd one out is a classic reasoning test. At its simplest, say when there are five circles and a square, the answer is obvious. But as the variations in shape become more complex, the odd one out can only be identified by considering several aspects of the information at the same time ([See diagram](#)). This relies on a pillar of wisdom known as deductive reasoning.

Brain region: Deductive reasoning tests generate a characteristic pattern of activity in the back and outer surface of the frontal lobes, at the intersection between the two hemispheres, and in the middle of the parietal

lobe at the back and top of the brain. A recent study of people with damage to some of these brain regions - as a result of a stroke, for example - showed that the extent of the damage was correlated with the degree to which this task was impaired.

8: Visuospatial processing

The survival of our ancestors depended on the ability to detect an important shape in a complex background. Think of a lion lurking in long grass, or a ripe fruit hanging from a branch. When you mentally compare complex images with each other you rely on another pillar of wisdom, your brain's visuospatial processing skills. Even in the modern world, this is a useful skill. Imagine being in a burning house, trying to find the key that will open the front door among a huge bunch of keys, as flames threaten to engulf you.

(Try a visuospatial processing task)

Brain region: Parietal cortex and higher visual areas in the occipital lobe at the back of the brain.

9: Visual attention

Spot-the-difference puzzles are an old favourite in newspapers and magazines, and now appear online too. In the most common form, two subtly different versions of an image are shown side by side, and you have to find differences between them. This is a perceptual task that requires you to concentrate or focus your attention on complex images.

(See diagram)

Brain region: Attention to visual features increases the activity in a range of visual areas at the very back and bottom of the brain.

10: Verbal reasoning

If you are told that A is bigger than B and that C is bigger than A, the pillar of wisdom known as verbal reasoning tells you that C must be bigger than B, even though this information is not explicitly stated in the problem. This pillar can be measured by a variant of the Grammatical Reasoning Test developed in 1968 by Alan Baddeley, the former director of the MRC Cognition and Brain Sciences Unit (then called the MRC Applied Psychology Unit).

Brain region: Reasoning tasks activate the dorsolateral frontal cortex, which lies on the outer surface of the frontal lobe about midway between the top and the bottom.

11: Verbal working memory

When you hold a new number in your head as you enter it into your phone, you rely on a pillar of wisdom known as verbal working memory - the ability to store a piece of verbal information for just as long as it is needed. This temporary memory bank allows you to make sense of convoluted sentences used by the likes of lawyers, bureaucrats and the manufacturers of electronic appliances.

Brain region: The ventrolateral areas of the frontal cortex, particularly the left hemisphere. The ventrolateral frontal cortex is crucial for laying down short-term memories, and also for retrieving them when they are needed.

12: Planning

Many activities are made up of a sequence of tasks that must be done in the right order. You have to buy the ingredients of a cake before you bake it; redecoration should take place before a room is carpeted; you need to check you have money before you go shopping. The capacity for such forward thinking can be probed with the Hampshire Tree task, which requires the subject to put a set of balls in the right order using as few moves as possible.

(Try the task)

The cognitive processes involved are surprisingly complex. First you must create mental representations of the starting and finishing arrangements of the balls. Then you have to work out how to link these representations, by searching through all possible solutions and evaluating how well they will work. Cognitive planning is at the apex of human achievement: there are very few documented examples of other animals truly planning.

Brain region: The frontal lobe is crucial for planning, as was demonstrated in the 1930s when neurosurgeon Wilder Penfield removed a tumour from his sister's right frontal lobe. This led to a dramatic change in her behaviour: for example, while she remained able to cook individual dishes, she could no longer plan a complete meal. More recently, brain scanning has revealed that planning involves a broad network of regions,

including the caudate nuclei near the centre of the brain, the supplementary motor area at the top and in the middle of the brain, posterior parietal regions at the back and top and the cerebellum.

Take part in our experiment

We would like to invite you to assess 12 facets of the way your brain works using a simple online test that should take around half an hour. The online audience of the Discovery Channel will also be invited to take part.

We hope that by measuring these "12 pillars of wisdom" in a large number of people we will at last be able to put the concept of generalised intelligence to a rigorous test. In the coming months, we will publish an analysis of what we find.

This could help to place the concept of intelligence on a firmer footing as a real attribute of human brain function, not merely a construct that reflects only an individual's skill at completing traditional intelligence tests. More usefully, and controversially, it could eventually help disentangle the effects of genetics, lifestyle and education on intelligence and, in turn, the effects of intelligence on other aspects of our lives. IQ scores are correlated with many aspects of general well-being, including lifespan, presumably reflecting how smart people make better choices about how to conduct their lives.

One thing is for sure: the ingredients of intelligence involve a complex interplay between our genetic make-up and our environment. It is not, as pioneering psychologist Charles Spearman and many of his peers believed, simply the intellectual gifts we inherit from our parents.

You can take part in the ultimate intelligence test at bit.ly/9M6NaP.

Adrian Owen is a senior scientist at the Medical Research Council Cognition and Brain Sciences Unit in Cambridge, UK.

Roger Highfield is the editor of New Scientist magazine

<http://www.newscientist.com/article/mg20827841.300-putting-your-intelligence-to-the-ultimate-test.html?full=true&print=true>

Children really do see things differently

- 31 October 2010
- Magazine issue 2784.



Kids need to learn grown-up vision

CHILDREN do not see objects in a fully grown-up way until the age of 13, a new study suggests. When judging whether shaded images are convex or concave, adult brains assume that light comes from above unless there is reason to think otherwise. Young children have to learn this ability. To investigate when this happens, Jim Stone at the University of Sheffield, UK, showed embossed shapes such as squares and shaded images such as footprints to 171 children aged from 4 to 10. Each child was shown 10 images and asked whether they were convex or concave. The "correct" answer assumed an object was lit from above. The children got better with age, with the average score out of 10 improving by 0.43 each year (*Perception*, DOI: [10.1068/p6725](https://doi.org/10.1068/p6725)). If children of other ages develop at the same rate, Stone predicts that babies will learn to assume that light comes from above at about 21 months. But this aspect of their visual perception won't be "fully grown" until the age of 13 or so. "Children really do see the world differently to adults, inasmuch as their perceptions seem to be more variable," says Stone. "No wonder they can't look at a cloud without seeing a dog or a bear."

<http://www.newscientist.com/article/mg20827844.700-children-really-do-see-things-differently.html>

Blue light taps directly into your emotions

- 30 October 2010
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Feeling blue (Image: Elemental Studios/Alamy)

WE'RE all happier on sunny days, but why? It seems that light taps directly into brain areas that process emotion - good and bad.

Although light is used to treat mood disorders, we don't understand how this works. While rods and cones in the eye process visible light, a third type of photoreceptor, particularly sensitive to blue light, mediates non-visual responses such as sleep cycles and alertness. So light may make us feel better because it helps regulate circadian rhythms.

Gilles Vandewalle at the University of Liège, Belgium, and colleagues wondered whether this pathway directly affects our emotional state too. To find out, they scanned the brains of volunteers exposed to green or blue light while a neutral or angry voice recited meaningless words. As expected, brain areas responsible for processing emotion responded more strongly to the angry voice, but this effect was amplified by blue light (*Proceedings of the National Academy of Sciences*, DOI: [10.1073/pnas.1010180107](https://doi.org/10.1073/pnas.1010180107)).

Vandewalle suggests blue light is likely to amplify emotions in both directions.

<http://www.newscientist.com/article/mg20827845.000-blue-light-taps-directly-into-your-emotions.html?full=true&print=true>

UK's chief measurer: Units unite the world

- 31 October 2010 by [Alison George](#)
- Magazine issue [2784](#). [Subscribe and save](#)
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Standardisation is a good thing (Image: National Physical Laboratory)

*SI units are 50 this month, and that's a cause for celebration says **Brian Bowsher**, head of the UK's National Physical Laboratory*

Units sound dull - so what's to celebrate?

The International System of Units, better known as SI, was established in 1960 at a conference in Paris. It agreed an international standard for core units, such as the metre to measure length. This has been great for trade, as life gets difficult with many different measures. Even now, there are three kinds of gallon. Not having a universal system can lead to disaster, such as when NASA lost its \$125 million Mars Climate Orbiter in 1999 after a mix-up between imperial and metric units.

What was wrong with the old units?

Basically they were defined in relation to physical objects. So if the unit was pegged to mass, for example, that could change over time through environmental contamination, and we wouldn't know. But since 1983, all but one of the SI units have been defined by universal, natural constants. The metre is now defined as the distance travelled by light in a vacuum in $1/299,792,458$ of a second. Only the kilogram is still defined by a physical object - the mass of a cylinder of platinum-iridium alloy, stored in a vault in Sèvres, France - and we plan to change that.

What does this mean for the real world?

Greatly improved standardisation - and accuracy. This accuracy really shows up in areas such as radiation treatment for cancer, where the dose delivered to the patient's tumour needs to be accurate to within 3 per cent to achieve the best outcome. Any further out and you fail to kill cancer cells, or kill healthy ones.

What about more everyday benefits?

For things like weighing groceries, scales are good enough. But newer technologies such as satellite positioning systems require high precision. For example, two satellites need to be synchronised incredibly accurately in order to pinpoint a spot precisely within a building. And by 2015 we hope to have developed clocks stable to better than 1 second in 10 billion years. These improvements will feed into GPS-style positioning systems that will ultimately have millimetre-level accuracy.

Where else can standardisation help?



Take the £100 billion market in carbon trading. In order to trade properly you have to have an agreed basis for measuring carbon emissions, which can come from very different sources such as agriculture, transport or industry. We need quality measurements everyone agrees on, and the National Physical Laboratory is in the driving seat for such international programmes.

What about climate change itself?

Better measurements should reduce the degree of uncertainty that is such an issue right now. At NPL, we are proposing a low-cost, small satellite mission to help set benchmarks for climate studies and to achieve tenfold improvement over previous measurements. After all, even the tiniest variation in the sun's temperature can cause an ice age.

Non-SI units are still alive and kicking. Will they ever be completely superseded?

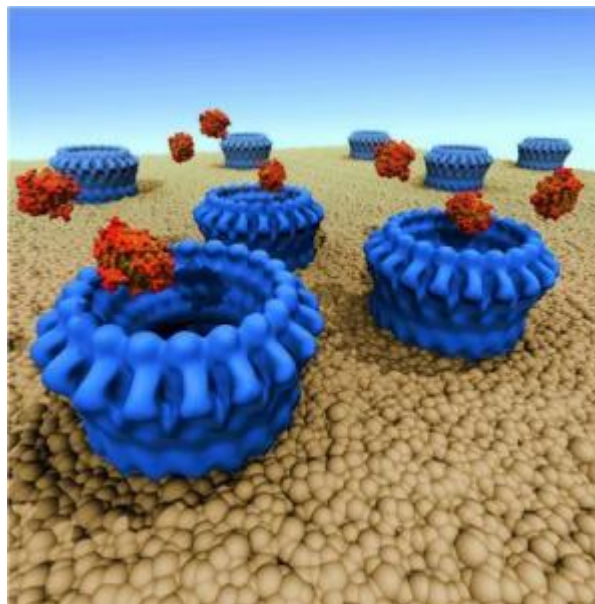
Even I still ask for a pint when I go to the pub, not 0.57 litres - so possibly not.

Profile

Brian Bowsher is director of the National Physical Laboratory, the UK's metrology centre. His PhD is in inorganic chemistry from the University of Southampton, UK

<http://www.newscientist.com/article/mg20827840.200-uks-chief-measurer-units-unite-the-world.html?full=true&print=true>

Human Immune System Assassin's Tricks Visualized for the First Time



Model of a membrane with perforin rings allowing the passage of granzymes into the cell. (Credit: Mike Kuiper)

ScienceDaily (Nov. 1, 2010) — Scientists from the UK and Australia have seen the human immune system's assassin -- a protein called perforin -- in action for the first time. The UK team is based at Birkbeck College where they used powerful electron microscopes to study the mechanism that perforin uses to punch holes in rogue cells.

The research is published on October 31 in *Nature*.

Professor Helen Saibil, who leads the UK team at Birkbeck College, said: "Perforin is a powerful bullet in the arsenal of our immune system -- without it we could not deal with the thousands of rogue cells that turn up in our bodies through our lives."

"Perforin is our body's weapon of cleansing and death," said project leader Professor James Whisstock from Monash University, Melbourne, Australia.

Perforin works by punching holes in cells that have become cancerous or have been invaded by viruses. The holes let toxic enzymes into the cells, which then destroy them.

If perforin isn't working properly the body can't fight infected cells. And there is evidence from mouse studies that defective perforin leads to an upsurge in malignancy, particularly leukaemia, so says Professor Joe Trapani, head of the Cancer Immunology Program at the Peter MacCallum Cancer Centre in Melbourne, Australia.

The first observations that the human immune system could punch holes in target cells was made by the Nobel Laureate Jules Bordet over 110 years ago, but we have had to wait for the latest advances in structural molecular biology to find out how exactly this happens.

Professor Saibil continued: "From our previous work we already knew that bacterial toxins, such as the one involved in pneumonia, dramatically change shape to punch holes in membranes. We were fascinated by perforin and wanted to know its structure and how that might change in order for it to act as a hole-punching machine."

The structure was revealed by combining information about a single perforin molecule -- visualised using the Australian Synchrotron -- with Professor Saibil's electron microscope images (taken in London) of a ring of perforin molecules clustered together to form a hole in a cell membrane.



Professor Whisstock added: "Now we know how it works, we can start to fine tune it to fight cancer, malaria and diabetes."

Another interesting finding is that the important parts of the perforin molecule are quite similar to those toxins deployed by bacteria such as anthrax, listeria and streptococcus, showing that this method of making holes in cell membranes is quite ancient in evolution. "The molecular structure has survived for close to two billion years, we think," said Professor Trapani.

Perforin is also the culprit when the wrong cells are marked for elimination, either in autoimmune disease conditions, such as early onset diabetes, or in tissue rejection following bone marrow transplantation. So the researchers are now investigating ways to boost perforin for more effective cancer protection and therapy for acute diseases such as cerebral malaria. And with the help of a £600K grant from the Wellcome Trust they are working on potential inhibitors to suppress perforin and counter tissue rejection.

Professor Douglas Kell, BBSRC Chief Executive said: "New technologies in microscopy and synchrotron experiments have opened up tremendous opportunities for molecular biologists. This is a great example where the knowledge we gain about the normal structure and function of a molecule has the potential to underpin important developments in our health and well being."

The lead authors are Ruby Law from Monash University, Natalya Lukoyanova from Birkbeck College, London, and Ilia Voskoboinik from the Peter MacCallum Cancer Centre and the University of Melbourne. The project leaders are: Joe Trapani (Peter Mac), Helen Saibil (Birkbeck) and James Whisstock (Monash). The research was supported by the above institutions, the NHMRC, the ARC, the UK Biotechnology and Biological Sciences Research Council and the Wellcome Trust.

Editor's Note: This article is not intended to provide medical advice, diagnosis or treatment.

Story Source:

The above story is reprinted (with editorial adaptations by ScienceDaily staff) from materials provided by **Biotechnology and Biological Sciences Research Council**, via [AlphaGalileo](#).

<http://www.sciencedaily.com/releases/2010/10/101031154015.htm>

Breast Milk Study Furthers Understanding of Critical Ingredients



Ask someone in the know to list the substances in breast milk that make it the ideal food for newborns and you may hear about proteins that guard against infection, fats that aid in the development of the nervous system and carbohydrates that promote the growth of healthy bacteria. But, you may not hear too much about the nitrite and nitrate in breast milk and their contributions to developing gastrointestinal, immune and cardiovascular systems. (Credit: iStockphoto/Oleg Kozlov)

ScienceDaily (Nov. 1, 2010) — Ask someone in the know to list the substances in breast milk that make it the ideal food for newborns and you may hear about proteins that guard against infection, fats that aid in the development of the nervous system and carbohydrates that promote the growth of healthy bacteria. But, you may not hear too much about the nitrite and nitrate in breast milk and their contributions to developing gastrointestinal, immune and cardiovascular systems.

In a study published online on Oct. 19 in advance of print in *Breastfeeding Medicine*, the official journal of the Academy of Breastfeeding Medicine, researchers at The University of Texas Health Science Center at Houston (UTHealth) announced the results of an observational study showing that the levels of nitrite and nitrate in breast milk change during the initial days after birth, which the scientists argue is to accommodate the changing physiologic requirements of developing babies.

"This research shows the essential nature of nitrite in breast milk," said Nathan Bryan, Ph.D., the study's senior author and an assistant professor at the UTHealth Brown Foundation Institute of Molecular Medicine for the Prevention of Human Diseases (IMM). "While the nitrite and nitrate composition of breast milk has been reported, this is the first study to demonstrate the changing levels of nitrite and nitrate early on."

Dietary nitrite and nitrate are part of a normal diet. When people eat nitrate-rich vegetables, the bacteria in their mouths and stomachs converts the nitrate into nitrite, which in turn aids in the production of nitric oxide. Nitric oxide keeps blood pressure levels normal, fights infection and supports the nervous system. Animal studies suggest nitric oxide might even guard against heart attack and stroke.

The scientists measured nitrite and nitrate levels in breast milk during the first three days of birth (colostrum), days three to seven (transition milk) and eight or more days (mature milk). Seventy-nine patient samples were analyzed and they were donated by mothers who were either admitted to Memorial Hermann -- Texas Medical Center (TMC) in Houston for childbirth or who were visiting a UT Physicians' clinic in the TMC. Bryan said colostrum has significantly higher concentrations of nitrite and significantly lower concentrations of nitrate than both transition and mature milk, which he believes may be nature's way of providing nitric oxide to the newborns whose gastrointestinal tract is not yet colonized by bacteria that convert nitrate to nitrite. Nitrite-rich colostrum overcomes this deficit, he said.

Human milk concentrations of colostrum, transition milk and mature milk were 0.08 mg/100ml nitrite and 0.19 mg/100ml nitrate, 0.001 mg/100ml nitrite and 0.52 mg/100ml nitrate, and 0.001 mg/100ml nitrite and 0.3 mg/100ml nitrate, respectively.

To corroborate their findings, researchers analyzed milk samples taken from two women on 14 consecutive days and the scientists observed the same change in the nitrite and nitrate levels.

Some women cannot nurse their children due to health issues. Other women may choose not to breastfeed so the investigators also measured the level of dietary nitrite and nitrate in alternative sources of newborn nutrition: formula, cow milk and soy milk.

Noting that breast milk is considered more beneficial to newborns than these others sources of nutrition, Bryan said the study revealed that colostrum contains the highest amount of nitrite of any of the milk products tested.

"This is another difference that has been noted between mother's milk and formula," said Pamela Berens, M.D., one of the study's authors and a professor of obstetrics, gynecology and reproductive science at the UTHealth Medical School. "Studies like this help us better understand the benefits of breast milk."

The World Health Organization (WHO) and the American Academy of Pediatrics recommend exclusive breastfeeding for the first six months of life. It is good for both mothers in that it can reduce the risk of breast and ovarian cancers and for babies in that it protects against disease and infection.

Bryan said the concentration of nitrite and nitrate found in breast milk calls into question the amount recommended by the Joint Food and Agricultural Organization/WHO Acceptable Daily Intake (WHO ADI) standards. Total daily nitrite intake for nursing infants is 20 times that recommended by the WHO ADI, he said.

Too much nitrite/nitrate or too little nitrite/nitrate can be bad for health, Bryan said. Much of the concern about nitrite/nitrate levels stems from a condition associated with too much nitrite in the blood system called methemoglobinemia (blue baby syndrome). Typically, this is caused by infant formulas made from bacteria and nitrate contaminated well water. The levels of nitrite and nitrate that cause blue baby syndrome are much higher than what is present in breast milk, he said.

"These data, considered together with nitrite and nitrate exposure estimates from foods, show that humans are exposed from birth to dietary sources of nitrite and nitrate. The presence of nitrite and nitrate in breast milk argues for a fundamental role in physiology, which is supported by a number of basic science studies and some clinical trials," Bryan said.

"Contrary to the prevailing scientific opinion about the biological effects of nitrite and nitrate, our data support the view that humans may require these dietary components from birth -- from nature's most perfect food," said Norman G. Hord, Ph.D., M.P.H., R.D., the study's lead author and an associate professor of food science and human nutrition at Michigan State University (MSU).

Other contributors include: Janine Ghannam, a medical student at MSU, and Harsha Garg, a research associate at the IMM.

The study titled "Nitrate and Nitrite Content of Human, Formula, Bovine and Soy Milks: Implications for Dietary Nitrite and Nitrate Recommendations" received support from the American Heart Association and Michigan Agricultural Experiment Station.

Editor's Note: *This article is not intended to provide medical advice, diagnosis or treatment.*

Story Source:

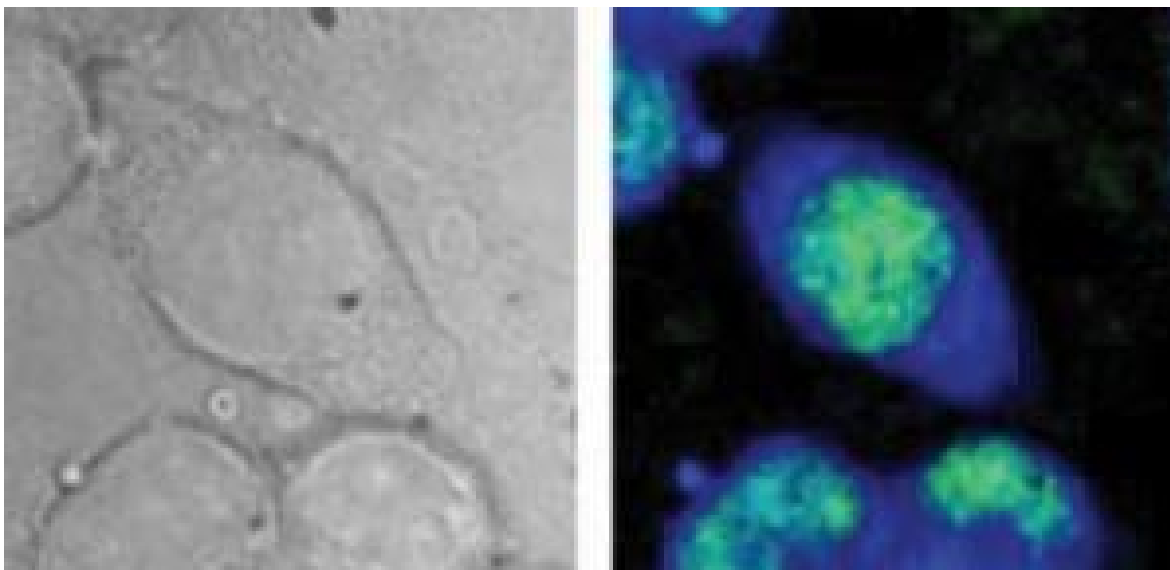
The above story is reprinted (with editorial adaptations by ScienceDaily staff) from materials provided by **University of Texas Health Science Center at Houston**.

Journal Reference:

1. Norman G. Hord, Janine S. Ghannam, Harsha K. Garg, Pamela D. Berens, Nathan S. Bryan. **Nitrate and Nitrite Content of Human, Formula, Bovine, and Soy Milks: Implications for Dietary Nitrite and Nitrate Recommendations.** *Breastfeeding Medicine*, 2010; : 101019053237064 DOI: [10.1089/bfm.2010.0070](https://doi.org/10.1089/bfm.2010.0070)

<http://www.sciencedaily.com/releases/2010/10/101027145849.htm>

Chemical Microscopy Shows Potential for Cell Diagnostics



B-CARS chemical imaging: Test cells from a mouse as seen in an optical microscope image (left), and using B-CARS (right). The CARS image detects specific molecules to highlight the cell nucleus (green) and intracellular fluid (blue). Images show an area approximately 40 micrometers across. B-CARS image represents approx. 17,000 individual spectra. (Credit: NIST)

ScienceDaily (Nov. 1, 2010) — A paper by researchers at the National Institute of Standards and Technology (NIST) may breathe new life into the use of a powerful -- but tricky -- diagnostic technique for cell biology. The paper, appearing in the *Biophysical Journal*, demonstrates that with improved hardware and better signal processing, a powerful form of molecular vibration spectroscopy can quickly deliver detailed molecular maps of the contents of cells without damaging them. Earlier studies have suggested that to be useful, the technique would need power levels too high for cells.

The technique, "B-CARS" (short for "broadband coherent anti-Stokes Raman scattering"), is one of several variations on Raman spectroscopy, which measures the frequencies associated with different modes of vibration of atoms and their bonds in a molecule. The exact mix of these frequencies is an extremely discriminating "fingerprint" for any particular molecule, so Raman spectroscopy has been used as a chemical microscope, able to detail the structure of complex objects by mapping the chemical composition at each point in a three-dimensional space.

In the biosciences, according to NIST chemist Marcus Cicerone, Raman spectroscopy has been used to detect microscopic cellular components such as mitochondria, detect how stem cells differentiate into new forms and distinguish between subtly different cell and tissue types. It can, for example, detect minor differences between various precancerous and cancerous cells, potentially providing valuable medical diagnostic information. Even better, it does this without the need to add fluorescent dyes or other chemical tags to identify specific proteins.

The catch, says Cicerone, is speed. The usual method, spontaneous Raman scattering takes a long time to gather enough data to generate a single spectrum -- as much as seven minutes for fine detail -- and that's for each point in the image. "Seven minutes or even five seconds per spectrum is not feasible when we need a million spectra for an image," he observes. CARS, which uses a pair of lasers to pump up the vibrational states and increase signal, is part of the answer. The current breakthroughs for a broadband CARS instrument developed at NIST since 2004, says Cicerone, gets the same information in 50 milliseconds per pixel.



The new catch is power. Recent papers have argued that to get the necessary data, the lasers used in CARS must run at power levels above the damage threshold for living cells, making the technique nearly useless for clinical purposes. Not quite, according to the NIST team. Their paper describes a combination of improved hardware to gather spectra over a very broad range of wavelengths, and a clever mathematical technique that effectively amplifies the useable signal by examining a portion of signal normally ignored as background interference. The result, says Cicerone, pushes their minimum power level below the damage threshold while retaining the speed of CARS. "We have all the information that you have in a Raman spectrum but we get it 5 to 100 times faster," he says, adding that some obvious modifications should push that higher, opening the door to more widespread use of vibrational spectroscopy in both biology and clinical diagnosis.

Editor's Note: *This article is not intended to provide medical advice, diagnosis or treatment.*

Story Source:

The above story is reprinted (with editorial adaptations by ScienceDaily staff) from materials provided by **National Institute of Standards and Technology (NIST)**.

Journal Reference:

1. S.H. Parekh, Y.J. Lee, K.A. Aamer and M.T. Cicerone. **Label-free cellular imaging by broadband coherent anti-Stokes Raman scattering microscopy**. *Biophysical Journal*, 2010; 99

<http://www.sciencedaily.com/releases/2010/10/101014121156.htm>

Scientists 'Watch' Formation of Cells' Protein Factories, Ribosomes, for First Time



A team from The Scripps Research Institute has revealed the first-ever pictures of the formation of cells' "protein factories." (Credit: Gabe Lander)

ScienceDaily (Nov. 1, 2010) — A team from The Scripps Research Institute has revealed the first-ever pictures of the formation of cells' "protein factories." In addition to being a major technical feat on its own, the work could open new pathways for development of antibiotics and treatments for diseases tied to errors in ribosome formation. In addition, the techniques developed in the study can now be applied to other complex challenges in the understanding of cellular processes.

Identifying and observing the molecules that form ribosomes -- the cellular factories that build the proteins essential for life -- has for decades been a key goal for biologists but one that had seemed nearly unattainable. But the new Scripps Research study, which appears in the October 29, 2010 issue of the journal *Science*, yielded pictures of the chemical intermediate steps in ribosome creation.

"For me it was a dream experiment," said project leader James Williamson, Ph.D., professor, member of the Skaggs Institute for Chemical Biology, and dean of graduate and postgraduate studies at Scripps Research, who credits collaborators at the Scripps Research National Resource for Automated Molecular Microscopy (NRAMM) facility for making it possible. "We have great colleagues at Scripps to collaborate with who are willing to try some crazy experiments, and when they work it's just beautiful."

Past studies of the intermediate molecules that combine to form ribosomes and other cellular components have been severely limited by imaging technologies. Electron microscopy has for many years made it possible to create pictures of such tiny molecules, but this typically requires purification of the molecules. To purify, you must first identify, meaning researchers had to infer what the intermediates were ahead of time rather than being able to watch the real process.

"My lab has been working on ribosome assembly intensively for about 15 years," said Williamson. "The basic steps were mapped out 30 years ago. What nobody really understood was how it happens inside cells."

Creating a New View

The NRAMM group, led by Scripps Research Associate Professors Clinton Potter and Bridget Carragher and working with Scripps Research Kellogg School of Science and Technology graduate students Anke Mulder and Craig Yoshioka, developed a new technique, described in the Science paper and dubbed discovery single-particle profiling, which dodges the purification problem by allowing successful imaging of unpurified samples. An automated data capture and processing system of the team's design enables them to decipher an otherwise impossibly complex hodgepodge of data that results.

For this project, second author Andrea Beck, a research assistant in the Williamson laboratory, purified ribosome components from cells of the common research bacterium *Escherichia Coli*. She then chemically broke these apart to create a solution of the components that form ribosomes. The components were mixed together and then were rapidly stained and imaged using electron microscopy. "We went in with 'dirty' samples that contained horribly complex mixtures of all different particles," said Williamson.

Mulder, who is first author on the paper, collected and analyzed the particles that were formed during the ribosome assembly reaction. Using the team's advanced algorithms, they were able to process more than a million data points from the electron microscope to ultimately produce molecular pictures.

The Pieces Fit

The team produced images that the scientists were able to match like puzzle pieces to parts of ribosomes, offering strong confirmation that they had indeed imaged and identified actual chemical intermediates in the path to ribosome production. "We always saw the same thing no matter how we processed the data, and this led us to believe this was real," said Williamson.

Further confirmation came as the researchers imaged components from different timeframes. After breaking down ribosome components, the scientists prepared samples at various stages allowing enough time for the molecular mix to begin combining as they do during ribosome creation in cells.

Imaging this time series, the team was able to show higher concentrations of larger, more complex molecules and fewer smaller molecules as time elapsed. These results fit with the limited information that was already available about the timing of formation steps, providing further confirmation of the team's success.

Interestingly, this work also confirmed that there are more than one possible paths in ribosome formation, a phenomenon known as parallel assembly that been suggested by prior research but never definitively confirmed.

Long-Term Potential

Williamson says that with the information now at hand, they will be able to move forward with studies of which additional molecules might be present in cells and essential for ribosome formation. Such data could offer exciting medical potential.

All bacteria contain and are dependent on ribosomes. Identification of molecules required for ribosome assembly could offer new targets for antibiotic drugs aimed at killing bacteria. "If we can figure out how to inhibit assembly, that would be a very important therapeutic avenue," said Williamson.

There are also indications that some diseases such as Diamond Blackfan Anemia might be caused, at least in some cases, by errors in ribosome production. Better understanding of that production could also reveal ways such errors might be repaired to cure or prevent disease.

At the more basic level, this successful project has also proven techniques that Scripps Research scientists and other researchers can apply to allow similar imaging and understanding of other complex but critical cellular processes.

In addition to Williamson, Mulder, Beck, Yoshioka, Potter, and Carragher, authors of the paper, entitled "Visualizing Ribosome Biogenesis: Parallel Assembly Pathways for the 30S Subunit," were Anne Bunner and Ronald Milligan from Scripps Research.



This research was supported by the National Institutes of Health and a fellowship from the National Science Foundation.

Editor's Note: *This article is not intended to provide medical advice, diagnosis or treatment.*

Story Source:

The above story is reprinted (with editorial adaptations by ScienceDaily staff) from materials provided by **Scripps Research Institute**.

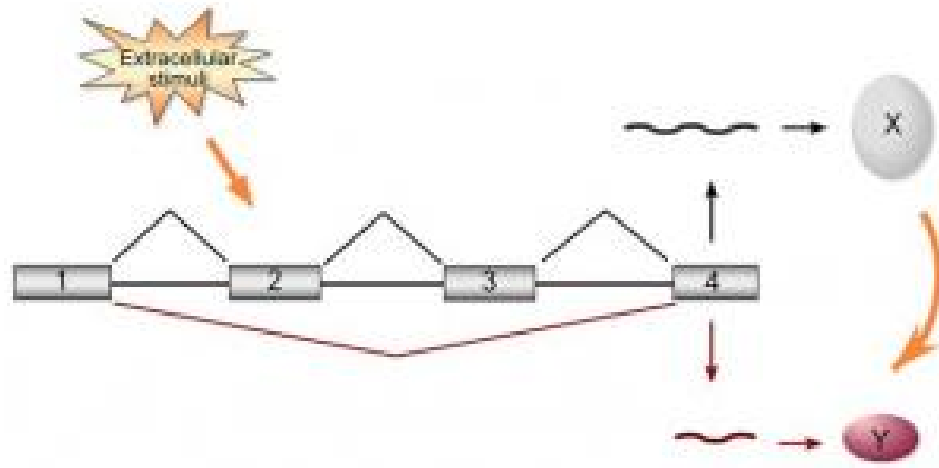
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How Variations of Same Protein Affect Immune Response

Understanding Signal-Induced Alternative Splicing



Signaling pathways can induce changes in splicing patterns so as to alter which protein is encoded by a given gene. (Credit: Kristen Lynch, PhD, University of Pennsylvania School of Medicine)

ScienceDaily (Nov. 1, 2010) — How a T cell decides to make protein X, Y, or Z can have profound effects for fighting foreign invaders or staving off dire autoimmune reactions. Researchers at the University of Pennsylvania School of Medicine have identified the steps that control how different forms of an immune cell protein called CD45, which is critical for activating the immune system when faced with pathogens, are controlled in the arc of a body's immune response.

The shift between different forms of CD45 helps T cells function properly and also prevents hyperactivity, which could lead to the body's own immune system attacking itself. Knowing precisely how this shifting system works has implications for understanding autoimmune and neurological diseases.

"We have identified a new paradigm for the regulation of a process called alternative splicing, which allows for a single gene to code for multiple variations of one type of protein," says Kristen W. Lynch, PhD, associate professor of Biochemistry and Biophysics. This study appeared in an October issue of *Molecular Cell*.

CD45, a receptor protein that sits on the surface of T cells, is essential for immunity, for example, severe combined immune deficiency (SCID), also known as "bubble boy" syndrome, is caused by the absence of CD45.

Normal CD45 comes in five forms, all different lengths. In resting T cells, longer forms of CD45 messenger RNA (mRNA) and protein predominate, but in activated cells, the shorter form of CD45 mRNA is most abundant. "There is a spectrum of forms that shift toward full length in resting cells and towards the shorter form in activated cells," says Lynch. Messenger RNA contains the chemical blueprint for how to make a protein.

"We knew that a protein called PSF was required for splicing out parts of CD45 RNA to make the different forms," says Lynch. Lynch and post-doctoral fellow Florian Heyd, PhD have shown that there are additional critical components to the system that control the relative levels of the five forms of CD45 mRNA.

The first component that they identified is that another molecule called glycogen synthase kinase 3 (GSK3) found in resting T cells adds a phosphate molecule to polypyrimidine-tract binding protein-associated splicing factor (PSF). The phosphorylated PSF is then sequestered in a large protein complex by the third molecule

called TRAP150. When PSF stays in this complex, the longer forms of CD45 predominate, and the T cell is ready to respond to foreign invaders. After a response, PSF loses its phosphates, and is released from TRAP150. As a consequence, PSF is then free to form the shortened forms of CD45 mRNA, which helps return the immune response to a resting state.

Splicing of CD45 mRNA involves recognition by PSF of a short length of RNA sequence called the exonic splicing silencer (ESS). Some variations within the ESS sequence are associated with autoimmune disease, especially multiple sclerosis. "We suspect that there are other spliced genes in T cells that follow the same path as CD45, and we are directing current efforts to identify them," said Lynch.

GSK3, a critical element in T cell activation, is important in other cell types and in other signaling pathways: It has been linked to the development of tauopathies, a group of neuronal diseases that includes Alzheimer's disease and Parkinson's disease. GSK3 is the focus of a search for drugs that might affect these and other diseases. For example, lithium is currently used to treat bipolar disorder by inactivating GSK3 in brain cells. "Known and potential GSK3 inhibitors may also affect the health of the immune system," notes Lynch. "This emphasizes the importance of better understanding the variety of functions of GSK3 in the body."

This study was funded by a grant from the National Institute of General Medical Science and a fellowship from the Deutsche Forschungsgemeinschaft.

Editor's Note: This article is not intended to provide medical advice, diagnosis or treatment.

Story Source:

The above story is reprinted (with editorial adaptations by ScienceDaily staff) from materials provided by **University of Pennsylvania School of Medicine**.

Journal Reference:

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<http://www.sciencedaily.com/releases/2010/10/101015150931.htm>

How Brain Is Wired for Attention



University of Utah (U of U) medical researchers have uncovered a wiring diagram that shows how the brain pays attention to visual, cognitive, sensory, and motor cues. The research provides a critical foundation for the study of abnormalities in attention that can be seen in many brain disorders such as autism, schizophrenia, and attention deficit disorder. (Credit: iStockphoto/Sebastian Kaulitzki)

ScienceDaily (Nov. 1, 2010) — University of Utah (U of U) medical researchers have uncovered a wiring diagram that shows how the brain pays attention to visual, cognitive, sensory, and motor cues. The research provides a critical foundation for the study of abnormalities in attention that can be seen in many brain disorders such as autism, schizophrenia, and attention deficit disorder.

The study appears Nov. 1, 2010, online in the *Proceedings of the National Academy of Sciences (PNAS)*. "This study is the first of its kind to show how the brain switches attention from one feature to the next," says lead researcher Jeffery S. Anderson, M.D., Ph.D., U of U assistant professor of radiology. Anderson and his team used MRI to study a part of the brain known as the intraparietal sulcus. "The brain is organized into territories, sort of like a map of Europe. There are visual regions, regions that process sound and areas that process sensory and motor information. In between all these areas is the intraparietal sulcus, which is known to be a key area for processing attention," Anderson says. "We discovered that the intraparietal sulcus contains a miniature map of all of these territories. We also found an organized pattern for how control regions of the brain connect to this map in the intraparietal sulcus. These connections help our brain switch its attention from one thing to another."

In addition, scientists discovered that this miniature map of all the things one can pay attention to is reproduced in at least 13 other places in the brain. They found connections between these duplicate maps and the intraparietal sulcus. Each copy appears to do something different with the information. For instance, one map processes eye movements while another processes analytical information. This map of the world that



allows us to pay attention may be a fundamental building block for how information is represented in the brain.

"The research uncovers how we can shift our attention to different things with precision," says Anderson. "It's a big step in understanding how we organize information. Furthermore, it has important implications for disease. There are several diseases or disorders where attention processing is off, such as autism, attention deficit disorder, and schizophrenia, among others. This research gives us the information to test theories and see what is abnormal. When we know what is wrong, we can talk about strategies for treatment or intervention."

Deborah Yurgelun-Todd, Ph.D., professor of psychiatry in the U of U School of Medicine and an investigator with the U of U Brain Institute and the Utah Science Technology and Research Initiative (USTAR), was the principal investigator and senior author of the study. The research was funded by a National Institutes of Health grant from the National Institute on Drug Abuse.

Editor's Note: *This article is not intended to provide medical advice, diagnosis or treatment.*

Story Source:

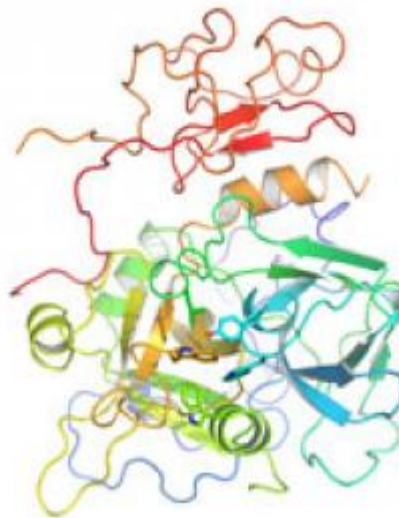
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Journal Reference:

1. Jeffrey S. Anderson, Michael A. Ferguson, Melissa Lopez-Larson, Deborah Yurgelun-Todd. **Topographic maps of multisensory attention.** *Proceedings of the National Academy of Sciences*, 2010; DOI: [10.1073/pnas.1011616107](https://doi.org/10.1073/pnas.1011616107)

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X-Ray Crystallography Reveals Structure of Precursor to Blood-Clotting Protein



Thrombin structure. (Credit: Image courtesy of Saint Louis University)

ScienceDaily (Nov. 1, 2010) — Using state-of-the-art robotic and x-ray crystallographic equipment, researchers at Saint Louis University have revealed for the first time the molecular structure of the zymogen, or inactive, form of a blood-clotting enzyme.

In an article published in *Proceedings of the National Academy of Sciences*, Enrico Di Cera, M.D., chair of the department of biochemistry and molecular biology at Saint Louis University School of Medicine and lead researcher of the study, said the NIH-funded research offers important information about the protein.

"This research is very basic and very important," said Di Cera. "It provides a missing link between the inactive zymogen form of thrombin and the mature enzyme generated upon vascular injury."

Before thrombin becomes active, it circulates throughout the blood in the inactive zymogen form. When the active enzyme is needed, for example after a vascular injury, the coagulation cascade is initiated and the zymogen is converted into an active enzyme that causes blood to clot.

Blood clotting performs the important function of stopping blood loss after an injury. However, when triggered in the wrong conditions, clotting can lead to debilitating or fatal conditions like heart attack, stroke and deep vein thrombosis.

In previous laboratory research, Di Cera re-engineered thrombin to act as an anticoagulant, stopping blood from clotting and opening the door to the development of new therapeutic strategies for the treatment of thrombosis, the presence of blood clots in blood vessels, which is responsible for nearly a third of all deaths in the U.S.

While researchers have an understanding of the structure of active thrombin, very little was known about its zymogen form. In order to learn more, researchers used x-ray crystallography to gather data about the molecular structure of the protein.

The process involves growing a crystal of the protein, shooting x-ray beams through the crystal and analyzing the diffraction pattern generated on a detector plate in order to detail the three-dimensional structure of the protein.

The structure of the zymogen form of thrombin provides crucial details about the activation mechanism that sheds light on the way the mature enzyme works. Future research can capitalize on these new findings to define better strategies for therapeutic intervention.



"Until now, we've known nothing about the zymogen form of thrombin or any blood-clotting enzyme," said Di Cera. "All the structural information has been limited to the active form.

"We now know that the zymogen form of thrombin is very different from the mature enzyme, in ways that open new opportunities for therapeutic intervention."

Established in 1836, Saint Louis University School of Medicine has the distinction of awarding the first medical degree west of the Mississippi River. The school educates physicians and biomedical scientists, conducts medical research, and provides health care on a local, national and international level. Research at the school seeks new cures and treatments in five key areas: cancer, liver disease, heart/lung disease, aging and brain disease, and infectious disease.

Editor's Note: This article is not intended to provide medical advice, diagnosis or treatment.

Story Source:

The above story is reprinted (with editorial adaptations by ScienceDaily staff) from materials provided by **Saint Louis University**.

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Scientists Find That Evergreen Agriculture Boosts Crop Yields

ScienceDaily (Nov. 1, 2010) — A unique acacia known as a "fertilizer tree" has typically led to a doubling or tripling of maize yields in smallholder agriculture in Zambia and Malawi, according to evidence presented at a conference in the Hague. The findings were central to the arguments of agroforestry experts at the conference, who urged decision makers to spread this technology more widely throughout the African nations most vulnerable to climate change and food shortages, and to think differently about more practical ways to solve the problems that are most pressing to smallholder farmers.

Speaking at The Hague Conference on Agriculture, Food Security and Climate Change, Dr. Dennis Garrity, Director General of the World Agroforestry Centre, said that evergreen agriculture -- or the integration of fertilizer trees into crop and livestock-holding farms -- is rapidly emerging as an affordable and accessible solution to improving production on Africa's farms.

"Doubling food production by mid-century, particularly in Africa, will require nonconventional approaches, particularly since so many of the continent's soils are depleted, and farmers are faced with a changing climate," Garrity said. "We need to reinvent agriculture in a sustainable and affordable way, so that it can reduce its emissions of greenhouse gases and be adapted to climate change."

Garrity spoke to leading agriculture and climate scientists, policymakers, development experts, and private sector representatives from around the world gathered at The Hague to develop a concrete action plan for linking agriculture-related investments, policies, and measures to transition agriculture to lower carbon-emitting, climate-resilient growth.

In a recent article in Food Security, Garrity and co-authors highlighted how evergreen agriculture has already provided benefits to several million farmers in Zambia, Malawi, Niger and Burkina Faso. Fertilizer trees draw nitrogen from the air and transfer it to the soil through their roots and leaf litter, replenishing exhausted soils with rich sources of organic nutrients. The trees bolster nutrient supply, increase food crop yields, and enhance the production of fodder, fuel and timber. These systems also provide additional income to farmers from tree products, while at the same time storing much greater amounts of carbon than other agricultural systems.

For example, farmers in Malawi have increased their maize yields by up to 280 percent when the crop is grown under a canopy of one particular fertilizing tree, *Faidherbia albida*. Unlike most other trees, *Faidherbia* sheds its leaves during the early rainy season and remains dormant during the crop-growing period. This makes it highly compatible with food crops because it does not compete with them for water, nutrients, or light -- only the bare branches of the tree's canopy spread overhead while crops of maize, sorghum, or millets grow to maturity below. The leaves and pods also provide a crucial source of fodder in the dry season for livestock when nearly all other plants have dried up. The trees may continue to provide these cost-free benefits for up to 70 to 100 years.

In Niger, there are now more than 4.8 million hectares of millet and sorghum being grown in agroforests that have up to 160 *Faidherbia* trees on each hectare.

The Intergovernmental Panel on Climate Change (IPCC) has already noted that transforming degraded agricultural lands into agroforestry has far greater potential to store carbon than any other managed land use change.

Researchers suggest that integrating agroforestry into farming systems on a massive scale would create a vital carbon bank. The IPCC estimates that a billion hectares of developing country farmland is suitable for conversion to carbon agroforestry projects.



A broad alliance is now emerging of governments, research institutions, and international and local development partners committed to expanding evergreen agriculture and agroforestry. The International Fund for Agricultural Development, the Alliance for a Green Revolution in Africa, the European Union, the Consultative Group on International Agricultural Research, and the UN Environment Programme are among those interested in developing partnerships to move the evergreen agriculture agenda forward.

"We are already working with 18 countries across the African continent to develop national plans for the accelerated implementation of evergreen agriculture," Garrity explained.

The next step is to further refine and adapt the technologies to a wider range of smallholder farming systems in diverse agricultural environments, so that millions more farmers can benefit now and for generations to come from such sustainable solutions to their food production challenges.

"Evergreen agriculture allows us to glimpse a future of more environmentally-sound farming where much of our annual food crop production occurs under a full canopy of trees," said Garrity.

For more information on evergreen agriculture, visit: http://www.worldagroforestry.org/evergreen_agriculture

Story Source:

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<http://www.sciencedaily.com/releases/2010/11/101102083149.htm>

Study Explores Relationship Between Urban Trees and Crime



Large trees can make a neighborhood seem well-cared for. Shown here is a neighborhood in Portland, Ore., where a study was conducted that explored the effects of trees and other factors on crime occurrence in the city. (Credit: Geoffrey Donovan, U.S. Forest Service, PNW Research Station)

ScienceDaily (Nov. 1, 2010) — Along with energy conservation and storm-water reduction, scientists may soon be adding crime-fighting to the list of benefits that urban trees provide. Researchers with the U.S. Forest Service's Pacific Northwest (PNW) and Southern Research Stations have published a new study that suggests that certain types of city trees may help lower property and violent crime rates.

Their study -- which is posted online in advance of its appearance in a forthcoming printed issue of the journal *Environment and Behavior* -- is the first to examine the effects of trees and other factors on crime occurrence in Portland, Ore.

"We wanted to find out whether trees, which provide a range of other benefits, could improve quality of life in Portland by reducing crime, and it was exciting to see that they did," said Geoffrey Donovan, research forester with the PNW Research Station who led the study. "Although a burglar alarm may deter criminals, it won't provide shade on a hot summer day, and it certainly isn't as nice to look at as a tree."

Donovan and his colleague Jeffrey Prestemon, with the Southern Research Station, obtained crime data from the Portland Police Bureau from 2005 to 2007 and grouped the incidents into seven categories. They examined only crimes for which a physical address was given and paired this information with additional data obtained from aerial photographs, onsite visits, and the Multnomah County Tax Assessor's Office. Their sample of 2,813 single-family homes experienced 394 property and 37 violent crimes.

The researchers then conducted statistical analyses to explore the relationships among crime and more than two dozen variables they compiled, including the number and size of trees on a lot and the size of trees on surrounding areas. Of the tree variables analyzed, canopy size of both street and yard trees and the number of



trees growing on a lot had the most effect on crime occurrence -- large trees were associated with a reduction in crime, while numerous small trees were associated with an increase.

"We believe that large street trees can reduce crime by signaling to a potential criminal that a neighborhood is better cared for and, therefore, a criminal is more likely to be caught," Donovan said. "Large yard trees also were associated with lower crime rates, most likely because they are less view-obstructing than smaller trees." In contrast, their analysis suggested that small yard trees might actually increase crime by blocking views and providing cover for criminals -- an effect that homeowners can mitigate by keeping trees pruned and carefully choosing the location of new trees.

Donovan and Prestemon plan to continue this line of research and may conduct similar studies in other cities.

Story Source:

The above story is reprinted (with editorial adaptations by ScienceDaily staff) from materials provided by **USDA Forest Service, Pacific Northwest Research Station**, via EurekAlert!, a service of AAAS.

Journal Reference:

1. G. H. Donovan, J. P. Prestemon. **The Effect of Trees on Crime in Portland, Oregon.** *Environment and Behavior*, 2010; DOI: [10.1177/0013916510383238](https://doi.org/10.1177/0013916510383238)

<http://www.sciencedaily.com/releases/2010/11/101101171240.htm>

For Elderly, Even Short Falls Can Be Deadly; Adults 70-Plus Three Times as Likely to Die Following Low-Level Falls



Elderly adults more likely to be severely injured or to die following short falls. (Credit: iStockphoto/Glenn Bo)

ScienceDaily (Nov. 1, 2010) — While simple falls, such as slipping while walking off a curb, may seem relatively harmless, they can actually lead to severe injury and death in elderly individuals, according to a new study published in *The Journal of Trauma: Injury, Infection, and Critical Care*. As the population continues to age, it is important for physicians and caregivers to be aware of and prepared to deal with this issue, which could significantly impact the overall health and wellbeing of older adults.

In contrast to falls from greater heights, ground-level falls -- essentially falls from a standing position, with feet touching the ground prior to the fall -- have traditionally been considered minor injuries. But, the new study found elderly adults -- 70 years or older -- who experience ground-level falls are much more likely to be severely injured and less likely to survive their injuries compared to adults younger than 70 years. Elderly patients are three times as likely to die following a ground-level fall compared to their under-70 counterparts. Trauma surgeon and researcher Julius Cheng, M.D., M.P.H, conducted the largest analysis to date of trauma patients experiencing ground-level falls. His team identified 57,302 patients with ground-level falls from 2001 through 2005 using the National Trauma Data Bank and analyzed demographics, type and severity of injuries and final outcomes.

"There is the potential to minimize what people see as a relatively trivial issue, such as slipping and falling on a wet tile floor. Our research shows that falls from low levels shouldn't be underestimated in terms of how bad they can be, especially in older patients," said Cheng, associate professor in the Department of Surgery at the University of Rochester Medical Center and lead author of the new study.

Between 1993 and 2003, there was a 55 percent increase in the rate of fatal falls for elderly adults. Because of the increasing age in the general population, the number of elderly patients visiting the emergency department with ground-level falls is increasing, and will likely continue to rise in the future. It is now estimated that 30 percent of adults older than 65 years will experience an unintentional fall each year.

"Instead of an influx of 'traditional' knife-and-gun club victims, trauma centers of the future may need to prepare for treatment of a less dramatic but no less relevant form of injury that may very well have a substantial impact on the health and independence of our older citizens," said Thomas S. Helling, M.D., from the Department of Surgery at the University of Mississippi Medical Center who wrote an editorial accompanying the study.

The negative effect of age on health outcomes has been well established in past studies in other areas as well. Many elderly adults are frail and have pre-existing medical conditions, such as heart disease. In these types of patients, a low-level fall that results in a broken hip could have serious, far-reaching consequences. According to Cheng, "An 80 year old often can't tolerate and recover from trauma like a 20 year old."

Cheng's team found that approximately 4.5 percent of elderly patients (70 years and above) died following a ground-level fall, compared to 1.5 percent of non-elderly patients. Elderly patients remained in the hospital and the intensive care unit longer and only 22 percent were able to function on their own after they left the hospital, compared to 41 percent of non-elderly patients.

Though low-level falls can potentially lead to significant injury and death, the reality is that almost three-quarters of patients with ground-level falls are not severely injured. Given the limited resources available to most medical centers across the United States and the increasing number of elderly patients needing treatment, Cheng's team identified two major predictors of death in patients who have experienced ground-level falls: Age older than 70 years and a Glasgow Coma Scale (a widely used indicator of brain injury) score of less than 15. These specific factors may help emergency department staff better determine which patients have a higher risk of death and are more likely to require aggressive evaluation and treatment.

While more research is needed on the management and treatment of the ever-expanding subpopulation of elderly patients in trauma centers, Cheng emphasizes the need to focus on prevention as well.

"This study brings up the important question of what we need to do as a society to help our older folks take care of themselves," said Cheng. "Instead of just treating falls as they happen, the focus should be on what we can do to help older people avoid them in the first place. This can be as simple as making sure there is no loose carpeting in their home and putting railings on both sides of stairways and in bathtubs and showers." In addition to Cheng, Konstantinos Spaniolas, M.D., Mark Gestring, M.D., Ayodele Sangosanya, M.D., Nicole Stassen, M.D. and Paul Bankey, M.D., from the University of Rochester Medical Center contributed to the study.

Editor's Note: This article is not intended to provide medical advice, diagnosis or treatment.

Story Source:

The above story is reprinted (with editorial adaptations by ScienceDaily staff) from materials provided by **University of Rochester Medical Center**.

Journal Reference:

1. Konstantinos Spaniolas, Julius D. Cheng, Mark L. Gestring, Ayodele Sangosanya, Nicole A. Stassen, Paul E. Bankey. **Ground Level Falls Are Associated With Significant Mortality in Elderly Patients.** *The Journal of Trauma: Injury, Infection, and Critical Care*, 2010; 69 (4): 821 DOI: [10.1097/TA.0b013e3181efc6c6](https://doi.org/10.1097/TA.0b013e3181efc6c6)

<http://www.sciencedaily.com/releases/2010/11/101101130135.htm>

At Great Expense, Railroad Bypassed First Black-Founded Town in the United States



Anthropology professor Christopher Fennell led an analysis of the decision by mid-19th-century railroad officials to reroute a proposed train line around New Philadelphia, Ill., "the first town in the United States planned, platted and legally registered by an African American." (Credit: Photo by L. Brian Stauffer) ScienceDaily (Nov. 1, 2010) — Ignoring topography, efficiency, expense and even their own surveyors' recommendations, regional railroad officials in the mid-19th century diverted a new rail line around New Philadelphia, Ill., "the first town in the United States planned, platted and legally registered by an African American," a University of Illinois researcher reports. The bypass pushed what would have been a fairly straight, even run of railroad tracks from Griggsville, Ill. to Hannibal, Mo., in a wide, hilly arc around New Philadelphia.

The findings, reported in *Historical Archaeology*, are the result of an exhaustive review of railroad company records, maps, government orders, land deeds, surveys, engineering reports and newspaper accounts from the period.

Founded in 1836, New Philadelphia began as an audacious experiment that tested the limits of racial tolerance in a country divided by slavery. Decades before the Civil War, black and white families lived and worked together in New Philadelphia. Frank McWorter, a Kentucky slave who had managed to buy his wife's freedom and then his own in the early 1800s, bartered for land in Illinois and later expanded his holdings to build the town. Over the years, McWorter rescued several other slaves, bringing them north to Illinois.

The 42-acre town was advantageously situated on a busy east-west wagon road, about half way between the Illinois and Mississippi rivers in Pike County in western Illinois. Farmers carrying produce or driving cattle to one or the other river for transit to market would use the road, which ran along the northern edge of town.

"Much of the growth of New Philadelphia was probably fueled by that wagon-based traffic going on that road," said University of Illinois anthropology professor and archaeologist Chris Fennell, who led the study.

"We see a whole host of merchants, blacksmiths, carpenters, a wheelwright and a wainwright (wagon builder) take up residence in the town."

At its peak, recorded in the 1865 state census, the town had about 160 residents. After the new rail line was completed, bypassing the town in 1870, New Philadelphia began to lose residents. In 1885, much of the town reverted to farmland; by the 1890s the town was defunct.

Fennell said he, his students and colleagues explored every hypothesis that could plausibly explain why the Pike County Railroad Company (PCRC, later called the Hannibal Naples Railway Company) chose to divert the rail line off an otherwise straight run between Griggsville and Hannibal.

The company paid for a survey of the proposed rail line in 1857, and the surveyors recommended that the railroad run in a straight, east-west line across most of Pike County. This new line would connect the vast eastern railway system that included the Illinois Central Railroad to the western regional railroad, which at that time went no further east than the Mississippi River. A fairly straight path between Naples, Ill., where the Central Railroad had a depot, and Hannibal, Mo., would have taken the rail line through New Philadelphia. That path also would have conserved the most expensive component of the new rail system: its iron rails. The Toledo Wabash Railroad Company, which was to run and maintain the railroad, insisted that the builders use only the highest-grade iron rails, Fennell said.

"They had to use English iron to do this because the American foundries couldn't produce the volume and consistency of iron needed," he said.

But the PCRC holding company asked the surveyors to modify their proposed route, bending the rail line north around the headwaters of Keyser Creek, which ran alongside New Philadelphia.

"There are many reasons that a particular railroad route might take one path rather than another," Fennell wrote. "If a topographic feature such as a high point of elevation or a deep ravine lies along a particular path, a railroad will often be diverted to avoid the expense of traversing that location."

But Keyser Creek was shallow, and a review of decades of newspaper clippings from the area found no reports of it ever flooding, Fennell said. A landscape analysis revealed that the topography of the area actually favored the original route.

"The northernmost part (of the rail line's loop around Keyser Creek) is 150 feet higher than all the rest of the length of this railroad," Fennell said.

The change in elevation was so abrupt that, once the railroad was built, the Toledo Wabash Railroad Company had to station a "helper locomotive" at Hannibal to "pull the freighter past the high point on the northern part of that arc," Fennell said. (This led many to call for the railroad company to rebuild that part of the line further south, as the surveyors had originally proposed.)

The cost of building a culvert over the shallow creek could not compare to the expense of the added iron rail, Fennell said.

"You actually are having an increase in iron not only for the curve in horizontal space but also because you're going up in elevation and down in elevation," he said.

Neither political nor economic pressure from people along the route was a factor either, Fennell found. There were no towns north of New Philadelphia between New Salem, where the bypass began, and Barry, where the rail line straightened out again. No wealthy or influential landowners to the north of New Philadelphia lobbied for the route change or contributed to the PCRC.

In fact, PCRC officials were so committed to their otherwise straight path across Pike County that, despite active lobbying by county officials, they refused to move the line further south to connect to the county seat, Pittsfield. Instead, they built a spur to connect Pittsfield to the main line.

"The last explanation standing," Fennell said, is that PCRC officials, who were based in Hannibal, a slave-market town, "did not want to see New Philadelphia thrive as a depot town."

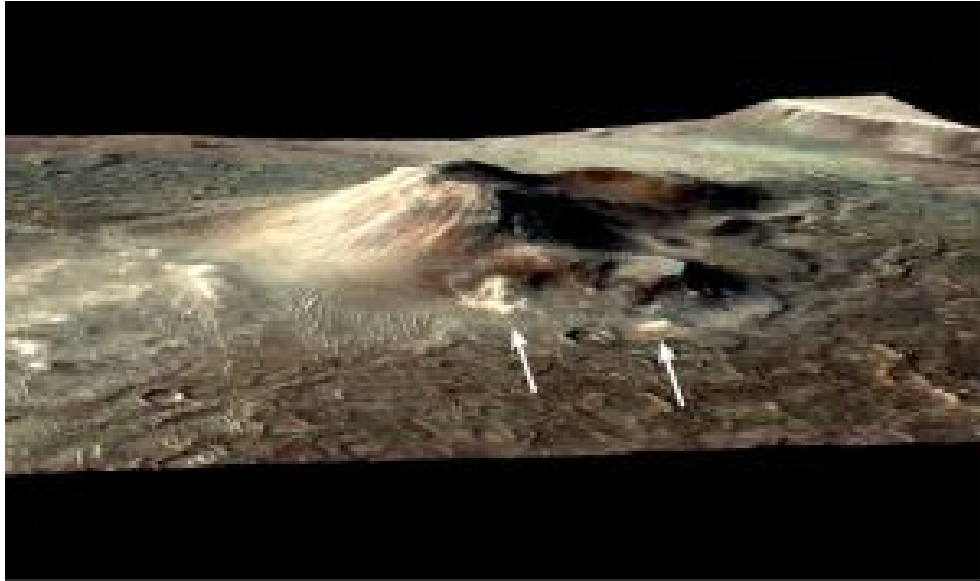
"This is an instance where racial ideology leads to a net loss for everyone," Fennell said.

Story Source:

The above story is reprinted (with editorial adaptations by *ScienceDaily* staff) from materials provided by **University of Illinois at Urbana-Champaign**.

<http://www.sciencedaily.com/releases/2010/11/101101130133.htm>

Mars Volcanic Deposit Tells of Warm and Wet Environment



This volcanic cone in the Nili Patera caldera on Mars has hydrothermal mineral deposits on the southern flanks and nearby terrains. Two of the largest deposits are marked by arrows, and the entire field of light-toned material on the left of the cone is hydrothermal deposits. Image Credit: (Credit: NASA/JPL-Caltech/MSSS/JHU-APL/Brown University)

ScienceDaily (Oct. 31, 2010) — Planetary scientists led by Brown University have found a volcanic deposit on Mars that would have been a promising wellspring for life. The silica deposit clearly shows the presence of water and heat. It was formed at a time when Mars' climate turned dry and chilly, which could mark it as one of the most recent habitable microenvironments on the red planet. The finding is published in *Nature Geoscience*.

Roughly 3.5 billion years ago, the first epoch on Mars ended. The climate on the red planet then shifted dramatically from a relatively warm, wet period to one that was arid and cold. Yet there was at least one outpost that scientists think bucked the trend.

A team led by planetary geologists at Brown University has discovered mounds of a mineral deposited on a volcanic cone less than 3.5 billion years ago that speak of a warm and wet past and may preserve evidence of one of the most recent habitable microenvironments on Mars.

Observations by NASA's Mars Reconnaissance Orbiter enabled researchers to identify the mineral as hydrated silica, a dead ringer that water was present at some time. That fact and the mounds' location on the flanks of a volcanic cone provide the best evidence yet found on Mars for an intact deposit from a hydrothermal environment -- a steam fumarole or a hot spring. Such environments may have provided habitats for some of Earth's earliest life forms.

"The heat and water required to create this deposit probably made this a habitable zone," said J.R. Skok, a graduate student at Brown and lead author of the paper in *Nature Geoscience*. "If life did exist there, this would be a promising spot where it would have been entombed -- a microbial mortuary, so to speak."

No studies have determined whether Mars has ever supported life, but this finding adds to accumulating evidence that at some times and in some places, Mars hosted favorable environments for microbial life. The deposit is located in the sprawling, flat volcanic zone known as Syrtis Major and was believed to have been left during the early Hesperian period, when most of Mars was already turning chilly and arid.

"Mars is just drying out," Skok said, "and this is one last hospitable spot in a cooling, drying Mars." Concentrations of hydrated silica have been identified on Mars previously, including a nearly pure patch found by NASA's Mars Exploration Rover Spirit in 2007. However, this is the first found in an intact setting that clearly signals the mineral's origin.

"You have spectacular context for this deposit," Skok said. "It's right on the flank of a volcano. The setting remains essentially the same as it was when the silica was deposited."

The small, degraded cone rises about 100 meters from the floor of a shallow bowl named Nili Patera. The patera spans about 50 kilometers (30 miles) in Syrtis Major of equatorial Mars. Before the cone formed, free-flowing lava blanketed nearby plains. The collapse of an underground magma chamber from which lava had emanated created the bowl. Subsequent lava flows, still with a runny texture, coated the floor of Nili Patera. The cone grew from even later flows, apparently after evolution of the underground magma had thickened its texture so that the erupted lava would mound up.

"We can read a series of chapters in this history book and know that the cone grew from the last gasp of a giant volcanic system," said John "Jack" Mustard, professor of geological sciences and a co-author of the paper, who is Skok's thesis adviser at Brown. "The cooling and solidification of most of the magma concentrated its silica and water content."

Observations by cameras on the Mars Reconnaissance Orbiter revealed patches of bright deposits near the summit of the cone, fanning down its flank, and on flatter ground in the vicinity. The Brown researchers partnered with Scott Murchie of Johns Hopkins University Applied Physics Laboratory to analyze the bright exposures with the Compact Reconnaissance Imaging Spectrometer for Mars (CRISM) instrument on the orbiter.

Silica can be dissolved, transported and concentrated by hot water or steam. Hydrated silica identified by the spectrometer in uphill locations -- confirmed by stereo imaging -- indicates that hot springs or fumaroles fed by underground heating created these deposits. Silica deposits around hydrothermal vents in Iceland are among the best parallels on Earth.

"The habitable zone would have been within and alongside the conduits carrying the heated water," Murchie said.

NASA funded the research.

Story Source:

The above story is reprinted (with editorial adaptations by *ScienceDaily* staff) from materials provided by **Brown University**.

<http://www.sciencedaily.com/releases/2010/10/101031131958.htm>

Miniature Human Livers Created in the Lab



An early milestone in the quest to grow replacement livers in the lab has been achieved. Researchers have used human liver cells to successfully engineer miniature livers that function -- at least in a laboratory setting -- like human livers. (Credit: iStockphoto/Sebastian Kaulitzki)

ScienceDaily (Oct. 31, 2010) — Researchers at the Institute for Regenerative Medicine at Wake Forest University Baptist Medical Center have reached an early, but important, milestone in the quest to grow replacement livers in the lab. They are the first to use human liver cells to successfully engineer miniature livers that function -- at least in a laboratory setting -- like human livers. The next step is to see if the livers will continue to function after transplantation in an animal model.

The ultimate goal of the research, which will be presented on October 31 at the annual meeting of the American Association for the Study of Liver Diseases in Boston, is to provide a solution to the shortage of donor livers available for patients who need transplants. Laboratory-engineered livers could also be used to test the safety of new drugs.

"We are excited about the possibilities this research represents, but must stress that we're at an early stage and many technical hurdles must be overcome before it could benefit patients," said Shay Soker, Ph.D., professor of regenerative medicine and project director. "Not only must we learn how to grow billions of liver cells at one time in order to engineer livers large enough for patients, but we must determine whether these organs are safe to use in patients."

Pedro Baptista, PharmD, Ph.D., lead author on the study, said the project is the first time that human liver cells have been used to engineer livers in the lab. "Our hope is that once these organs are transplanted, they will maintain and gain function as they continue to develop," he said.

To engineer the organs, the scientists used animal livers that were treated with a mild detergent to remove all cells (a process called decellularization), leaving only the collagen "skeleton" or support structure. They then

replaced the original cells with two types of human cells: immature liver cells known as progenitors, and endothelial cells that line blood vessels.

The cells were introduced into the liver skeleton through a large vessel that feeds a system of smaller vessels in the liver. This network of vessels remains intact after the decellularization process. The liver was next placed in a bioreactor, special equipment that provides a constant flow of nutrients and oxygen throughout the organ.

After a week in the bioreactor system, the scientists documented the progressive formation of human liver tissue, as well as liver-associated function. They observed widespread cell growth inside the bioengineered organ.

The ability to engineer a liver with animal cells had been demonstrated previously. However, the possibility of generating a functional human liver was still in question.

The researchers said the current study suggests a new approach to whole-organ bioengineering that might prove to be critical not only for treating liver disease, but for growing organs such as the kidney and pancreas. Scientists at the Wake Forest Institute for Regenerative Medicine are working on these projects, as well as many other tissues and organs, and also working to develop cell therapies to restore organ function.

Bioengineered livers could also be useful for evaluating the safety of new drugs. "This would more closely mimic drug metabolism in the human liver, something that can be difficult to reproduce in animal models," said Baptista.

Co-researchers were Dipfen Vyas, B.Sc., Zhan Wang, M.D., and Anthony Atala, M.D., director of the institute.

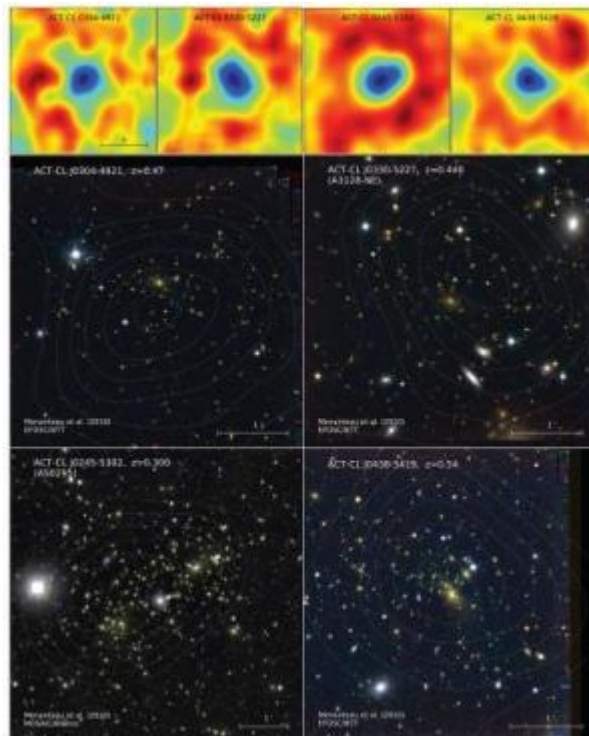
The abstract, "The Use of Whole Organ Decellularization for the Bioengineering of a Human Vascularized Liver," will be presented on Oct. 31.

Editor's Note: This article is not intended to provide medical advice, diagnosis or treatment.

Story Source:

The above story is reprinted (with editorial adaptations by ScienceDaily staff) from materials provided by **Wake Forest University Baptist Medical Center**.

Astrophysicists Discover New Galaxy Clusters Revealed by Cosmic 'Shadows'



Four Atacama Cosmology Telescope (ACT) images of cosmic background radiation, top row, with dark blue colors indicating "shadows" cast by galaxy clusters. Below, four optical images of the galaxy clusters, with white contour lines corresponding to the cosmic background radiation intensity levels in the ACT images. (Credit: Top row: Tobias Marriage, Johns Hopkins University, Princeton University. Bottom matrix: Felipe Menanteau, Rutgers University)

ScienceDaily (Nov. 1, 2010) — An international team of scientists led by Rutgers University astrophysicists has discovered 10 new massive galaxy clusters from a large, uniform survey of the southern sky. The survey was conducted using a breakthrough technique that detects "shadows" of galaxy clusters on the cosmic microwave background radiation, a relic of the "big bang" that gave birth to the universe.

In a paper published in the Nov. 10 issue of *The Astrophysical Journal*, the Rutgers scientists and collaborators at the Pontifical Catholic University of Chile (PUC) describe their visual telescope observations of these galaxy clusters, which were essential to verify the cosmic shadow sightings. Both observations will help scientists better understand how the universe was born and continues to evolve.

The research began in 2008 with a new radio telescope in the Atacama Desert of Chile -- one of the driest places on Earth. The instrument, known as the Atacama Cosmology Telescope (ACT), collects millimeter-length radio waves that reveal images of the otherwise invisible cosmic background radiation. Millimeter waves are easily blocked by water vapor, hence the telescope's home high in the Andes Mountains of northern Chile, where there is barely any atmospheric moisture.

"The groundbreaking observations at Atacama, led by Lyman Page of Princeton University, surveyed large areas of the sky to reveal shadows that pointed astronomers to these previously unseen massive galaxy clusters," said Felipe Menanteau, a research scientist in physics and astronomy, School of Arts and Sciences, at Rutgers.

Theorists Rashid Sunyaev and Yakov Zel'dovich predicted the shadow phenomenon 40 years ago, now known as the Sunyaev-Zel'dovich effect, or S-Z effect. Shortly thereafter astronomers verified it by observing shadows cast by previously known galaxy clusters. The higher sensitivity and resolution of ACT now makes

it practical for astronomers to essentially reverse the procedure -- to search the cosmic background radiation for shadows that indicate the presence of unseen clusters.

"The 'shadows' that ACT revealed are not shadows in the traditional sense, as they are not caused by the galaxy clusters blocking light from another source," said Jack Hughes, professor of physics and astronomy at Rutgers. "Rather, the hot gases within the galaxy clusters cause a tiny fraction of the cosmic background radiation to shift to higher energies, which then makes them appear as shadows in one of ACT's observing bands."

Cosmic background radiation was first observed by two Bell Labs astronomers in New Jersey back in the 1960s, a discovery that earned them the Nobel Prize in Physics in 1978.

Hughes and Menanteau worked with Chilean professors Leopoldo Infante and Felipe Barrientos to collect optical images of dozens of candidates, which led to the discovery of ten entirely new massive galaxy clusters. The Rutgers and PUC team, which also included PUC undergraduate student Jorge González, worked on two optical telescopes in Chile over the course of seven nights during October and December of 2009.

"We knew the experiment was working when we could see the giant clusters clearly, even in the raw images as they came through the telescope," said Menanteau.

"The technical challenges involved in exploiting the S-Z technique are daunting, and it is fantastic to see this method working so well," said Priyamvada Natarajan, professor of astronomy and physics at Yale University and a leading theoretical cosmologist not affiliated with the study. "It will build our inventory of the most massive and distant clusters in the universe, which will provide important constraints on the currently accepted cosmological model. I am personally excited to see the large number of strong lensing clusters that ACT is turning up."

The Rutgers and PUC observations were funded by the National Science Foundation's Partnerships for International Research and Education, in an award to Princeton with sub-awards to Rutgers and the University of Pennsylvania. The astronomers carried out their optical observations on the SOAR telescope in Cerro Pachón and the NTT in La Silla. The Atacama Cosmology Telescope project is funded by the National Science Foundation.

Story Source:

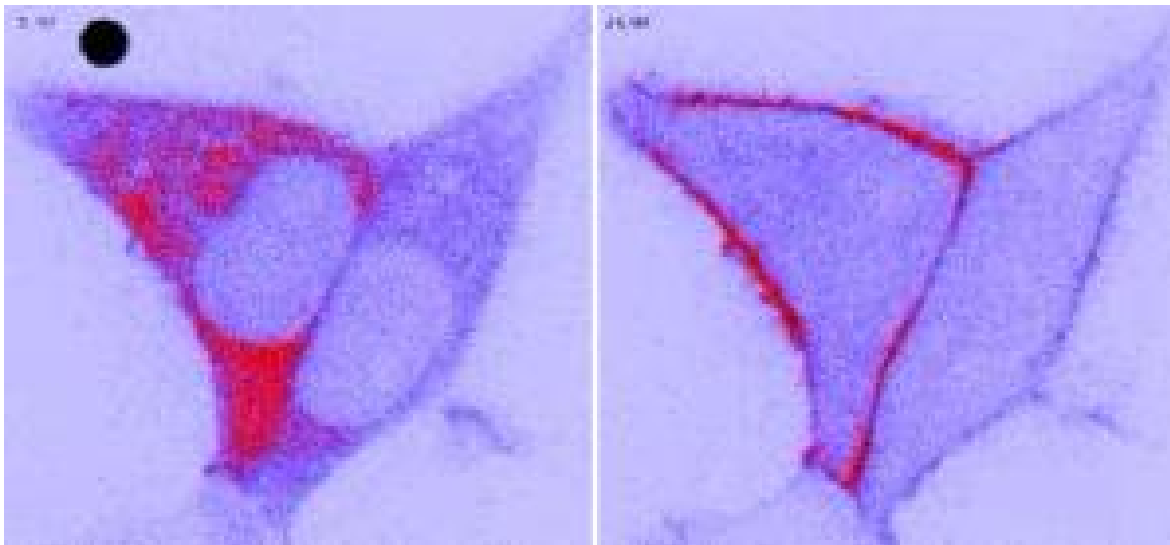
The above story is reprinted (with editorial adaptations by *ScienceDaily* staff) from materials provided by [Rutgers University](#).

Journal Reference:

1. Felipe Menanteau, Jorge González, Jean-Baptiste Juin, Tobias A. Marriage, Erik D. Reese, Viviana Acquaviva, Paula Aguirre, John William Appel, Andrew J. Baker, L. Felipe Barrientos, Elia S. Battistelli, J. Richard Bond, Sudeep Das, Amruta J. Deshpande, Mark J. Devlin, Simon Dicker, Joanna Dunkley, Rolando Dünner, Thomas Essinger-Hileman, Joseph W. Fowler, Amir Hajian, Mark Halpern, Matthew Hasselfield, Carlos Hernández-Monteagudo, Matt Hilton, Adam D. Hincks, Renée Hlozek, Kevin M. Huffenberger, John P. Hughes, Leopoldo Infante, Kent D. Irwin, Jeff Klein, Arthur Kosowsky, Yen-Ting Lin, Danica Marsden, Kavilan Moodley, Michael D. Niemack, Michael R. Nolte, Lyman A. Page, Lucas Parker, Bruce Partridge, Neelima Sehgal, Jon Sievers, David N. Spergel, Suzanne T. Staggs, Daniel Swetz, Eric Switzer, Robert Thornton, Hy Trac, Ryan Warne, Ed Wollack. **The Atacama Cosmology Telescope: Physical Properties and Purity of a Galaxy Cluster Sample Selected via the Sunyaev-Zel'dovich Effect.** *The Astrophysical Journal*, 2010; 723 (2): 1523 DOI: [10.1088/0004-637X/723/2/1523](https://doi.org/10.1088/0004-637X/723/2/1523)

<http://www.sciencedaily.com/releases/2010/11/101101161907.htm>

Plant's Light Switch Could Be Used to Control Cells



Within milliseconds of a blue flash of light, a red fluorescent protein that typically sits in a cell (left) interacts with a plant protein attached to the cell membrane. The fluorescent protein then migrates to the cell's edge (right). (Credit: Chandra Tucker, Duke)

ScienceDaily (Nov. 2, 2010) — Chandra Tucker shines a blue light on yeast and mammalian cells in her Duke University lab and the edges of them start to glow. The effect is the result of a light-activated switch from a plant that has been inserted into the cell.

Researchers could use this novel "on-off switch" to control cell growth or death, grow new tissue or deliver doses of medication directly to diseased cells, said Tucker, an assistant research professor in the biology department at Duke.

She and colleagues created the switch by genetically inserting two proteins from a mustard plant, *Arabidopsis thaliana*, into yeast cells, kidney cells and cultured rodent brain tissue. The two proteins interact under light to provide the control over cell functions.

The switch is similar to one described last year where researchers genetically inserted a different light-receptive plant protein and its interacting protein partner from *Arabidopsis* into mammalian cells. In response to red light, these proteins interacted to cause mammalian cells to change shape, moving in the direction of the light.

Tucker's switch uses *Arabidopsis* proteins that respond to blue light. Unlike the red-light activated proteins, which need an added cofactor, a chemical that is required for the light response, the blue-light switch doesn't need any additional chemicals to work because it uses a cofactor that naturally exists in non-plant organisms. "It's hard to deliver a chemical to a fly or to individual cells. This new approach, with one of the molecules already in the mammalian or yeast cells, makes building a light-controlled switch a lot easier," Tucker said. Her team describes the switch in the Oct. 31 *Nature Methods*.

To test the switch, the team fused one of the light-sensitive *Arabidopsis* proteins to a red fluorescent protein and the other to a green fluorescent protein, which was in turn attached to the cell membrane. When the researchers flashed blue light on the cell, the plant proteins interacted, causing the red fluorescent protein to rapidly move to the cell membrane, which then glowed yellow due to the merging of the red and green fluorescing proteins. The team found that this interaction was reversible and could be triggered repeatedly with light exposure.

The switch is one among several that have been designed to give researchers better control of different functions of the cell. The next step in developing the switch will be to make the interacting proteins more effective, Tucker said. The approach is expected to be applicable not only for studies in cultured cells and yeast, but also worms, fruit flies, mice and other model organisms. Eventually this method could allow researchers to test how cells in a tissue affect neighboring cells in a tissue, to guide axon growth in neurons to repair brain tissue, or even to kill cancer cells.

Tucker's new approach will be a "major boon" to those who wish to apply light activation to their own experimental systems, said Klaus Hahn, a pharmacologist at the University of North Carolina at Chapel Hill, whose lab reported on another blue-light responsive protein to control movement of mammalian cells last year.

Hahn said the "elegant work will likely see broad use, in many fields and for applications that will surprise us," and it is already going to be applied to important areas of research, such as control of gene expression.

Editor's Note: *This article is not intended to provide medical advice, diagnosis or treatment.*

Story Source:

The above story is reprinted (with editorial adaptations by ScienceDaily staff) from materials provided by **Duke University**.

Journal Reference:

1. Matthew J Kennedy, Robert M Hughes, Leslie A Peteya, Joel W Schwartz, Michael D Ehlers, Chandra L Tucker. **Rapid blue-light-mediated induction of protein interactions in living cells.** *Nature Methods*, 2010; DOI: [10.1038/nmeth.1524](https://doi.org/10.1038/nmeth.1524)

<http://www.sciencedaily.com/releases/2010/10/101031154011.htm>

Expanding Croplands Chipping Away at World's Carbon Stocks



Combining global cropland distribution and changes in carbon stocks due to cropland expansion into native ecosystems shows that carbon loss per ton of annual crop yield is nearly three times as high in the tropics compared to temperate regions. (Credit: Map courtesy Paul West, UW-Madison Center for Sustainability and the Global Environment and UW-Madison Center for Limnology)

ScienceDaily (Nov. 1, 2010) — Nature's capacity to store carbon, the element at the heart of global climate woes, is steadily eroding as the world's farmers expand croplands at the expense of native ecosystem such as forests.

The tradeoff between agricultural production and maintaining nature's carbon reservoirs -- native trees, plants and their carbon-rich detritus in the soil -- is becoming more pronounced as more and more of the world's natural ecosystems succumb to the plow. The problem, experts say, is most acute in the tropics, where expanding agriculture often comes at the expense of the tropical forests that act as massive carbon sinks because of their rich diversity and abundance of plant life.

The seriousness of the problem is documented in the most comprehensive and fine-grained analysis of the world's existing carbon stocks and global crop yields. The study is published online this in the *Proceedings of the National Academy of Sciences* (PNAS) by a team of researchers from the University of Wisconsin-Madison, the University of Minnesota, Stanford University, Arizona State University and The Nature Conservancy. The article is part of a special PNAS feature on climate mitigation and agricultural productivity in the tropics.

"We analyzed the tradeoffs between carbon storage and crop production at a level of detail that has never been possible before," according to Stephen Carpenter, one of the senior authors of the study and a professor at the Center for Limnology at UW-Madison. "The main news is that agricultural production by clearing land in the tropics releases a lot of greenhouse gases per unit of food produced."

Compared to the world's temperate regions, the tropics release nearly twice as much carbon to the atmosphere for each unit of land cleared, explains Paul C. West, a UW-Madison graduate student and the lead author of the new study. "Tropical forests store a tremendous amount of carbon, and when a forest is cleared, not only do you lose more carbon, but crop yields are not nearly as high as they are in temperate areas."

"This creates a kind of 'double whammy' for a lot of tropical agriculture: we have to clear carbon-rich ecosystems to create tropical croplands, and unfortunately they often have lower yields than temperate systems," says Jonathan Foley, director of the University of Minnesota's Institute on the Environment and a

co-author on the study. "In terms of balancing the needs of food production and slowing carbon dioxide emissions, this is a tough tradeoff."

In the tropics, for example, it is estimated that for every ton of crop yield, carbon stocks are diminished by as much as 75 tons. Such attrition, say West and his colleagues, makes a strong case for intensifying agriculture on already-converted land instead of putting new fields into production.

"One path is to expand agricultural land," says West. "The other path is to intensify agriculture on existing lands. The reality is there will be some of both."

Today, about 20 percent of the land in temperate regions is in cropland. In the tropics, 11 percent of the land is farmed. However, in the tropics pressure to plant more land is growing fastest due to increasing human population, changing diets, food security concerns, and a rising demand for the raw materials of biofuels. Carbon is one of the planet's most abundant elements. It is present in all known life forms and moves naturally between the biosphere, oceans and atmosphere in a process that allows the element to be continuously recycled. Human processes, and in particular agriculture, accelerate the process by rapidly converting carbon stocks in trees, other plants and the soil to carbon dioxide, the primary greenhouse gas. Global carbon stocks, notes West, can be analogous to a checking account: "The math is pretty simple. When you clear a forest, it is like making a big withdrawal from the checking account."

The new study utilized a combination of satellite data and government reports to determine the extent of cultivation for 175 different crop plants worldwide.

Estimates of global carbon stocks in natural vegetation, obtained from a recent Intergovernmental Panel on Climate Change (IPCC) report, were based on field measurements and averaged according to vegetation type, climate and continent. The data were then used to quantify and map the tradeoff between carbon stocks and crop production globally on a grid at a resolution of 10 kilometers by 10 kilometers.

"We have a very fine resolution of both what the carbon stocks and the yields are globally," says West.

"Spatially, it is much more explicit than anything that has been produced before."

The result, explains the Wisconsin researcher, is a set of "paint by numbers maps" showing global cropland distribution and yields, and changes in carbon stock due to cropland conversion.

Carpenter, West and Foley believe the new analysis will be a valuable tool for governments, nonprofit organizations and businesses. Already, commercial carbon exchanges are beginning to emerge and detailed knowledge of where carbon stocks are preserved or could be expanded will be valuable information.

In addition to West, Carpenter and Foley, authors of the new study include Holly K. Gibbs of Stanford University, Chad Monfreda of Arizona State University, John Wagner of the Nature Conservancy, and Carol Barford of UW-Madison. NASA, The Nature Conservancy and the U.S. Department of Energy funded the study.

Story Source:

The above story is reprinted (with editorial adaptations by ScienceDaily staff) from materials provided by **University of Wisconsin-Madison**. The original article was written by Terry Devitt.

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Frontal Lobe of the Brain Is Key to Automatic Responses to Various Stimuli, Say Scientists



These are the average brain activations in people who have each applied a simple categorization rule more than 11,000 times. (Credit: Sebastien Helie, UCSB)

ScienceDaily (Nov. 1, 2010) — Some people may excel at riding a bike, tying a tie, or playing the piano, but those same people may find it difficult to explain or teach those skills to someone else.

These motor skills are learned in one part of the brain, whereas classroom instruction and information read in a book are acquired in another area of the brain, explained F. Gregory Ashby, professor and chair of UC Santa Barbara's Department of Psychology. This second area of learning is the frontal cortex -- the area immediately behind the forehead -- where executive function is located.

A study of different categories of learning is reported by Ashby and his research team in the current issue of the *Journal of Neuroscience*. A group of 16 UCSB undergraduates took part in thousands of visual tests, so the psychologists could study their responses. A significant number of the trials took place in the university's brain imaging scanner using fMRI, which allowed the scientists to observe areas of the brain during testing.

The team found that tasks with explicit reasoning behind them were much simpler for test subjects. "When you can't explain the reasoning, it takes test subjects about 10 times as many trials to master," said Ashby.

These areas without explicit reasoning are grasped in a lower part of the brain, the basal ganglia. "It is similar to the fact that you can't explain what your fingers are doing when you are playing the piano," said Ashby.

However, he went on to explain that once a behavior becomes automatic, it becomes cortical. "Automatic behaviors are stored in similar ways, in the frontal cortex, regardless which system of the brain learned it first," he said.

Ashby cited the example of an excellent tennis player with Parkinson's disease. He said that scientists used to think that tennis skills were stored in the basal ganglia, where they were learned, and the area of the brain affected by Parkinson's disease. The player, however, was able to hit moving tennis balls with the same skill exhibited before he was diagnosed with Parkinson's. According to Ashby, it is because it was an automatic response for him, one that is entirely mediated in the cortical area.

This could explain why people can react quickly with an automatic response to an event that is first perceived in sensory areas, such as seeing an oncoming vehicle and slamming on the brakes. Again, these automatic behaviors are stored in similar ways regardless of which brain system learned the behavior first.

The other authors are first author and postdoctoral fellow Sebastien Helie, and graduate student Jessica L. Roeder. Both are with UCSB's Department of Psychology.



Editor's Note: *This article is not intended to provide medical advice, diagnosis or treatment.*

Story Source:

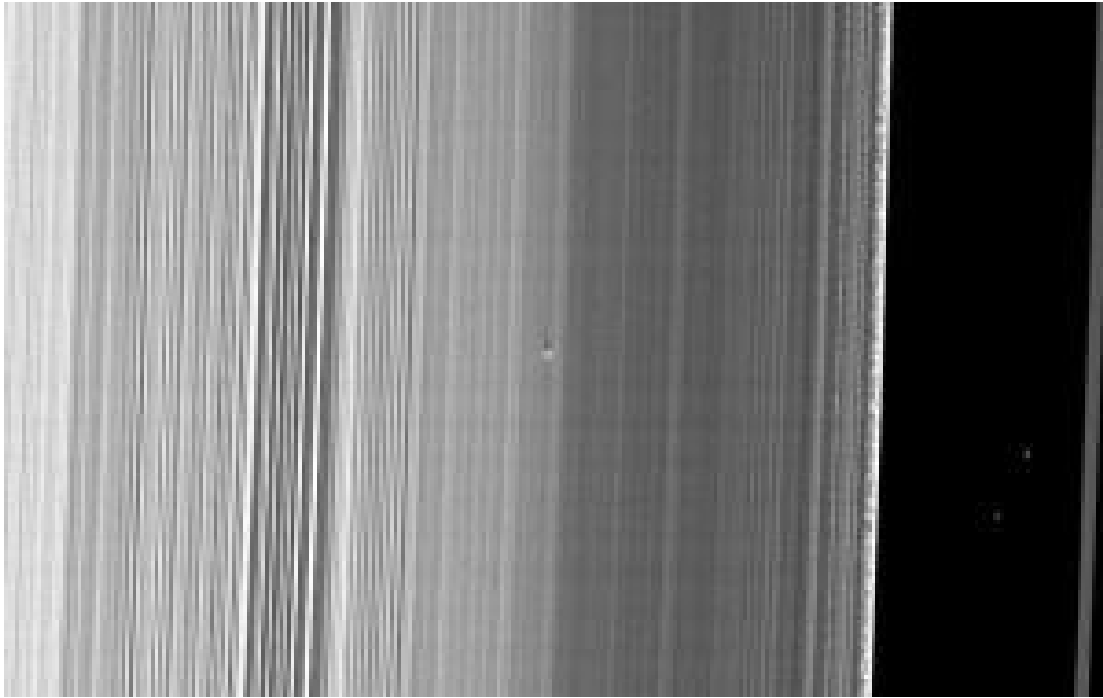
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Cassini Sees Saturn Rings Oscillate Like Mini-Galaxy



A Small Find Near Equinox: NASA's Cassini spacecraft captured this image of a small object in the outer portion of Saturn's B ring casting a shadow on the rings as Saturn approached its August 2009 equinox. (Credit: NASA/JPL-Caltech/SSI)

ScienceDaily (Nov. 1, 2010) — Scientists believe they finally understand why one of the most dynamic regions in Saturn's rings has such an irregular and varying shape, thanks to images captured by NASA's Cassini spacecraft. And the answer, published online in *The Astronomical Journal*, is this: The rings are behaving like a miniature version of our own Milky Way galaxy.

This new insight, garnered from images of Saturn's most massive ring, the B ring, may answer another long-standing question: What causes the bewildering variety of structures seen throughout the very densest regions of Saturn's rings?

Another finding from new images of the B ring's outer edge was the presence of at least two perturbed regions, including a long arc of narrow, shadow-casting peaks as high as 3.5 kilometers (2 miles) above the ring plane. The areas are likely populated with small moons that might have migrated across the outer part of the B ring in the past and got trapped in a zone affected by the moon Mimas' gravity. This process is commonly believed to have configured the present-day solar system.

"We have found what we hoped we'd find when we set out on this journey with Cassini nearly 13 years ago: visibility into the mechanisms that have sculpted not only Saturn's rings, but celestial disks of a far grander scale, from solar systems, like our own, all the way to the giant spiral galaxies," said Carolyn Porco, co-author on the new paper and Cassini imaging team lead, based at the Space Science Institute, Boulder, Colo.

New images and movies of the outer B ring edge can be found at <http://www.nasa.gov/cassini>, <http://saturn.jpl.nasa.gov> and <http://ciclops.org>.

Since NASA's Voyager spacecraft flew by Saturn in 1980 and 1981, scientists have known that the outer edge of the planet's B ring was shaped like a rotating, flattened football by the gravitational perturbations of Mimas. But it was clear, even in Voyager's findings, that the outer B ring's behavior was far more complex than anything Mimas alone might do.

Now, analysis of thousands of Cassini images of the B ring taken over a four-year period has revealed the source of most of the complexity: at least three additional, independently rotating wave patterns, or oscillations, that distort the B ring's edge. These oscillations, with one, two or three lobes, are not created by any moons. They have instead spontaneously arisen, in part because the ring is dense enough, and the B ring edge is sharp enough, for waves to grow on their own and then reflect at the edge.

"These oscillations exist for the same reason that guitar strings have natural modes of oscillation, which can be excited when plucked or otherwise disturbed," said Joseph Spitale, lead author on the article and an imaging team associate at the Space Science Institute. "The ring, too, has its own natural oscillation frequencies, and that's what we're observing."

Astronomers believe such "self-excited" oscillations exist in other disk systems, like spiral disk galaxies and proto-planetary disks found around nearby stars, but they have not been able to directly confirm their existence. The new observations confirm the first large-scale wave oscillations of this type in a broad disk of material anywhere in nature.

Self-excited waves on small, 100-meter (300-foot) scales have been previously observed by Cassini instruments in a few dense ring regions and have been attributed to a process called "viscous overstability." In that process, the ring particles' small, random motions feed energy into a wave and cause it to grow. The new results confirm a Voyager-era predication that this same process can explain all the puzzling chaotic waveforms found in Saturn's densest rings, from tens of meters up to hundreds of kilometers wide.

"Normally viscosity, or resistance to flow, damps waves -- the way sound waves traveling through the air would die out," said Peter Goldreich, a planetary ring theorist at the California Institute of Technology in Pasadena. "But the new findings show that, in the densest parts of Saturn's rings, viscosity actually amplifies waves, explaining mysterious grooves first seen in images taken by the Voyager spacecraft."

The two perturbed B ring regions found orbiting within Mimas' zone of influence stretch along arcs up to 20,000 kilometers (12,000 miles) long. The longest one was first seen last year when the sun's low angle on the ring plane betrayed the existence of a series of tall structures through their long, spiky shadows. The small moons disturbing the material are probably hundreds of meters to possibly a kilometer or more in size.

The Cassini-Huygens mission is a cooperative project of NASA, the European Space Agency and the Italian Space Agency. The Jet Propulsion Laboratory, a division of the California Institute of Technology in Pasadena, manages the mission for NASA's Science Mission Directorate, Washington. The Cassini orbiter and its two onboard cameras were designed, developed and assembled at JPL. The imaging operations center is based at the Space Science Institute in Boulder, Colo.

Story Source:

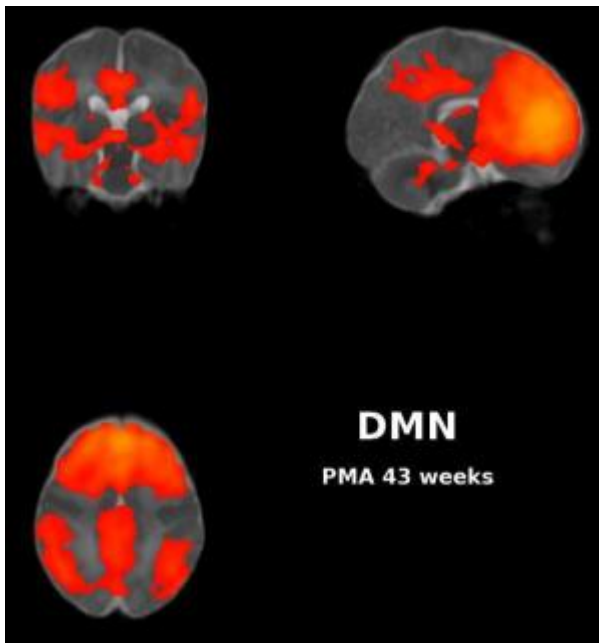
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Study of Babies' Brain Scans Sheds New Light on the Brain's Unconscious Activity and How It Develops



Still image from a movie showing the usual development of the default mode network from 30 -- 43 weeks using the link below. (Credit: Imperial College London)

ScienceDaily (Nov. 1, 2010) — Full-term babies are born with a key collection of networks already formed in their brains, according to new research that challenges some previous theories about the brain's activity and how the brain develops.

The study is published in the journal *Proceedings of the National Academy of Sciences*.

Researchers led by a team from the MRC Clinical Sciences Centre at Imperial College London used functional MRI scanning to look at 'resting state' networks in the brains of 70 babies, born at between 29 and 43 weeks of development, who were receiving treatment at Imperial College Healthcare NHS Trust.

Resting state networks are connected systems of neurons in the brain that are constantly active, even when a person is not focusing on a particular task, or during sleep. The researchers found that these networks were at an adult-equivalent level by the time the babies reached the normal time of birth.

One particular resting state network identified in the babies, called the default mode network, has been thought to be involved in introspection and daydreaming. MRI scans have shown that the default mode network is highly active if a person is not carrying out a defined task, but is much less active while consciously performing tasks.

Earlier research had suggested that the default mode network was not properly formed in babies and that it developed during early childhood. The fact that the default mode network has been found fully formed in newborns means it may provide the foundation for conscious introspection, but it cannot be only thing involved, say the researchers behind this latest study.

Professor David Edwards, lead author of the study from the MRC Clinical Sciences Centre at Imperial College London, said: "Some researchers have said that the default mode network is responsible for introspection -- retrieving autobiographical memories and envisioning the future, etc. The fact that we found it in newborn babies suggests that either being a fetus is a lot more fun than any of us can remember -- lying there happily introspecting and thinking about the future -- or that this theory is mistaken.

"Our study shows that babies' brains are more fully formed than we thought. More generally, we sometimes expect to be able to explain the activity we can see on brain scans terms of someone thinking or doing some

task. However, most of the brain is probably engaged in activities of which we are completely unaware, and it is this complex background activity that we are detecting."

The researchers found that the resting state networks mainly develop after 30 weeks -- in the third trimester -- and are largely complete by 40 weeks when most babies are born. They reached their conclusions after carrying out functional MRI scans on 70 babies, born at between 29 and 43 weeks of development, who were receiving treatment at Imperial College Healthcare NHS Trust and whose parents had given consent for them to be involved in the study. Some of the babies scanned were under sedation and others were not, but the researchers found no difference in results between sedated and non-sedated babies.

The researchers used a 4-dimensional brain atlas developed with scientists in the Department of Computing at Imperial College London to map the activity that they found in the babies' brains against what is known about the location of different brain networks.

The next step for this research is to find out how these networks are affected by illnesses and to see if they can be used to diagnose problems.

The research involved collaboration between researchers at Imperial College London and clinicians at Imperial College Healthcare NHS Trust, as part of the Academic Health Science Centre (AHSC), a unique kind of partnership between the College and the Trust, formed in October 2007. The AHSC's aim is to improve the quality of life of patients and populations by taking new discoveries and translating them into new therapies as quickly as possible.

The study was carried out by researchers from Imperial College London and University College London, who are funded by the Medical Research Council, the Wellcome Trust and the Garfield Weston Foundation.

Editor's Note: *This article is not intended to provide medical advice, diagnosis or treatment.*

Story Source:

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Alcohol 'Most Harmful Drug', According to Multicriteria Analysis

A new study places alcohol as the most harmful drug, above heroin and crack, based on harm caused to both the user and others. (Credit: iStockphoto/Marcio Silva)

ScienceDaily (Nov. 1, 2010) — A new system that ranks drugs on the basis of harm caused to both the user and others places alcohol as the most harmful drug, above heroin and crack. The scale, developed by drug experts led by Professor David Nutt of Imperial College London, is published online in *The Lancet*.

Drugs including alcohol and tobacco products are a major cause of harms to individuals and society. To provide better guidance to policy makers in health, policing, and social care, the harms that drugs cause need to be properly assessed. This task is not easy because of the wide range of ways in which drugs can cause harm, the researchers say.

When Professor Nutt and colleagues attempted this assessment previously in 2007, they engaged experts to score each drug according to nine criteria of harm, ranging from the intrinsic harms of the drugs to social and healthcare costs. This analysis provoked major interest and public debate, although it raised concerns about the choice of the nine criteria and the absence of any differential weighting of them.

To rectify these drawbacks, the authors undertook a review of drug harms with the multicriteria decision analysis (MCDA) approach. MCDA technology has been used successfully to lend support to decision makers facing complex issues characterised by many, conflicting objectives, such as policies for disposal of nuclear waste.

Multicriteria decision analysis

The new analysis uses nine criteria that relate to the harms that a drug produces in the individual and seven to the harms to others both in the UK and overseas. These harms are clustered into five subgroups representing physical, psychological, and social harms.

Drugs were scored with points out of 100, with 100 assigned to the most harmful drug on a specific criterion. Zero indicated no harm. Explaining their model, the authors say: "In scaling of the drugs, care is needed to ensure that each successive point on the scale represents equal increments of harm. Thus, if a drug is scored at 50, then it should be half as harmful as the drug that scored 100." A zero means no harm is caused.

The criteria are weighted according to a judgement of their relative importance. "The issue of the weightings is crucial since they affect the overall scores," the authors say. "The weighting process is necessarily based on judgement, so it is best done by a group of experts working to consensus."

The nine categories in harm to self are drug-specific mortality, drug-related mortality, drug-specific damage, drug-related damage, dependence, drug-specific impairment of mental function, drug-related impairment of mental functioning, loss of tangibles, loss of relationships, and injury. The harm to others categories are crime, environmental damage, family conflict, international damage, economic cost, and decline in community cohesion.



Overall, MCDA modelling showed alcohol was the most harmful drug (overall harm score 72), with heroin (55) and crack (54) in second and third places. Heroin, crack, and crystal meth were the most harmful drugs to the individual, whereas alcohol, heroin, and crack were the most harmful to others. The other drugs assessed followed in this order in terms of overall harm: Crystal meth (33), cocaine (27), tobacco (26), amphetamine/speed (23), cannabis (20), GHB (18), benzodiazepines (eg valium) (15), ketamine (also 15), methadone (14), mephedrone (13), butane (10), khat (9), ecstasy (9), anabolic steroids (9), LSD (7), buprenorphine (6), mushrooms (5).

Thus the new ISCD MCDA modelling showed that as well as being the most harmful drug overall, alcohol is almost three times as harmful as cocaine or tobacco. It also showed that alcohol is more than five times more harmful than mephedrone, which was recently a so-called legal high in the UK before it was made a class B controlled drug in April 2010. Ecstasy, which has had much harm-related media attention over the past two decades, is only one eighth as harmful as alcohol in this new analysis.

Implications for drug policy

The authors say that their work correlates with both the previous analysis by Nutt and colleagues and that of other such as the Dutch addiction medicine expert group. However, there is almost no relation between the results and the current UK drug classification system based on the UK Misuse of Drugs Act (1971).

Professor Nutt, from the Department of Medicine at Imperial College London, says: "What a new classification system might look like would depend on what set of harms -- to self or others -- you are trying to reduce. But if you take overall harm, then alcohol, heroin and crack are clearly more harmful than all others so perhaps drugs with a score of 40 or more could be class A; 39 to 20 class B; 19-10 class C and 10 or under class D."

The authors say the MCDA process provides a powerful means to deal with complex issues that drug misuse represents.

They conclude: "Our findings lend support to previous work in the UK and the Netherlands, confirming that the present drug classification systems have little relation to the evidence of harm. They also accord with the conclusions of previous expert reports that aggressively targeting alcohol harms is a valid and necessary public health strategy."

Editor's Note: This article is not intended to provide medical advice, diagnosis or treatment.

Story Source:

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New Strain of 'High-Runner' Rats Uniquely Resistant to Disease



In a new study, researchers bred high-runners with high-runners and low-runners with low-runners to divide and concentrate the genes for these traits in two groups of rats. After 11 generations of selection, "high-runner" rats could run three times as far as the "low-runner" rats. The low-runner rats appeared to be at a higher risk for disease than the high-runner rats. (Credit: iStockphoto)

ScienceDaily (Nov. 1, 2010) — Everybody knows that if you're physically fit, you're less likely to get a wide range of diseases. What most people don't know is that some people are "naturally" in better shape than others, and this variation in conditioning makes it difficult to test for disease risk and drug effectiveness in animal models.

A new research paper published in the November 2010 print issue of *The FASEB Journal* started out as a study to explain the strong statistical link between low aerobic exercise capacity and common diseases, but ultimately led to an animal model that breaks through the limitations of current systems that target single disease pathways.

Because common disease risks arise from complex interactions of many genetic pathways, future animal model systems, like this one, must account for multiple pathways. The animal model developed in this study can be used to evaluate mechanisms by which positive and negative environmental effects influence disease risks and explore a wide variety of pathways, rather than focusing on a single target.

"We hope that our approach of using a more realistic animal model system of disease risks will lead to information that is explanatory and ultimately predictive of mechanisms underlying disease," said Heikki Kainulainen, Ph.D., co-author of the study from the Neuromuscular Research Center at the University of Jyväskylä in Finland. "This seems to be the only path for developing diagnostics and therapeutics that have high efficacy."

To create this animal model, researchers bred high-runners with high-runners and low-runners with low-runners to divide and concentrate the genes for these traits in two groups of rats. After 11 generations of selection, "high-runner" rats could run three times as far as the "low-runner" rats. The low-runner rats appeared to be at a higher risk for disease than the high-runner rats. Genetic analysis of the two groups of rats revealed that the expression levels of seven functionally related groups of genes correlated with differences in aerobic running traits and disease risks between the low- and high- runner rats. This makes the low-runner and high-runner rat model system a valuable tool to explore mechanisms underlying disease risks at all levels of biological organization.



"Genes that increase resistance to common diseases in high-runner rats are also present across species," said Gerald Weissmann, M.D., Editor-in-Chief of *The FASEB Journal*. "As our understanding of disease grows in complexity, so does our need for animal models that can mimic disease susceptibility in humans."

Editor's Note: This article is not intended to provide medical advice, diagnosis or treatment.

Story Source:

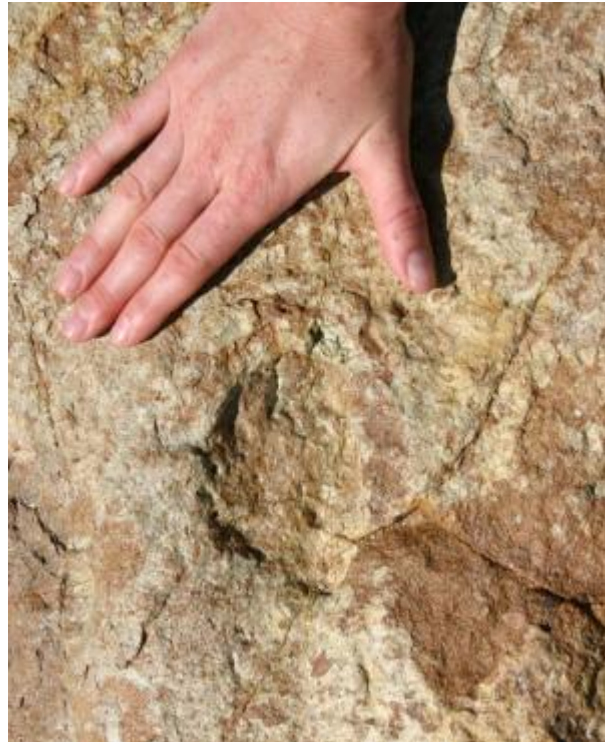
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Tracks of a Running Bipedal Baby Brontosaur? Baby Sauropod Footprints Discovered in Colorado



Recently discovered baby sauropod hind track from the Late Jurassic Morrison Formation, Morrison, Colorado, USA. (Credit: Copyright 2010, Morrison Museum of Natural History (MNHM) / Matthew T. Mossbrucker)

ScienceDaily (Nov. 1, 2010) — Staff at the Morrison Natural History Museum have again discovered infant dinosaur footprints in the foothills west of Denver, Colorado, near the town of Morrison. Dating from the Late Jurassic, some 148 million years ago, these tracks were made before the Rocky Mountains rose, when Morrison was a broad savanna full of dinosaurs.

The fossil tracks represent infant sauropods, according to discoverer Matthew Mossbrucker, the museum's director. Sauropods are giant, herbivorous long-necked dinosaurs, sometimes known as "brontosaurus." The sauropod *Apatosaurus* was first discovered in Morrison in 1877. As long as three school buses parked end to end, and weighing as much as eight Asian elephants combined, *Apatosaurus* is the largest dinosaur found in the Denver metro area.

Information regarding the new tracks will be presented Nov. 1 at the 2010 Geologic Society of America Annual Meeting & Exposition in Denver.

In 1877, Arthur Lakes uncovered the very first apatosaurus -- three skeletons of the 30-ton giant that was named *Apatosaurus ajax*. Later discoveries in Wyoming and Utah proved that sauropods were among the dominant giant herbivores in the Late Jurassic.

Lakes was brilliant -- he scrutinized the soft grey-green mudrock and the granite-hard sandstone at the Town of Morrison and recovered great blocks of stone filled with bone. But he did miss some things. He didn't realize that the top of the bone layer was churned by dinosaur feet.

Leading paleontologist Dr. Robert T. Bakker of the Houston Museum of Natural Sciences (who also serves as the Morrison Museum's volunteer curator of paleontology) remarks, "The latest discovery by the Morrison Natural History Museum is a tribute to Director Matt Mossbrucker and his crew of sharp-eyed volunteers. Never before has science given us such an intimate glimpse of baby brontosaurus -- a window into Jurassic Family Values."

"Three years ago the Morrison Museum crew detected adult and baby Stegosaurus, hinting that the area had been near a stego nesting ground. The new baby sauropod tracks may well be the very smallest, youngest apatosaurus ever discovered, in the form of bone or trackways. Was Morrison an apatosaur nursery? The evidence is fascinating," muses Bakker.

The tracks are ovular and can be nearly eclipsed by a coffee mug, suggesting that the infant sauropods were about the size of a small dog. While one animal left average walking footprints, another infant dinosaur ran parallel to adult tracks.

The running trackway is unusual. "The distance between each step is two-times wider than what we observe in walking tracks indicating the animal was at a low speed run," remarks Mossbrucker. "I am not aware of any running sauropod tracks anywhere." Nor is Bakker.

Mossbrucker jokes that the diminutive dinosaur was "the world's fastest long-neck." How fast is unknown, but Mossbrucker thinks his brood of four kids wouldn't have a problem catching up to "Speedy the Sauropod." Surprising to Mossbrucker and colleagues is that the running trackway demonstrates only hindpaw tracks. "Perhaps while the little dinosaur was running the hindpaw eclipsed and crushed the frontpaw track leaving no trace, or perhaps this critter was running only on its hind paws," Mossbrucker states. The walking-gait tracks do show a forepaw track.

Tail drag troughs are absent on both trackways, which is not surprising, because most sauropod trackways do not show a tail drag mark. This evidence, combined with detailed studies of the tail point, lead researchers to believe that sauropod tails were carried off the ground.

"In the end, we might have a baby sauropod that is running like a Basilisk lizard, a modern lizard that is mostly a quadruped, but when spooked it runs on its hindlegs." Studies are underway to understand the biomechanics of Morrison's sauropods and what a running baby sauropod would look like.

Although collected five years ago, these tracks were a part of a backlog of new discoveries made by Museum staff. The continuous stream of discoveries coming from the Morrison Museum lab demonstrates that an energetic small natural history institution can make unique contributions to science and science education.

The tracks are on permanent display at the Morrison Natural History Museum in the recently redesigned "Fossils of the Foothills" exhibition funded by Scientific and Cultural Facility District (SCFD) grants. The Museum is open daily.

Story Source:

The above story is reprinted (with editorial adaptations by *ScienceDaily* staff) from materials provided by **The Geological Society of America**.

<http://www.sciencedaily.com/releases/2010/11/101101083150.htm>

Did Neanderthals Make Jewellery After All?



Remains of some of the personal ornaments, rings, awls, pierced animal teeth and ivory pendants that have been excavated from the Châtelperronian levels at the site. (Credit: M. Vanhaeren)

ScienceDaily (Nov. 1, 2010) — The theory that later Neanderthals might have been sufficiently advanced to fashion jewellery and tools similar to those of incoming modern humans has suffered a setback. A new radiocarbon dating study, led by Oxford University, has found that an archaeological site that uniquely links Neanderthal remains to sophisticated tools and jewellery may be partially mixed.

The study, published in the early online version of the journal *PNAS*, suggests that the position of key finds in the archaeological layers of the Grotte du Renne at Arcy-sur-Cure in France may not be trustworthy. The research team, from the UK and France, dated material from the site and discovered their radiocarbon ages were extremely variable and did not correspond with the expected sequence indicated by the excavated archaeological layers. The Grotte du Renne has 15 archaeological layers, covering a depth of about four metres spanning periods from the Mousterian to the Gravettian periods.

For decades scholars have debated the extent of cognitive and behavioural development in Neanderthals before they disappeared from Europe about 30,000 years ago. Neanderthals are the most recent, extinct modern human relative. We have a common ancestor from around 700,000-800,000 years ago and recent work in decoding the Neanderthal genome shows we share between one to four per cent of their DNA. One pivotal period is around 35,000-40,000 years ago when the earliest modern humans dispersed into Western Europe. Finds made in the 1950s and 1960s at the Grotte du Renne site have provided persuasive evidence to suggest either that Neanderthals developed a more modern type of behaviour before modern human dispersal, developing their own complex ornaments and tools, or that they mimicked the behaviour of the modern humans that they encountered after their arrival. Over the years the site has yielded 29 Neanderthal teeth and a piece of ear bone from a Neanderthal skull in the same archaeological levels as rings made of ivory, awls, bone points, pierced animal teeth, shell and ivory pendants. The finds were recovered

from three archaeological levels (VII, IX, X) associated with the Châtelperronian industry, a tool culture thought to have evolved from the earlier Neanderthal, Mousterian industry. For this study, researchers from the Oxford Radiocarbon Accelerator Unit analysed 59 remains of cut-marked bones, horse teeth smashed by humans, awls, ornaments fashioned from animal teeth and mammoth ivory tusks from six key archaeological levels of the site. They included the three Châtelperronian levels (VIII, IX and X) and the Aurignacian level with material derived from modern humans in level VII. Thirty-one new radiocarbon dates were obtained: the oldest material in the Aurignacian level was dated at around 35,000 years ago, but when the researchers dated materials from the lower Châtelperronian levels they discovered many of the ages were hugely variable, with some much younger and several at about the same age as dates from the Aurignacian level. The most serious chronological problems were in the oldest part of the Châtelperronian layer (X) where more than a third of the radiocarbon ages were outside the ranges expected. Lead author Dr Thomas Higham, Deputy Director of the Oxford Radiocarbon Accelerator Unit, said: 'Our results confirm that material has moved up and down and is out of sequence in the Châtelperronian levels. We think that there has probably been some physical disturbance which has disrupted the proper sequence of the layers. This means that any chronological interpretation from this site should be viewed with extreme caution. 'Our study raises questions about the link between Neanderthals and the tools and jewellery found in the Châtelperronian levels. This site is one of only two in the French Palaeolithic that seems to show a link between ornaments and Neanderthal remains. This has previously been interpreted as indicating that Neanderthals were not intellectually inferior to modern people but possessed advanced cognition and behaviour. Our work says there is a big question mark over whether this link exists.'

Story Source:

The above story is reprinted (with editorial adaptations by *ScienceDaily* staff) from materials provided by **University of Oxford**.

Journal Reference:

1. T. Higham, R. Jacobi, M. Julien, F. David, L. Basell, R. Wood, W. Davies, C. B. Ramsey. **Chronology of the Grotte du Renne (France) and implications for the context of ornaments and human remains within the Chatelperronian.** *Proceedings of the National Academy of Sciences*, 2010; DOI: [10.1073/pnas.1007963107](https://doi.org/10.1073/pnas.1007963107)

<http://www.sciencedaily.com/releases/2010/10/101026131252.htm>

Physical Fitness Curbs Frequency and Severity of Colds, Study Finds

ScienceDaily (Nov. 1, 2010) — People who are physically fit and active have fewer and milder colds, indicates research published online in the *British Journal of Sports Medicine*.

The US researchers base their findings on 1,000 adults up to the age of 85 whose respiratory health was tracked for 12 weeks during the autumn and winter of 2008.

Six out of 10 participants were women, and four out of 10 were aged between 18 and 39; 40% were middle aged, and one in four were aged 60 and older.

All the participants reported back on how frequently they took aerobic exercise and rated their fitness levels using a validated 10 point scoring system. They were also asked about lifestyle, diet and recent stressful events, as these can all affect immune system response.

The number of days with cold symptoms varied considerably between winter and autumn, with an average of 13 days in the winter and 8 days in the autumn.

Being older, male, and married, seemed to reduce the frequency of colds, but after taking account of other influential factors, the most significant factors were perceived fitness and the amount of exercise taken.

The number of days with symptoms among those who said they were physically active on five or more days of the week and felt fit was almost half (43% to 46% less) that of those who exercised on only one or fewer days of the week.

The severity of symptoms fell by 41% among those who felt the fittest and by 31% among those who were the most active.

In the US, an average adult can expect to have a cold two to four times a year, while children can catch between half a dozen and 10 colds a year, on average, all of which costs the US economy around \$40 billion dollars.

Bouts of exercise spark a temporary rise in immune system cells circulating around the body, say the authors. Although these levels fall back within a few hours, each bout is likely to enhance surveillance of harmful viruses and bacteria, so reducing the number and severity of infections, such as the common cold.

Editor's Note: This article is not intended to provide medical advice, diagnosis or treatment.

Story Source:

The above story is reprinted (with editorial adaptations by ScienceDaily staff) from materials provided by **BMJ-British Medical Journal**, via EurekAlert!, a service of AAAS.

Journal Reference:

1. David C. Nieman, Dru A. Henson, Melanie D. Austin, Wei Sha. **Upper respiratory tract infection is reduced in physically fit and active adults.** *British Journal of Sports Medicine*, 2010; DOI: [10.1136/bjism.2010.077875](https://doi.org/10.1136/bjism.2010.077875)

<http://www.sciencedaily.com/releases/2010/11/101101191545.htm>

Successful Mothers Get Help from Their Friends, Dolphin Study Finds



A new study has found that female dolphins who have help from their female friends are far more successful as mothers than those without such help. (Credit: iStockphoto/Krzysztof Odziomek)

ScienceDaily (Nov. 1, 2010) — Female dolphins who have help from their female friends are far more successful as mothers than those without such help, according to a landmark new study.

Previous research into reproductive success in animal populations has had mixed findings: some studies point to the benefits of inherited genetic characteristics, while others show the benefits of social effects, such as having an honorary aunt or uncle or other unrelated helpers.

The new study is the first to look at the effects of these factors together in a wild animal population and has shown that social and genetic effects are both important for reproduction.

The finding, published in the journal *Proceedings of the National Academy of Sciences*, was only possible thanks to 25 years of field observations by an international team of behavioural researchers on the dolphin population at Shark Bay, in Western Australia, plus more than a decade of genetic samples taken by a team led by Dr Bill Sherwin of the UNSW School of Biological, Earth and Environmental Sciences and Dr Michael Krutzen of the University of Zurich.

"Surprisingly, the genetic and social effects on reproduction have never been studied together in natural populations," says Dr Sherwin. "One of my doctoral students, Celine Frere, who led the latest study, realised that we could do so by using the long-term observations about which females were associating with each other, and putting that together with what we knew about their genetic relationships."

Dr Frere found that a female's calving success is boosted either by social association with other females that had high calving success, or by the female having relatives who are good at calving.

"Not only that, but the social and genetic effects interact in an intriguing way," says Dr Sherwin. "Having successful sisters, aunts and mothers around certainly boosts a female's calving success. But the benefits of social associates were more important for female pairs who were less genetically related."



Dr Frere, who is now at the University of Queensland, says it is still unclear why female dolphins need such help to be more successful mothers: "Dolphins in this population are attacked by sharks, so protection by other females may help reproduction," she says. "But the females may need protection against their own species as well, especially when they are younger."

In another study published earlier this year, the team showed that younger females are susceptible to inbred matings, which reduce their reproductive output because such calves are slower to wean.

Dr Frere's PhD was carried out in the UNSW Evolution and Ecology Research Centre. Her co-supervisors were Michael Krutzen (now at the University of Zürich), and Janet Mann (Georgetown University). Other participants in this study were Richard Connor (UMASS-Dartmouth) and Lars Bejder (Murdoch University).

Story Source:

The above story is reprinted (with editorial adaptations by *ScienceDaily* staff) from materials provided by **University of New South Wales**, via EurekAlert!, a service of AAAS.

Journal Reference:

1. Celine H. Frère, Michael Krützen, Janet Mann, Richard C. Connor, Lars Bejder, William B. Sherwin. **Social and genetic interactions drive fitness variation in a free-living dolphin population.** *Proceedings of the National Academy of Sciences*, 2010; DOI: [10.1073/pnas.1007997107](https://doi.org/10.1073/pnas.1007997107)

<http://www.sciencedaily.com/releases/2010/11/101101151719.htm>

After Good or Bad Events, People Forget How They Thought They'd Feel

ScienceDaily (Nov. 1, 2010) — People aren't very accurate at predicting how good or bad they'll feel after an event -- such as watching their team lose the big game or getting a flat-screen TV. But afterwards, they "misremember" what they predicted, revising their prognostications after the fact to match how they actually feel, according to new research.

These findings appear in the November issue of the *Journal of Experimental Psychology: General*, published by the American Psychological Association.

Although the process of predicting emotions seems imprecise from start to finish, misremembering predictions might actually be motivating. Trust in one's emotional instincts could be "nature's feedback mechanism to steer us toward actions that are good for us," said psychologist Tom Meyvis, PhD, of New York University. Our ignorance of this tendency might help keep us motivated to avoid what we expect to be awful and work for what we hope will be great, he suggested.

Four studies compared an actual and recollected prediction to post-event feelings for each of four different scenarios:

- Before the 2005 Super Bowl football game, 19 Philadelphia Eagles fans were asked: *How happy will you be if they lose to the Patriots?* After the loss, they were asked: *How happy are you? How happy did you think you would be?*
- Before the 2008 presidential election, 73 supporters of John McCain were asked: *How upset will you be if Obama wins?* After his win, they were asked: *How upset are you about Obama's win? How upset did you think you would be?*
- Before making an important purchase, 40 participants were asked: *How happy will it make you feel?* After the purchase, they were asked: *How happy are you? How happy did you think you'd be?*
- Before they ate a jelly bean in two separate sequences (after eating a more preferred or less preferred flavor), 53 participants were asked: *How much will you enjoy this jelly bean in each sequence?* After eating both sequences of jelly beans, they were asked: *How much did you enjoy the jelly bean in each sequence? How much did you think you would enjoy it?*

Across the studies, participants inaccurately predicted their feelings and wrongly recalled their predictions. Indeed, whether an event had been anticipated or dreaded, peoples' revised predictions shifted toward how they actually felt. For example, Eagles fans said in advance they'd hate it if the Patriots won but afterward, they shrugged off the loss and said they always knew they'd be OK.

The results reveal a bias toward using current feelings to infer our earlier predictions. People don't realize they made a mistake, so they don't learn from that mistake -- and keep making the same errors, said the researchers. "So, next time, Eagles fans will again expect to be devastated after their team's loss," Meyvis predicted.

Editor's Note: *This article is not intended to provide medical advice, diagnosis or treatment.*

Story Source:

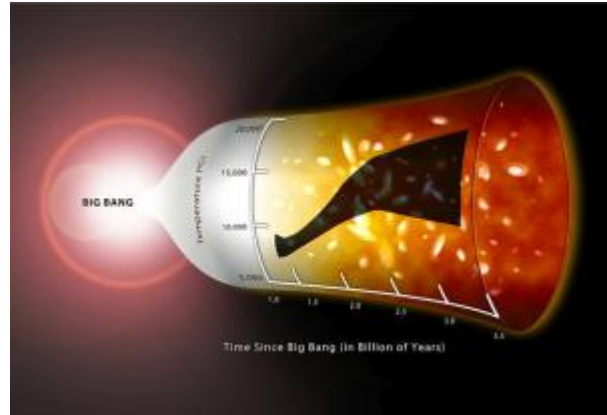
The above story is reprinted (with editorial adaptations by ScienceDaily staff) from materials provided by **American Psychological Association**.

Journal Reference:

1. Tom Meyvis, Rebecca K. Ratner, Jonathan Levav. **Why Don't We Learn to Accurately Forecast Feelings? How Misremembering Our Predictions Blinds Us to Past Forecasting Errors.** *Journal of Experimental Psychology: General*, 2010; 139 (4): 579-589 DOI: [10.1037/a0020285](https://doi.org/10.1037/a0020285)

<http://www.sciencedaily.com/releases/2010/11/101101171236.htm>

Astronomers Find Evidence of 'Cosmic Climate Change'



A graph showing the temperature of the all-pervasive intergalactic medium when the universe was between one and three billion years old, overlaid on an artist's impression of the emergence of galaxies over the same period. The shaded region shows the range of possible temperatures measured from the team's data. The warming occurred at a time when the growth of galaxies was in full swing. (Credit: Amanda Smith / IoA)

ScienceDaily (Nov. 2, 2010) — A team of astronomers has found evidence that the universe may have gone through a warming trend early in its history. They measured the temperature of the gas that lies in between galaxies, and found a clear indication that it had increased steadily over the period from when the universe was one tenth to one quarter of its current age. This cosmic climate change is most likely caused by the huge amount of energy output from young, active galaxies during this epoch.

The researchers publish their results in a forthcoming paper in the journal *Monthly Notices of the Royal Astronomical Society*.

"Early in the history of the universe, the vast majority of matter was not in stars or galaxies," University of Cambridge astronomer George Becker explains. "Instead, it was spread out in a very thin gas that filled up all of space." The team, led by Becker, was able to measure the temperature of this gas using the light from distant objects called quasars. "The gas, which lies between us and the quasar, adds a series of imprints to the light from these extremely bright objects," Becker continues, "and by analyzing how those imprints partly block the background light from the quasars, we can infer many of the properties of the absorbing gas, such as where it is, what it's made of, and what its temperature is."

The quasar light the astronomers were studying was more than ten billion years old by the time it reached Earth, and had travelled through vast tracts of the universe. Each intergalactic gas cloud the light passed through during this journey left its own mark, and the accumulated effect can be used as a fossil record of temperature in the early universe. "Just as Earth's climate can be studied from ice cores and tree rings," says Becker, "the quasar light contains a record of the climate history of the cosmos.

'Of course, the temperatures we measured are a bit different from what you find on Earth," commented Becker. "One billion years after the Big Bang, the gas we measured was a 'cool' 8,000 degrees Celsius. By three and a half billion years the temperature had climbed to at least 12,000 degrees Celsius."

The warming trend is believed to run counter to normal cosmic climate patterns. Normally the universe is expected to cool down over time. As the cosmos expands, the gas should get colder, much like gas escaping from an aerosol can. To create the observed rise in temperature, something substantial must have been heating the gas.

"The likely culprits in this intergalactic warming are the quasars themselves," explains fellow team member Martin Haehnelt, who is also at Cambridge University's newly-established Kavli Institute for Cosmology.

"Over the period of cosmic history studied by the team, quasars were becoming much more common. These



objects, which are thought to be giant black holes swallowing up material in the centres of galaxies, emit huge amounts of energetic ultraviolet light. These UV rays would have interacted with the intergalactic gas, creating the rise in temperature we observed."

One of the lightest and most abundant elements in these intergalactic clouds, helium, played a vital role in the heating process. Ultraviolet light stripped the electrons from a helium atom, freeing the electrons to collide with other atoms and heat up the gas. Once the supply of fresh helium was exhausted, the universe started to cool down again. Astronomers believe this probably occurred after the cosmos was one quarter of its present age.

The team's discovery was made possible by data taken with the 10-meter Keck telescopes in Hawaii, aided by advanced simulations run on a supercomputer at the University of Cambridge. Along with Becker and Haehnelt, the team included James Bolton at the University of Melbourne, and Wallace Sargent at the California Institute of Technology.

Story Source:

The above story is reprinted (with editorial adaptations by *ScienceDaily* staff) from materials provided by **Royal Astronomical Society (RAS)**, via [AlphaGalileo](#).

Journal Reference:

1. Becker G. D., Bolton J. S., Haehnelt G. M., Sargent W. L. W. **Detection of Extended He II Reionization in the Temperature Evolution of the Intergalactic Medium.** *Monthly Notices of the Royal Astronomical Society*, 2010; (accepted) [[link](#)]

<http://www.sciencedaily.com/releases/2010/11/101102083644.htm>

Rabbit's Food Brings Luck in Decreasing Estrogen Levels in Wastewater



UC's Ruth Marfil-Vega and Makram Suidan at Cincinnati's Mill Creek Wastewater Treatment Plant. They were part of the research team that experimented with rabbit's food as a treatment to decrease estrogen levels in wastewater in the lab. (Credit: Photo by Dottie Stover)

ScienceDaily (Nov. 2, 2010) — Experiments at the University of Cincinnati show that rabbit's food resulted in the abiotic (non-biological) transformation and absorption of four different types of estrogen, reducing the levels of these estrogen hormones by more than 80 percent in wastewater.

The research, published in the November 2010 issue of the journal *Environmental Pollution*, has practical implications since it could point to inexpensive treatment technologies and materials for reducing estrogens in wastewater.

Currently, estrogen in wastewater represents a major conduit for the entry of the hormone, whether in its naturally occurring forms or synthetic form (birth-control pills), into the environment. There, it's believed the hormone causes responses in the endocrine systems of fish, birds and other wildlife in and around streams and rivers, groundwater, sediments and sludge. In other words, causing effects in wildlife such as the presence of both male and female sex organs, feminization of males, abnormal and malformed reproductive organs, skewed sex ratios, reduced fertility and more.

Population growth and the use of synthetic estrogens (birth-control pills) have increased the presence of the hormone (both in its naturally occurring forms and its synthetic forms) in the environment.

Rabbit Food and the Estrogen Effect

In their study, authors Makram Suidan, UC professor of environmental engineering; Mark Mills, research engineer with the U.S. Environmental Protection Agency's National Risk Management Research Laboratory; and Ruth Marfil-Vega, UC doctoral student in environmental engineering, detail their success in harnessing natural materials in improving the removal of estrogen from the environment.

The experiments hold great promise, according to lead author Makram Suidan because "it would be an inexpensive process to replicate in wastewater treatment plants and because the UC experiments with the rabbit food proved effective in dramatically reducing the levels of naturally occurring estrogens but also the synthetic estrogen, which typically has the longest staying power in wastewater and the environment." While the UC team tested a variety of materials -- clays, casein (a protein molecule found in cheese and milk), tryptone (an amino acid) and starch -- only the rabbit food proved effective in greatly reducing estrogen levels. In fact, in testing the clays, casein, typtone and starch for effects on wastewater hormone levels, the UC experiments found that these four alternate materials only reduced wastewater estrogen levels by 10 percent.

Stated Suidan, "We are now experimenting to find out, specifically, why the rabbit food proved so effective in reducing estrogen levels. Rabbit food was a material we chose because, unlike dog food, rabbit food is hormone free. Rabbit food is merely ground up, organic vegetable matter -- not unlike vegetable matter that could safely be added to wastewater."

The experiments were repeated several times using synthetic wastewater in stainless steel containers (to avoid any absorption of the tested hormones that might have been possible with plastic containers). As stated, the rabbit food reduced the levels of the four estrogens by more than 80 percent after a 72-hour contact period. Explained Suidan, "While absorption of estrogen by the rabbit food played some role, we believe that a catalytic process occurred, meaning the estrogen compounds appeared to bind to the rabbit food when oxygen was present."

No Effect on Male Hormones Found in Wastewater

In the experiments, the UC team not only tested materials that might reduce estrogen levels in wastewater but also tested the efficacy of these same materials (rabbit food, casein, clays, tryptone and starch) in reducing the levels of male hormones (testosterone, androstenedione and progesterone) in wastewater.

However, none of the treatment materials -- including the rabbit food -- had any effect on the presence of these male hormone levels in the wastewater.

The research was internally funded.

Story Source:

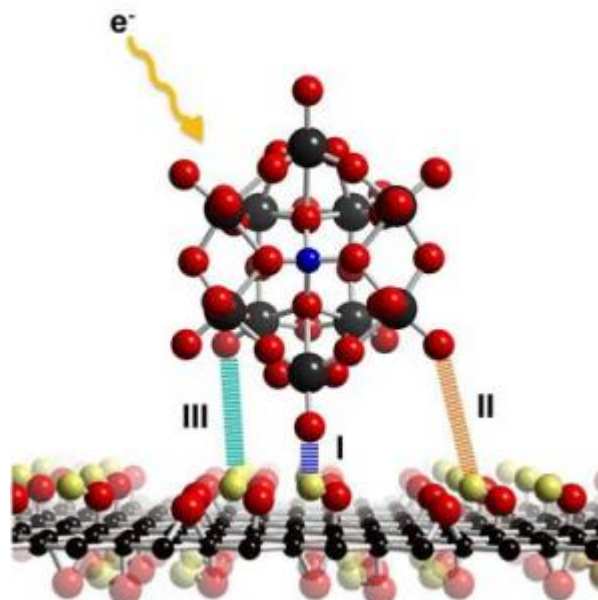
The above story is reprinted (with editorial adaptations by *ScienceDaily* staff) from materials provided by **University of Cincinnati**. The original article was written by M.B. Reilly.

Journal Reference:

1. Ruth Marfil-Vega, Makram T. Suidan, Marc A. Mills. **Abiotic transformation of estrogens in synthetic municipal wastewater: An alternative for treatment?** *Environmental Pollution*, 2010; 158 (11): 3372 DOI: [10.1016/j.envpol.2010.07.042](https://doi.org/10.1016/j.envpol.2010.07.042)

<http://www.sciencedaily.com/releases/2010/11/101101093604.htm>

Pivoting Hooks of Graphene's Chemical Cousin Could Revolutionize Work of Electron Microscopes



Material binding to graphene oxide "hook". (Credit: Image courtesy of University of Warwick)

ScienceDaily (Nov. 2, 2010) — The single layer material graphene was the subject of a Nobel prize this year, and now research led by a team of scientists at the University of Warwick has found molecular hooks on the surface of its close chemical cousin, graphene oxide, that could provide massive benefits to researchers using transmission electron microscopes. These hooks could even be used in building molecular scale mechanisms. The research team, which includes Drs. Jeremy Sloan, Neil Wilson and PhD student Priyanka Pandey from the Department of Physics and Dr. Jon Rourke from the Department of Chemistry together with the groups of Drs. Kazu Suenaga and Zheng Liu from AIST in Japan and Drs. Ian Shannon and Laura Perkins in Birmingham were looking at the possibility of using graphene as a base to mount single molecules for imaging by transmission electron microscopy. As graphene forms a sheet just one atom thick that is transparent to electrons it would enable high precision, high contrast imaging of the molecules being studied as well as the study of any interactions they have with the supporting graphene.

While this idea is great in theory, graphene is actually very difficult to create and manipulate in practice. The researchers therefore turned to graphene's easier to handle cousin, graphene oxide. This choice turned out to be a spectacularly better material as they found extremely useful properties, in the form of ready-made molecular hooks that could make graphene oxide the support material of choice for future transmission electron microscopy of any molecule with oxygen on its surface.

Graphene oxide's name obscures the fact that it is actually a combination of carbon, oxygen and hydrogen. For the most part it still resembles the one atom thin sheet of pure graphene, but it also has "functional groups" consisting of hydrogen paired with oxygen. These functional groups can bind strongly to molecules with external oxygens making them ideal tethers for researchers wishing to study them by transmission electron microscopy.

This feature alone will probably be enough to persuade many researchers to turn to graphene oxide as a support for the analysis of a range of molecules by transmission electron microscopy, but the researchers found yet another intriguing property of these handy hooks -- the molecules attached to them move and pivot around them.

Dr Jeremy Sloan said: "Under the right conditions the functional groups not only provide molecular tethers that hold molecules in an exact spot they also allow the molecule to be spun in that position. This opens up a



range of new opportunities for the analysis of such molecules but could also be a useful mechanism for anyone seeking to create molecular sized 'machinery.'"

The research is published in the journal *Nano Letters*.

Story Source:

The above story is reprinted (with editorial adaptations by *ScienceDaily* staff) from materials provided by **University of Warwick**.

Journal Reference:

1. Jeremy Sloan, Zheng Liu, Kazu Suenaga, Neil R. Wilson, Priyanka A. Pandey, Laura M. Perkins, Jonathan P. Rourke, Ian J. Shannon. **Imaging the Structure, Symmetry, and Surface-Inhibited Rotation of Polyoxometalate Ions on Graphene Oxide.** *Nano Letters*, 2010; : 101026114929015 DOI: [10.1021/nl1026452](https://doi.org/10.1021/nl1026452)

<http://www.sciencedaily.com/releases/2010/11/101101083146.htm>

New Way of Removing Excess Nitrogen from the Environment



An Illinois denitrifying bioreactor removes nitrogen from the croplands of the U.S. midwest. (Credit: Corey Mitchell, University of Illinois)

ScienceDaily (Nov. 1, 2010) — Excess nitrogen from agricultural and urban lands is contaminating groundwater, streams, lakes and estuaries, where it causes harmful algal blooms and contributes to fish kills. Cost-effective approaches to removing this nitrogen from croplands and urban stormwater runoff before it reaches sensitive water bodies have been elusive.

But simple and inexpensive technologies are on the horizon. A recent scientific workshop on denitrification brought together ecologists, engineers and policy experts to find answers.

Denitrification is a biological process carried out by soil and aquatic microorganisms, in which forms of reactive nitrogen are converted to unreactive and harmless dinitrogen gas.

Findings from the workshop, held in May, 2009, at the University of Rhode Island, are published in the November, 2010, special issue of the scientific journal *Ecological Engineering*.

The workshop was sponsored by the National Science Foundation (NSF)'s Denitrification Research Coordination Network (RCN), established to enhance collaboration among researchers investigating denitrification.

"This special issue of *Ecological Engineering*, with its focus on managing denitrification in human-dominated landscapes, highlights our need to understand Earth's microorganisms and their processes," says Matt Kane, program director in NSF's Division of Environmental Biology, which funded the RCN and the workshop.

"The RCN brought together an international and interdisciplinary group of scientists and engineers to synthesize the knowledge necessary to provide pure water for generations to come."

At the workshop, more than 40 participants combined their expertise to address the goal of using ecological principles in engineering design to control nitrogen pollution.

One workshop goal was to evaluate a new and relatively inexpensive way to treat wastewater and drainage from agricultural lands using "denitrifying bioreactors."

These bioreactors use common waste products, such as wood chips, to provide a food source for naturally occurring microorganisms. The microbes convert dissolved nitrogen into harmless nitrogen gas, which is then released to the atmosphere.

Research results in *Ecological Engineering* are reported from New Zealand, Canada and several locations in the United States.

All confirm that denitrifying bioreactors may be used in many settings, and operate well in a range of temperatures.

The systems have been successful in the cleanup of domestic effluent from small townships, septic tank systems and wastes from dairy farms, says Louis Schipper of the University of Waikato, New Zealand, author of the lead paper in the journal.

"Denitrifying bioreactors have been integrated into agricultural fields," adds Eric Davidson of The Woods Hole Research Center in Falmouth, Mass., and co-author of the journal's lead paper.

"Underground drainage pipes there remove excess water that contains excess nitrogen. By intercepting some of this drainage water, direct inputs of nitrate to surface water can be reduced."

The largest bioreactor tested, by Schipper and colleagues Stewart Cameron and Soren Warneke at the University of Waikato, is 200 meters long by five meters wide by two meters deep. It treats effluent from greenhouse-grown tomatoes.

Research led by Will Robertson of the University of Waterloo found that bioreactors may operate for more than a decade without replacement of wood chips or substantive maintenance.

Similar longevity was confirmed in research in Iowa by Tom Moorman of the USDA-Agricultural Research Service.

Studies by D.Q. Kellogg and Art Gold of the University of Rhode Island demonstrate that recent advances in geospatial data--such as computer-based maps of geologic and land-use patterns--provide a decision-support tool for local regulatory and planning agencies.

These advances, Kellogg and Gold say, will help reduce nitrate-loading to downstream waters.

A study conducted at the University of California at Davis by Harold Leverenz and reported in the journal showed that plants may be grown on the surface of denitrifying bioreactors, providing biodiversity benefits.

"Research presented in this special issue of Ecological Engineering goes a long way toward applying a scientific understanding of the biological processes of denitrification to the engineering challenges of denitrifying bioreactors," says Davidson.

"The resulting guidelines and principles for denitrifying bioreactor design and operation are an additional option in the land manager's tool box."

Story Source:

The above story is reprinted (with editorial adaptations by *ScienceDaily* staff) from materials provided by **National Science Foundation**.

<http://www.sciencedaily.com/releases/2010/11/101101151853.htm>

Mandatory Curbs on Food Salt Content 20 Times More Effective Than Voluntary Curbs, Study Finds

ScienceDaily (Nov. 1, 2010) — Imposing statutory limits on the salt content of processed foods could be 20 times more effective than voluntary curbs by industry, finds research published online in the journal *Heart*. The Australian researchers assessed the public health benefits and cost effectiveness of different strategies for reducing dietary salt content -- a factor known to have a key role in the increased risk of heart disease and stroke.

They looked at the current Australian 'Tick' programme. This enables food manufacturers to buy an endorsed logo for use on product packaging to achieve higher sales in return for voluntarily reducing the salt content of these products.

They also looked at the impact of mandatory reductions in salt content; and professional advice to cut dietary salt for those at increased and high risk of cardiovascular disease.

They then costed the different strategies in terms of their impact on years of good health over a lifetime, and the associated savings in long term healthcare spend. And they compared the results with what would happen if none of these strategies were in place.

They took into consideration the salt content of bread, margarine, and cereals; the tonnage of product sold; average consumption per head of these products; the costs of drafting and enforcing legislation; and systematic reviews of the evidence for the impact of dietary advice from healthcare professionals.

Their calculations showed that 610,000 years of healthy life could be gained if everyone reduced their salt intake to recommended limits (maximum of 6 g a day).

But providing dietary advice to reduce salt intake is not cost effective, even if directed towards those with the highest blood pressure readings, and most at risk of cardiovascular disease. It would only cut ill health from cardiovascular disease by less than 0.5%.

Voluntary industry restrictions on the salt content of processed foods under the current incentive scheme are cost effective, and would cut ill health from cardiovascular disease by almost 1%, which is substantial at population level.

But the health benefits across the population could be 20 times greater if the government imposed mandatory limits, the figures showed, amounting to a reduction of 18% in ill health from cardiovascular disease.

Salt is a cheap ingredient for food manufacturers and is not essential at such high levels, say the authors.

"Food manufacturers have a responsibility to make money for their shareholders, but they also have a responsibility to society. If corporate responsibility fails, may be there is an ethical justification for government to step in and legislate," they conclude.

Editor's Note: This article is not intended to provide medical advice, diagnosis or treatment.

Story Source:

The above story is reprinted (with editorial adaptations by ScienceDaily staff) from materials provided by **BMJ-British Medical Journal**, via **EurekAlert!**, a service of AAAS.

Journal Reference:

1. Linda J. Cobiac, Theo Vos, J. Lennert Veerman. **Cost-effectiveness of interventions to reduce dietary salt intake.** *Heart*, 2010; DOI: [10.1136/hrt.2010.199240](https://doi.org/10.1136/hrt.2010.199240)

<http://www.sciencedaily.com/releases/2010/11/101101191547.htm>

Comprehensive Primary Care Programs Treat Older Patients With Chronic Conditions

ScienceDaily (Nov. 2, 2010) — In a review of comprehensive primary care programs for older adults with multiple chronic conditions, authors identified three models that appear to have the greatest potential for improving quality of care and life for these patients, while reducing or not increasing the costs of their health care, according to an article in the November 3 issue of *JAMA*, a theme issue on aging.

Chad Boulton, M.D., M.P.H., M.B.A., of the Johns Hopkins Bloomberg School of Public Health, Baltimore, presented the findings of the study at a *JAMA* media briefing at the National Press Club.

"Older patients with multiple chronic health conditions and complex health care needs often receive care that is fragmented, incomplete, inefficient, and ineffective," write Dr. Boulton and co-author G. Darryl Wieland, Ph.D., M.P.H., of Palmetto Health Richland Hospital, Columbia, S.C. To identify models of care that may be more effective, the authors conducted a search of the medical literature for studies regarding U.S. models of comprehensive primary care for older patients with multiple chronic conditions.

The authors write that, based on expert consensus about the available evidence, there are 4 proactive, continuous processes that can substantially improve the primary care of this patient population: comprehensive assessment, evidence-based care planning and monitoring, promotion of patients' and (family caregivers') active engagement in care, and coordination of professionals in care of the patient -- all tailored to the patient's goals and preferences.

Using these criteria, three models of chronic care were identified that include these processes and that appear to improve some aspects of the effectiveness and the efficiency of complex primary care -- the Geriatric Resources for Assessment and Care of Elders (GRACE) model, Guided Care, and the Program of All-inclusive Care for the Elderly (PACE).

All 3 models are based on care by teams of health care professionals, including primary care physicians, registered nurses and other health professionals. Teams in all 3 models provide many of the same services to older patients with complex health care needs, including:

- comprehensive assessment
- development of a comprehensive care plan that incorporates evidence-based protocols
- implementation of the plan over time
- proactive monitoring of the patient's clinical status and adherence to the care plan
- coordination of primary care, specialty care, hospitals, emergency departments, skilled nursing facilities, other medical institutions, and community agencies
- facilitation of the patient's transitions from hospitals to post-acute settings and the patient's access to community resources, such as meals programs, handicapped-accessible transportation, adult day care centers, support groups, and exercise programs.

The authors add that these models do have some significant differences in certain aspects of their structures and operations. In the GRACE model, an advance practice nurse and a social worker collaborate with primary care physicians in community health centers to provide comprehensive care for low-income patients. Care is reviewed regularly by an offsite geriatrics interdisciplinary team. In the Guided Care model, 2 to 5 primary care physicians partner with a registered nurse practicing at the same site to provide comprehensive primary care to 55 to 60 older patients who are at high risk for using extensive health services during the following year. Each PACE site operates as a managed care plan that receives capitated payments from Medicare and Medicaid and uses these funds to pay for all of the health-related services required by its patients.

"As the United States implements new models of chronic care, such as the 3 described here, more research is needed to define the optimal methods for identifying the patients who will benefit most, for providing the essential clinical processes, for disseminating and expanding the reach of these models, and for paying for excellent chronic care. Also necessary will be significant advances in the education of health care professionals and the managerial infrastructure that underlies new models of care," the authors write.

In an accompanying commentary in this issue of *JAMA*, Arpita Chattopadhyay, Ph.D., and Andrew B. Bindman, M.D., of San Francisco General Hospital, University of California, San Francisco, discuss the barriers to implementing comprehensive primary care programs for frail elderly patients. "With increasing health care costs and an aging population, the United States needs to expedite the development and scaling up of cost-effective models of integrated care," the authors suggest. "Health care reform has given CMS [Centers for Medicare & Medicaid Services] new authority to promote the process."

Editor's Note: *This article is not intended to provide medical advice, diagnosis or treatment.*

Story Source:

The above story is reprinted (with editorial adaptations by *ScienceDaily* staff) from materials provided by **JAMA and Archives Journals**.

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1. A. Chattopadhyay, A. B. Bindman. **Linking a Comprehensive Payment Model to Comprehensive Care of Frail Elderly Patients: A Dual Approach.** *JAMA: The Journal of the American Medical Association*, 2010; 304 (17): 1948 DOI: [10.1001/jama.2010.1634](https://doi.org/10.1001/jama.2010.1634)
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<http://www.sciencedaily.com/releases/2010/11/101102101621.htm>

Mystery of 'Alien Pod' Solved: Colony of Freshwater Bryozoans



Bryozoan: This freshwater bryozoan was found in the lake in City Center at Oyster Point (Newport News). Bryozoans are filter feeders that live in encrusting and branching colonies, mostly in seawater. This colony is about 4 feet in diameter; most colonies of marine bryozoans occur as thin sheets. (Credit: Photo submitted by Mr. Charles Schmuck)

ScienceDaily (Nov. 1, 2010) — Tracy Collier, an employee at Home Technologies in City Center at Oyster Point, was walking her employer's Westie around the Center's manmade lake on Thursday when she saw a large, mysterious blob floating in the water.

Co-worker Charlie Schmuck says: "The lake is behind our office. Tracy was walking by the lake, saw the object, and asked everyone else to come out and take a look."

Tracy thought it was "a huge dead snake."

Charlie thought it "looked like some weird underwater fungus, like the ones that explode when you poke them."

Perhaps because it was just a few days before Halloween, co-worker Dale Leonart's initial guess was that "it has to be an alien pod." After further consideration, he thought it might be some type of sponge.

Hoping to solve the mystery, Charlie took some pictures of the object and e-mailed them along with a description to the Virginia Institute of Marine Science in Gloucester Point.

The scientists at VIMS were equally intrigued. The e-mail read: "The object is about 4 feet in diameter. It has moved about 6 feet down the shoreline in the last 24 hours. It 'jiggles' when the waves in the lake hit it... when we prod it, it seems to be spongy feeling... The texture appears to be that of a rock with algae spots on it -- it is brown and yellow, with a pattern of some type."

A brief flurry of internal e-mails followed. The marine tunicate *Eudistoma hepaticum*? Unlikely, as the lake contains fresh water. A Halloween prank in which someone moved a marine organism to the lake? Perhaps. The final consensus was that the organism is *Pectinatella magnifica* -- the "magnificent bryozoan."

"Moss Animals"

That identification is itself somewhat surprising, as the vast majority of bryozoans -- thousands of species -- live in salt water. Marine bryozoans are common but inconspicuous filter feeders that grow in thin, encrusting colonies atop rocks, kelp blades, shellfish, and other hard objects. When the individual animals extend their

tentacles to feed, the colony takes on a fuzzy appearance, hence the bryozoans' common name of "moss animal."

Although individual bryozoans are built on a simple plan -- a U-shaped gut inside a bag-like body with no lungs or gills, and no circulatory or excretory system -- they are true survivors, with a fossil record that dates back some 500 million years.

Freshwater bryozoans are far less diverse than their marine cousins, with only about 50 species worldwide, but what they lack in numbers they make up for in size -- like the 4-foot blob found floating in Newport News. The City Center blob is actually much larger than most reports for the species, which put a large colony at only 1-2 feet across.

Colonies of *Pectinatella magnifica* feature a surface layer of adjoining "rosettes" -- each with 12-18 animals or "zooids" -- around a central jelly-like mass that is 99% water. The colonies can be free floating or attached to a piling or other submerged object. One study even showed that young colonies of *P. magnifica* can actually move on their own by coordinated pulsing of the individual animals.

VIMS professor Carl Hershner notes that bryozoans consume algae, so the "alien pod" is "actually a good thing to have around, despite its looks." "It's not a sign of bad water quality," he adds, "and it doesn't hurt fish. It can clog pipes, though, and it will be smelly if it's removed from the water."

Story Source:

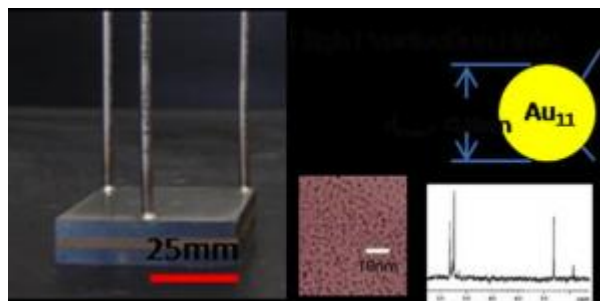
The above story is reprinted (with editorial adaptations by *ScienceDaily* staff) from materials provided by **Virginia Institute of Marine Science**. The original article was written by David Malmquist.

<http://www.sciencedaily.com/releases/2010/11/101101142517.htm>

Microreactor Speeds Nanotech Particle Production by 500 Times

A "multilayer micromixer" production process developed at Oregon State University allows a much higher production rate of nanotech particles than conventional approaches, with no loss of quality. (Credit: Image courtesy of Oregon State University)

ScienceDaily (Nov. 1, 2010) — Engineers at Oregon State University have discovered a new method to speed the production rate of nanoparticles by 500 times, an advance that could



play an important role in making nanotechnology products more commercially practical.

The approach uses an arrayed microchannel reactor and a "laminated architecture" in which many sheets, each with thousands of microchannels in them, are stacked in parallel to provide a high volume of production and excellent control of the processes involved.

Applications could be possible in improved sensors, medical imaging, electronics, and even solar energy or biomedical uses when the same strategy is applied to abundant materials such as copper, zinc or tin.

A patent has been applied for, university officials say. The work, just published in the journal *Nanotechnology*, was done in the research group of Brian Paul, a professor in the OSU School of Mechanical, Industrial and Manufacturing Engineering.

"A number of new and important types of nanoparticles have been developed with microtechnology approaches, which often use very small microfluidic devices," said Chih-hung Chang, a professor in the OSU School of Chemical, Biological and Environmental Engineering, and principal investigator on the study.

"It had been thought that commercial production might be as simple as just grouping hundreds of these small devices together," Chang said. "But with all the supporting equipment you need, things like pumps and temperature controls, it really wasn't that easy. Scaling things up to commercial volumes can be quite challenging."

The new approach created by a research team of five engineers at OSU used a microreactor with the new architecture that produced "undecagold nanoclusters" hundreds of times faster than conventional "batch synthesis" processes that might have been used.

"In part because it's faster and more efficient, this process is also more environmentally sensitive, using fewer solvents and less energy," Chang said. "This could be very significant in helping to commercialize nanotech products, where you need high volumes, high quality and low costs."

This research, Chang said, created nanoparticles based on gold, but the same concept should be applicable to other materials as well. By lowering the cost of production, even the gold nanoclusters may find applications, he said, because the cost of the gold needed to make them is actually just a tiny fraction of the overall cost of the finished product.

Nanoparticles are extraordinarily tiny groups of atoms and compounds that, because of their extremely small size and large surface areas, can have unusual characteristics that make them valuable for many industrial, electronic, medical or energy applications.

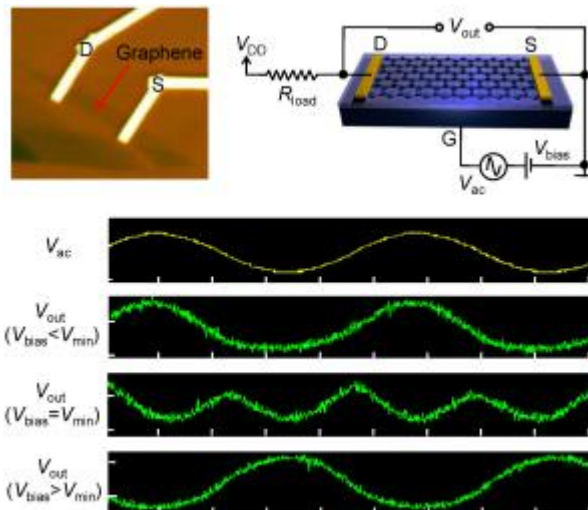
This work was supported by the Safer Nanomaterials and Nanomanufacturing Initiative of the Oregon Nanoscience and Microtechnologies Institute, or ONAMI. Funding was also provided by the Air Force Research Laboratory and the W.M. Keck Foundation.

Story Source:

The above story is reprinted (with editorial adaptations by ScienceDaily staff) from materials provided by **Oregon State University**.

<http://www.sciencedaily.com/releases/2010/11/101101130137.htm>

Triple-Mode Transistors Show Potential: Researchers Introduce Graphene-Based Amplifiers



Researchers report that triple-mode, single-transistor amplifiers based on graphene -- the one-atom-thick form of carbon -- could become key components in future electronic circuits. (Credit: Image courtesy of Rice University)

ScienceDaily (Nov. 1, 2010) — Rice University research that capitalizes on the wide-ranging capabilities of graphene could lead to circuit applications that are far more compact and versatile than what is now feasible with silicon-based technologies.

Triple-mode, single-transistor amplifiers based on graphene -- the one-atom-thick form of carbon that recently won its discoverers a Nobel Prize -- could become key components in future electronic circuits. The discovery by Rice researchers was reported this week in the online journal *ACS Nano*.

Graphene is very strong, nearly transparent and conducts electricity very well. But another key property is ambipolarity, graphene's ability to switch between using positive and negative carriers on the fly depending on the input signal. Traditional silicon transistors usually use one or the other type of carrier, which is determined during fabrication.

A three-terminal single-transistor amplifier made of graphene can be changed during operation to any of three modes at any time using carriers that are positive, negative or both, providing opportunities that are not possible with traditional single-transistor architectures, said Kartik Mohanram, an assistant professor of electrical and computer engineering at Rice. He collaborated on the research with Alexander Balandin, a professor of electrical engineering at the University of California, Riverside, and their students Xuebei Yang (at Rice) and Guanxiong Liu (at Riverside).

Mohanram likened the new transistor's abilities to that of a water tap. "Turn it on and the water flows," he said. "Turn it off and the water stops. That's what a traditional transistor does. It's a unipolar device -- it only opens and closes in one direction."

"But if you close a tap too much, it opens again and water flows. That's what ambipolarity is -- current can flow when you open the transistor in either direction about a point of minimum conduction."

That alone means a graphene transistor can be "n-type" (negative) or "p-type" (positive), depending on whether the carrier originates from the source or drain terminals (which are effectively interchangeable). A third function appears when the input from each carrier is equal: The transistor becomes a frequency multiplier. By combining the three modes, the Rice-Riverside team demonstrated such common signaling schemes as phase and frequency shift keying for wireless and audio applications.

"Our work, and that of others, that focuses on the applications of ambipolarity complements efforts to make a better transistor with graphene," Mohanram said. "It promises more functionality." The research demonstrated that a single graphene transistor could potentially replace many in a typical integrated circuit, he said.

Graphene's superior material properties and relative compatibility with silicon-based manufacturing should allow for integration of such circuits in the future, he added.

Technological roadblocks need to be overcome, Mohanram said. Such fabrication steps as dielectric deposition and making contacts "wind up disturbing the lattice, scratching it and introducing defects. That immediately degrades its performance (limiting signal gain), so we have to exercise a lot of care in fabrication.

"But the technology will mature, since so many research groups are working hard to address these challenges," he said.

The National Science Foundation and the DARPA-Semiconductor Research Corporation's Focus Center Research Program supported the work.

Story Source:

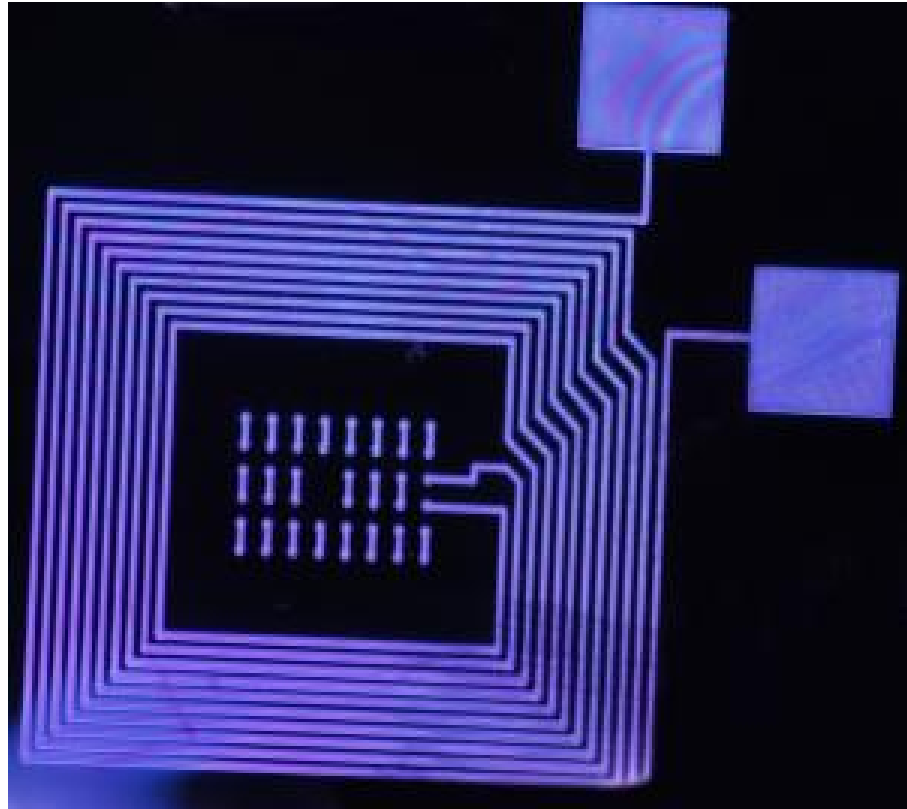
The above story is reprinted (with editorial adaptations by *ScienceDaily* staff) from materials provided by **Rice University**.

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1. Xuebei Yang, Guanxiong Liu, Alexander A. Balandin, Kartik Mohanram. **Triple-Mode Single-Transistor Graphene Amplifier and Its Applications**. *ACS Nano*, 2010; : 101012103608036 DOI: [10.1021/nn1021583](https://doi.org/10.1021/nn1021583)

<http://www.sciencedaily.com/releases/2010/10/101013122750.htm>

Conserving Resources: Producing Circuit Boards With Plasma



Patterns like this one can be created on flexible films with the aid of plasma printing. Shown here: an RFID structure. (Credit: © Fraunhofer IST)

ScienceDaily (Nov. 1, 2010) — There is a large growth market for flexible circuits, RFID antennas and biosensors on films. Researchers from the Fraunhofer Institute for Surface Engineering and Thin Films IST are presenting a new technology at K 2010, the international trade fair for plastics and rubber (Hall 3, E91): the experts can now apply conductive metal circuits to plastic substrates in a process that is energy- and material-conserving and thus more sustainable.

Flexible circuits can be found in many devices where space and weight considerations are dominant in the design of electronics: in cars, in cameras and video equipment, in mini-computers for athletes or in inkjet printers. And the market continues to grow: according to the business consultancy Frost & Sullivan, sales in this area will grow to more than \$16 billion by the year 2014.

At K 2010, the trade fair for plastics in Düsseldorf, Germany, scientists from the IST in Braunschweig will unveil a new reel-to-reel technology for the production of flexible circuits and biosensors; the new technology is known as "P3T," which is shorthand for "Plasma Printing and Packaging Technology." The benefits: P3T involves considerably fewer process steps than existing processes, and it conserves raw materials. Unlike previous methods, the researchers do not start with a polymer film metalized over its entire surface from which excess metal is then removed to create the circuits. Instead, to produce flexible circuit boards, they apply circuits made of copper to the film that serves as substrate. In the case of biosensors, palladium is used. They use plasma at atmospheric pressure and galvanization instead of vacuum-pressure and laser-based methods to achieve inexpensive and resource-efficient production.

Dr. Michael Thomas, director of the research group at IST, explains: "During production of circuits for an RFID antenna, you often have to etch away between 50 and 80 percent of the copper used. This results in considerable amounts of copper scrap that either has to be disposed or reprocessed using relatively elaborate



methods." The IST approach is different: there, scientists use the additive process to apply the structures they want directly to the substrate sheeting.

The first two process steps are plasma printing at atmospheric pressure and metallization using well-known galvanization methods. Plasma printing uses the kind of deeply engraved roller familiar from the area of conventional rotogravure printing. During the printing process, microplasmas are electrically generated in the engraved recesses of the roller; these microplasmas chemically alter the surface of the plastic substrate where the circuits are to be applied later in the process.

The process gas from which the plasma is created is usually a mixture of nitrogenous gases. As IST researcher Thomas emphasizes: "The chemical changes we need begin to form on the surface of the film; these changes ensure that the plastic can be wetted with water in these precise areas and will be metallizable using suitable plating baths. This means considerable savings of energy and material," Thomas adds. And this is a decisive competitive factor: the prices for raw materials -- for copper and palladium, for example -- have risen by around 150 percent in the past three years.

In the joint P3T project sponsored by the German Federal Ministry of Education and Research (BMBF) P3T, researchers are currently working very hard to improve the individual processes involved in the manufacture of flexible circuit boards and biosensors. They are closely scrutinizing all of the P3T production steps -- from plasma printing to assembly and coordinating all of the processes with one another in a production line.

Story Source:

The above story is reprinted (with editorial adaptations by *ScienceDaily* staff) from materials provided by **Fraunhofer-Gesellschaft**.

<http://www.sciencedaily.com/releases/2010/10/101019111327.htm>



Speed Installation of System to Monitor Vital Signs of Global Ocean, Scientists Urge



Scientists explore on and beneath polar ice. Their aircraft remotely sense animals through properties of scattered light. Marine animals themselves carry tags that store records of their travels and dives and communicate with satellites. Fish carry tags that revealed their migration past acoustic listening lines. Sounds that echoed back to ships portray schools of fish assembling, swimming, and commuting up and down. Standardized frames and structures dropped near shores and on reefs provide information for comparing diversity and abundance. Manned and unmanned undersea vehicles plus divers photograph sea floors and cliffs. Deep submersibles sniff and videotape smoking seafloor vents. And nets and dredges catch specimens, shallow and deep, for closest study. (Credit: E. Paul Oberlander / Census of Marine Life)

ScienceDaily (Nov. 1, 2010) — The ocean surface is 30 percent more acidic today than it was in 1800, much of that increase occurring in the last 50 years -- a rising trend that could both harm coral reefs and profoundly impact tiny shelled plankton at the base of the ocean food web, scientists warn.

Despite the seriousness of such changes to the ocean, however, the world has yet to deploy a complete suite of available tools to monitor rising acidification and other ocean conditions that have a fundamental impact on life throughout the planet.

Marine life patterns, water temperature, sea level, and polar ice cover join acidity and other variables in a list of ocean characteristics that can and should be tracked continuously through the expanded deployment of existing technologies in a permanent, integrated global monitoring system, scientists say.

The Partnership for Observation of the Global Oceans (POGO), representing 38 major oceanographic institutions from 21 countries and leading a global consortium called Oceans United, will urge government officials and ministers meeting in Beijing Nov. 3-5 to help complete an integrated global ocean observation system by target date 2015.

It would be the marine component of a Global Earth Observation System of Systems under discussion in Beijing by some 71 member nations of the intergovernmental Group on Earth Observations.

The cost to create an adequate monitoring system has been estimated at \$10 billion to \$15 billion in assets, with \$5 billion in annual operating costs.

Some 600 scientists with expertise in all facets of the oceans developed an authoritative vision of characteristics to monitor at a 2009 conference on ocean observations.

Dr. Trevor Platt, Executive Director of POGO, Plymouth Marine Laboratory, UK said, "We rely on the oceans for transportation, protein, pharmaceuticals, minerals and hydrocarbons. But we do not know nearly enough about how the oceans are changing. The world's coastal fringes, where 40 percent of humanity resides, suffer increasingly costly storms and flooding. Without the proper information, we are powerless to anticipate and prepare for what may come in the future. Our best defense is an observing network for the global ocean to warn of trouble."

Furthermore, as documented in the forthcoming proceedings of the 2009 conference (to be published shortly by the European Space Agency), the value of such information to the world's financial interests and to human security would dwarf the investment required.

"Although the US and European Union governments have recently signaled support, international cooperation is desperately needed to complete a global ocean observation system that could continuously collect, synthesize and interpret data critical to a wide variety of human needs," says Dr. Kiyoshi Suyehiro, Chairman of POGO.

"Most ocean experts believe the future ocean will be saltier, hotter, more acidic, and less diverse," states Jesse Ausubel, a founder of POGO and of the recently completed Census of Marine Life. "It is past time to get serious about measuring what's happening to the seas around us."

The risks posed by ocean acidification exemplify the many good reasons to act urgently.

POGO-affiliated scientists at the UK-based Sir Alister Hardy Foundation for Ocean Science recently published a world atlas charting the distribution of the subset of plankton species that grow shells at some point in their life cycles. Not only are these shelled plankton fundamental to the ocean's food web, they also play a major role in planetary climate regulation and oxygen production. Highly acidic sea water inhibits the growth of plankton shells.

The Foundation says the average level of pH at the ocean surface has dropped from 8.2 to 8.1 units, "rendering the oceans more acidic than they have been for 20 million years," with expectations of continuing acidification due to high concentrations of carbon dioxide in the atmosphere.

Because colder water retains more carbon dioxide, the acidity of surface waters may increase fastest at Earth's high latitudes where the zooplankton known as pteropods are particularly abundant. Pteropods (see links to images below) are colorful, free-swimming pelagic sea snails and sea slugs on which many animals higher in the food chain depend. Scientists caution that the overall global marine impact of rising carbon dioxide is unclear because warming of the oceans associated with rising greenhouse gases in the air could in turn lead to lower retention of carbon dioxide at lower latitudes and to potential countervailing effects.

Says Foundation Director Dr. Peter Burkill: "Ocean acidification could have a devastating effect on calcifying organisms, and perhaps marine ecosystems as a whole, and we need global monitoring to provide timely information on trends and fluxes from the tropics to the poles. Threatened are tiny life forms that help the oceans absorb an estimated 50 gigatonnes of carbon from Earth's atmosphere annually, about the same as all plants and trees on land. Humanity has a vital interest in authoritative information about ocean conditions and a global network of observations is urgently needed."

Ocean conditions that require monitoring can be divided into three categories:

- Chemical -- including pollution, levels of oxygen, and rising acidity;
- Physical / Geological -- including sound, tide and sea levels, as well as sudden wave energy and bottom pressure changes that could provide precious minutes of warning before a tsunami; and
- Biological -- including shifts in marine species diversity, distribution, biomass and ecosystem function due to changing water conditions.

Benefits of the comprehensive ocean system envisioned include:

- Improved short-term and seasonal forecasts to mitigate the harm caused by drought, or by severe storms, cyclones, hurricanes and monsoons, such as those that recently put one-fifth of Pakistan temporarily underwater and left 21 million people homeless or injured. International lenders estimate the damage to Pakistan's infrastructure, agriculture and other sectors at \$9.5 billion. Improved weather forecasting would also enhance the safety of the fishing and shipping industries, and offshore operations such as wind farms and oil drilling. Sea surface temperature is a key factor in the intensity and location of severe weather events;
- Early identification of pollution-induced eutrophication that spawns algal blooms responsible for health problems in humans and marine species, and harm to aquaculture operations;
- Timely alerts of changes in distributions of marine life that would allow identification of areas needing protective commercial re-zoning, and of immigration by invasive species;
- Minimized biodiversity loss on coral reefs, the importance of which, for species diversity, is comparable to that of the planet's rainforests.

Says Dr. Suyehiro: "What happens in the world's oceans profoundly affects the success of life throughout the Earth. We now have remarkable and proven ground-based, ocean-drifting, air-borne and space-based technologies to measure and report changing ocean conditions quickly, often in real-time. The right kind of data streams from the ocean will help us forecast regime shifts in weather patterns over continents and their consequences for agriculture, fisheries, tourism and other sectors. The value of the knowledge within our reach -- to human health, security and commerce -- is overwhelmingly large relative to its cost."

"The situation of scientists today is akin to that of a doctor schooled in the range of technologies that could record a patient's vital signs, sound an alarm when required, and suggest remedial options -- if only we would make the investment."

Says Tony Knap, Director of the Bermuda Institute of Ocean Sciences and a leader of POGO: "The top three meters of the oceans hold as much heat as Earth's atmosphere and changes in marine conditions are felt on land in profound ways. To obtain clear warning of weather-related disasters, we need to monitor oceans in an integrated, continuous and systematic manner. It will not be cheap, but it has to be done."

Elements of the ocean monitoring system in place today include:

Chemical

- A scientific instrument with a suite of environmental sensors, recently deployed at Australia's Heron Island to observe changes in the acidity of waters covering the Great Barrier Reef, among other data gathered. The instrumentation also includes carbon dioxide sensors developed with the long-term aim of building a global network of carbon dioxide observations at sea. The Heron Island site is the newest in a growing network of 25 moorings through the Pacific and Atlantic valued at about \$20 million. Other moorings are planned for the Great Barrier Reef and the Australian coast in the next year as part of the nation's Integrated Marine Observing System.

Physical

- Underwater cabled observatories: long lines of cable on the seabed dotted with nodes of instruments relaying insights into underwater volcanic eruptions and earthquakes that can cause tsunamis. Installed by Japan at a cost of roughly \$100 million, the Dense Oceanfloor Network System for Earthquakes and Tsunamis, coupled with a national warning system, can avoid an estimated 7,500 to 10,000 (of 25,000) fatalities and about \$10 billion (of \$100 billion) in estimated economic losses if and when another major (M8) earthquake occurs in the waters off central Japan.

- The recently completed North-East Pacific Time-Series Underwater Networked Experiments cabled observatory system off Canada's west coast will take continuous measurements on the seafloor, equipped with such gadgets as a Doppler ocean current profiler, multi-beam SONAR to reveal masses of life in the water, microbial life samplers, sediment traps, plankton recorders, hydrophones and high resolution video and still cameras.
- A robotic navy of some 3,000 small, drifting "Argo" probes, deployed at a cost of \$15 million per year to measure pressure, salinity and temperature at depths down to 2 km and return to the surface every 10 days to transmit readings via satellite. POGO officials say up to 10 times as many floats are needed to produce a high-resolution global picture of shifting marine conditions, incorporating biological and optical measurements;
- Three Equatorial moored buoys, each valued at \$5 million, to measure temperature, currents, waves and winds, salinity and carbon dioxide.
- Some 60 globally-distributed reference stations, each valued at \$1 million, measuring the oceans' physical, chemical and biogeochemical properties throughout the water column;
- Deep Ocean Assessment and Reporting of Tsunamis: DART stations, consisting of a surface buoy and a seafloor bottom pressure recorder that both reports water temperature and detects tsunamis. When a potential tsunami is detected, the buoy reports measurements every 15 seconds for several minutes, followed by 1-minute averages for 4 hours. The US array, completed in 2008, totals 39 stations in the Pacific Ocean, Atlantic Ocean, and Caribbean Sea. Australia, Chile, Indonesia, India and Thailand have also deployed tsunami warning systems.

Biological

- An expanding global Ocean Tracking Network, currently valued at \$150 million, which allows scientists to follow the migrations of tagged salmon and other animals.
- Thousands of pelagic "animal oceanographers" spanning 50 species -- elephant seals, tunas, white sharks, leatherback turtles, squid and others -- equipped with electronic tags that record the light, depth, temperature and salinity conditions they pass through, while revealing their speed, heart rate, biodiversity hotspots, nurseries, and migratory routes that need protection;
- At-sea DNA sequencing of microbial, bacterial, and planktonic life forms, yielding real-time marine equivalents of "pollen counts";
- The Continuous Plankton Recorder Survey, which has been monitoring the Atlantic for almost 80 years. At a current cost of \$6 million per year, the survey recently extended into the Arctic and Pacific, with plans underway to monitor plankton worldwide;
- A growing network, NaGISA, of more than 200 sites around the world using standardized protocols to measure near-shore biodiversity and changes that climate and pollution could cause.

To embrace the challenge of monitoring ocean life, world experts are formally puzzling through a recommended installation sequence; in other words, what, where and how many "life gauges" are top priorities in the proposed system.

Moving forward

The parts of the system now installed represent only a fraction of what's required for authoritative accuracy and global perspective, according to POGO. Needed are expansion of the array of the technologies above as well as:



- So-called 'air-clippers': atmosphere and ocean surface sensors tethered to balloons with which scientists have achieved concurrent atmospheric and ocean measurements from within the eye of a strong cyclone where the balloons become trapped;
- A suite of novel "Autonomous Reef Monitoring Structures," valued at \$50 million -- dollhouse-like structures into which animals migrate for collection and analysis later. The ARMS devices allow for standardized global comparisons and monitoring of reef life and benthic biodiversity;
- A Chlorophyll Globally-Integrated Network (ChloroGIN), which aims to monitor the coastal ecosystem using in situ and satellite techniques, at a cost of \$5 million per year.
- Merchant marine and research vessels programs to make observations along their routes. The cost of instituting the global programs is estimated at, respectively, \$50 million and \$75 million per year.

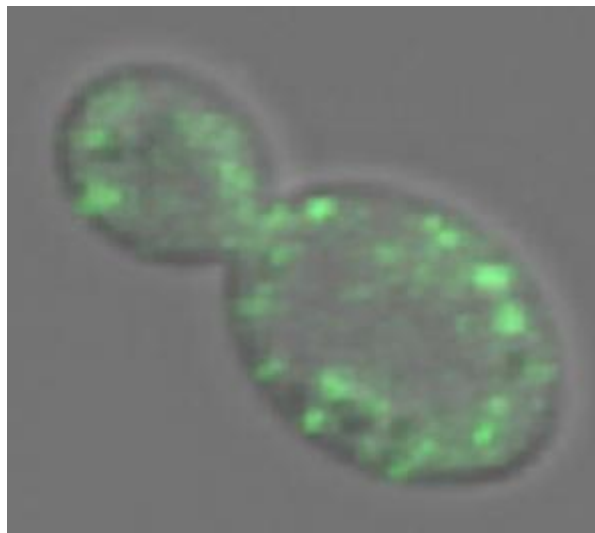
The in situ observations would complement a suite of satellite-borne devices tracking sea-surface roughness, temperature, currents, ice cover and shifting distributions of marine plants. Satellites provide wide aerial coverage, but provide little information from deep within the ocean; hence the need for both types of observations.

Story Source:

The above story is reprinted (with editorial adaptations by *ScienceDaily* staff) from materials provided by **Partnership for Observation of the Global Oceans**, via EurekAlert!, a service of AAAS.

<http://www.sciencedaily.com/releases/2010/10/101031131953.htm>

Size of Protein Aggregates, Not Abundance, Drives Spread of Prion-Based Disease



Less is more Green spots in an infected yeast cell are fluorescent prion structures. The size of prion structures is crucial. Smaller structures move more efficiently between cells, so they are more likely to spread disease. (Credit: Serio Lab / Brown University)

ScienceDaily (Nov. 1, 2010) — Mad Cow disease and its human variant Creutzfeldt -- Jakob disease, which are incurable and fatal, have been on a welcome hiatus from the news for years, but because mammals remain as vulnerable as ever to infectious diseases caused by enigmatic proteins called prions, scientists have taken no respite of their own. In the Oct. 29 edition of the journal *Science*, researchers at Brown University report a key new insight into how prion proteins -- the infectious agents -- become transmissible: In yeast at least, it is the size of prion complexes, not their number, that determines their efficiency in spreading.

"The dogma in the field was that the misfolding of the protein is sufficient to cause disease, and the clinical course of the infection depended on the amplification of the misfolded protein," said Tricia Serio, associate professor of molecular biology, cell biology and biochemistry. "But over the years in mammals it has become clear that the abundance of misfolded protein is not a good predictor of disease progression. The question is, What else has to happen for you to get the clinical pathology?"

Cells make prion proteins naturally, although biologists do not understand what their normal role is in mammals. When those proteins misfold in cells, they assemble into structures called aggregates, but other proteins, known as chaperones, attempt to break down the aggregates. The rates at which this assembly and disassembly occurs are determined by the shape or conformation that the prion protein has adopted.

"Different conformations of the same prion protein can dramatically alter the spread of pathology and the incubation time of prion diseases," Serio said. "We wanted to learn how."

By combining experiments in yeast cells with mathematical models, the Brown team found that what affects a prions' ability to transmit from cell to cell is the size of the structures into which they assemble, Serio said. If the aggregates become too large, they lose their transmissibility among cells. Prion aggregates that remain small are transmitted with greater efficiency.

"In this paper we changed the transmissibility just by shifting the size," Serio said. "We could change it in either direction."

The proof was plain to see. Postdoctoral researcher Aaron Derdowski monitored differently sized prion aggregates as they moved among cells under the microscope and could see that smaller ones fared better than larger ones. He also kept track of the spread of different prion structures through a genetic analysis of affected cell populations.

In concert with the experimental work, Suzanne Sindi, a postdoctoral researcher with a joint appointment in molecular biology, cell biology and biochemistry and the Center for Computational Molecular Biology,



modeled how cells make and spread prion aggregates, providing a novel simulation of the process that she ran on a computing cluster in the Center for Computation and Visualization at Brown. The model that best replicated experimental observations was the one in which aggregate size, rather than abundance, was the key factor.

Implications for disease

Serio says the insights the team has gained in yeast may better explain what others have observed in mammals as well.

"Previously it was not clear why you would have those outcomes," she said.

Ultimately the findings could inform future strategies for developing a treatment for prion infection. If researchers unaware of the importance of aggregate size developed a therapy to hinder prion aggregate formation, they might inadvertently make things worse by producing smaller aggregates, Serio said.

"A more effective strategy might be to control the size of the aggregates," she said, "rather than their presence or absence."

The findings may also relate to other neurodegenerative diseases that depend on misfolding proteins, such as Alzheimer's disease or Parkinson's disease, Serio said.

Other authors on the paper include graduate students Courtney Klaipe and Susanne DiSalvo. The National Institutes of Health funded the work.

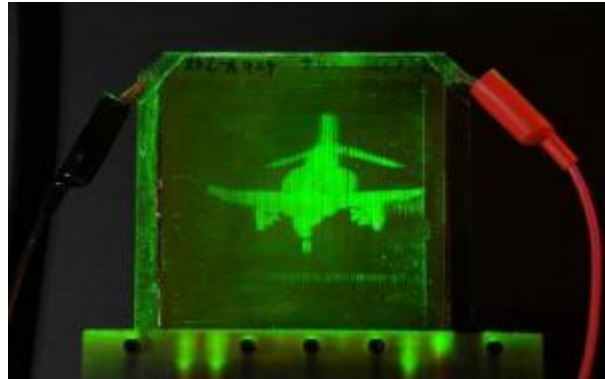
***Editor's Note:** This article is not intended to provide medical advice, diagnosis or treatment.*

Story Source:

The above story is reprinted (with editorial adaptations by ScienceDaily staff) from materials provided by **Brown University**.

<http://www.sciencedaily.com/releases/2010/10/101028141751.htm>

Moving Holograms: From Science Fiction to Reality



This is a refreshable, holographic image of an F-4 Phantom Jet created on a photorefractive polymer at the College of Optical Sciences, the University of Arizona. (Credit: gargaszphotos.com/University of Arizona) ScienceDaily (Nov. 3, 2010) — A new type of holographic telepresence allows the projection of a three-dimensional, moving image without the need for special eyewear such as 3D glasses or other auxiliary devices.

Remember the Star Wars scene in which R2D2 projects a three-dimensional image of a troubled Princess Leia delivering a call for help to Luke Skywalker and his allies? What used to be science fiction is now close to becoming reality thanks to a breakthrough in 3D holographic imaging technology developed at the University of Arizona College of Optical Sciences.

A team led by optical sciences professor Nasser Peyghambarian developed a new type of holographic telepresence that allows the projection of a three-dimensional, moving image without the need for special eyewear such as 3D glasses or other auxiliary devices. The technology is likely to take applications ranging from telemedicine, advertising, updatable 3D maps and entertainment to a new level.

The journal *Nature* chose the technology to feature on the cover of its Nov. 4 issue.

"Holographic telepresence means we can record a three-dimensional image in one location and show it in another location, in real-time, anywhere in the world," said Peyghambarian, who led the research effort.

"Holographic stereography has been capable of providing excellent resolution and depth reproduction on large-scale 3D static images," the authors wrote, "but has been missing dynamic updating capability until now."

"At the heart of the system is a screen made from a novel photorefractive material, capable of refreshing holograms every two seconds, making it the first to achieve a speed that can be described as quasi-real-time," said Pierre-Alexandre Blanche, an assistant research professor in the UA College of Optical Sciences and lead author of the *Nature* paper.

The prototype device uses a 10-inch screen, but Peyghambarian's group is already successfully testing a much larger version with a 17-inch screen. The image is recorded using an array of regular cameras, each of which views the object from a different perspective. The more cameras that are used, the more refined the final holographic presentation will appear.

That information is then encoded onto a fast-pulsed laser beam, which interferes with another beam that serves as a reference. The resulting interference pattern is written into the photorefractive polymer, creating and storing the image. Each laser pulse records an individual "hogel" in the polymer. A hogel (short for holographic pixel) is the three-dimensional version of a pixel, the basic units that make up the picture.

The hologram fades away by natural dark decay after a couple of minutes or seconds depending on experimental parameters. Or it can be erased by recording a new 3D image, creating a new diffraction structure and deleting the old pattern.

Peyghambarian explained: "Let's say I want to give a presentation in New York. All I need is an array of cameras here in my Tucson office and a fast Internet connection. At the other end, in New York, there would be the 3D display using our laser system. Everything is fully automated and controlled by computer. As the

image signals are transmitted, the lasers inscribe them into the screen and render them into a three-dimensional projection of me speaking."

The overall recording setup is insensitive to vibration because of the short pulse duration and therefore suited for industrial environment applications without any special need for vibration, noise or temperature control. One of the system's major hallmarks never achieved before is what Peyghambarian's group calls full parallax: "As you move your head left and right or up and down, you see different perspectives. This makes for a very life-like image. Humans are used to seeing things in 3D."

The work is a result of a collaboration between the UA and Nitto Denko Technical, or NDT, a company in Oceanside, Calif. NDT provided the polymer sample and media preparation. "We have made major advances in photorefractive polymer film fabrication that allow for the very interesting 3D images obtained in our upcoming Nature article," said, Michiharu Yamamoto, vice president at NDT and co-author of the paper. Potential applications of holographic telepresence include advertising, updatable 3D maps and entertainment. Telemedicine is another potential application: "Surgeons at different locations around the world can observe in 3D, in real time, and participate in the surgical procedure," the authors wrote.

The system is a major advance over computer-generated holograms, which place high demands on computing power and take too long to be generated to be practical for any real-time applications.

Currently, the telepresence system can present in one color only, but Peyghambarian and his team have already demonstrated multi-color 3D display devices capable of writing images at a faster refresh rate, approaching the smooth transitions of images on a TV screen. These devices could be incorporated into a telepresence set-up in near future.

The research was funded through grants from the Air Force Office of Scientific Research, the Defense Advanced Research Projects Agency and the National Science Foundation's Engineering Research Center on Integrated Access Networks.

Story Source:

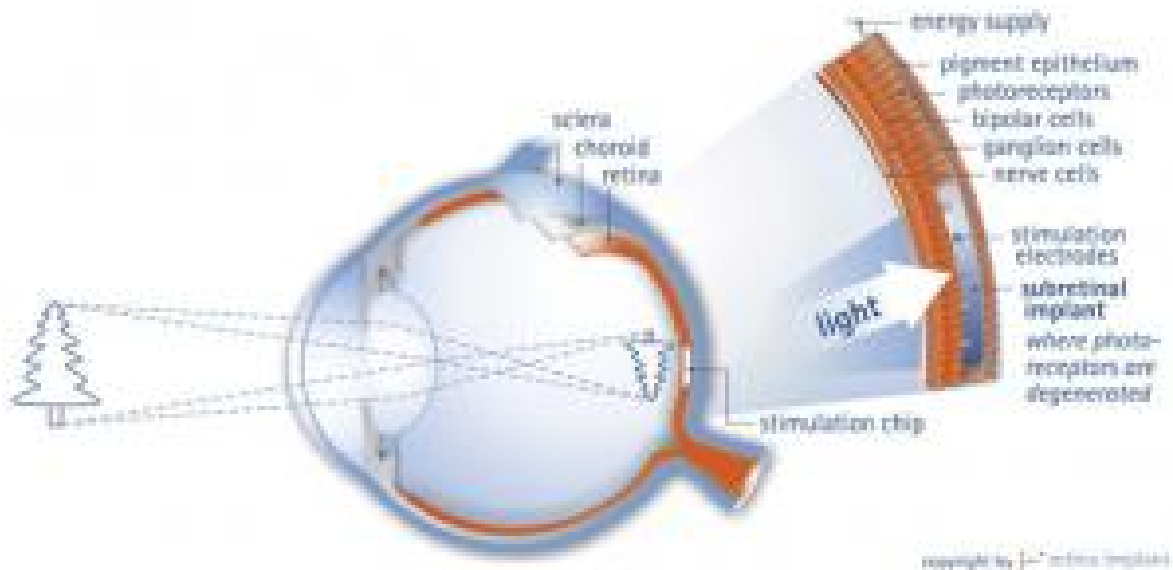
The above story is reprinted (with editorial adaptations by *ScienceDaily* staff) from materials provided by **University of Arizona**.

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<http://www.sciencedaily.com/releases/2010/11/101103141527.htm>

New Retinal Implant Enables Blind People to See Shapes and Objects



Functional scheme of subretinal implants. (Credit: © Retina Implant AG)

ScienceDaily (Nov. 3, 2010) — Research published in *Proceedings of the Royal Society B* reveals that a group of researchers based in Germany have developed a retinal implant that has allowed three blind people to see shapes and objects within days of the implant being installed.

One blind person was even able to identify and find objects placed on a table in front of him, as well as walking around a room independently and approaching people, reading a clock face and differentiating seven shades of grey. The device, which has been developed by the company Retinal Implant AG together with the Institute for Ophthalmic Research at the University of Tuebingen, represents an unprecedented advance in electronic visual prostheses and could eventually revolutionise the lives of up 200,000 people worldwide who suffer from blindness as a result of retinitis pigmentosa, a degenerative eye disease.

In this disease light receptors in the eye cease to function. Writing in *Proceedings of the Royal Society B*, Prof. Dr. Eberhart Zrenner (founding Director of Retinal Implant AG and Director and Chairman of the University of Tuebingen Eye Hospital) states that "The results of this pilot study provide strong evidence that the visual functions of patients blinded by a hereditary retinal dystrophy can, in principle, be restored to a degree sufficient for use in daily life."

The device -- known as a subretinal implant -- sits underneath the retina, directly replacing light receptors lost in retinal degeneration. As such, it uses the eyes' natural image processing capabilities beyond the light detection stage to produce a visual perception in the patient that is stable and follows their eye movements. Other types of retinal implants -- known as epiretinal implants -- sit outside the retina and because they bypass the intact light-sensitive structures in the eyes they require the user to wear an external camera and processor unit.

The subretinal implant described in this paper achieves unprecedented clarity because it has a great deal more light receptors than other similar devices. As Prof. Dr. Zrenner states, "The present study...presents proof-of-concept that such devices can restore useful vision in blind human subjects, even though the ultimate goal of broad clinical application will take time to develop."



Editor's Note: *This article is not intended to provide medical advice, diagnosis or treatment.*

Story Source:

The above story is reprinted (with editorial adaptations by ScienceDaily staff) from materials provided by **Royal Society**.

Journal Reference:

1. Eberhart Zrenner, Karl Ulrich Bartz-Schmidt, Heval Benav, Dorothea Besch, Anna Bruckmann, Veit-Peter Gabel, Florian Gekeler, Udo Greppmaier, Alex Harscher, Steffen Kibbel, Johannes Koch, Akos Kusnyerik, Tobias Peters, Katarina Stingl, Helmut Sachs, Alfred Stett, Peter Szurman, Barbara Wilhelm, Robert Wilke. **Subretinal electronic chips allow blind patients to read letters and combine them to words.** *Proceedings of the Royal Society B*, 2010; DOI: [10.1098/rspb.2010.1747](https://doi.org/10.1098/rspb.2010.1747)

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How Ancient Plants and Soil Fungi Turned Earth Green



Colonized plant. (Credit: Image courtesy of University of Sheffield)d

ScienceDaily (Nov. 2, 2010) — New research by scientists at the University of Sheffield has shed light on how Earth's first plants began to colonize the land over 470 million years ago by forming a partnership with soil fungi.

The research, published in *Nature Communications*, has provided essential missing evidence showing that an ancient plant group worked together with soil-dwelling fungi to 'green' Earth in the early Palaeozoic era, nearly half a billion years ago.

The research, which also involved experts from the Royal Botanic Gardens, Kew, Imperial College London and the University of Sydney, has provided new insights into our understanding of the evolving dynamic behavior of Earth's land plants and fungi.

Scientists have long-suspected that soil fungi formed mutually beneficial relationships with early land plants to play an essential role in assisting their initial colonization of terrestrial environments. However, until now there has been a lack of evidence demonstrating if and how the earliest ancient land plants, from the early Palaeozoic era (over 470 million years ago), might have cooperated with fungi for mutual benefit.

The team studied a thalloid liverwort plant, which is a member of the most ancient group of land plants that still exists and still shares many of the original features of its ancestors. They used controlled-environment growth rooms to simulate a CO₂-rich atmosphere, similar to that of the Palaeozoic era when these plants originated. This environment significantly amplified the benefits of the fungi for the plant's growth and so favored the early formation of the association between the plant and its fungal partner.

The team found that when the thalloid liverwort was colonized by the fungi, it significantly enhanced photosynthetic carbon uptake, growth and asexual reproduction, factors that had a beneficial impact on plant fitness. The plants grow and reproduce better when colonized by symbiotic fungi because the fungi provide

essential soil nutrients. In return, the fungi also benefit by receiving carbon from the plants. The research found that each plant was supporting fungi that had an area of 1-2 times that of a tennis court.

Professor David Beerling, from the Department of Animal and Plant Sciences at the University of Sheffield, said: "By studying these ancient plants we open a window on the past to investigate how the earliest land plants evolved. Our results support the idea that the 'greening' of the Earth was promoted by a symbiosis between plants and fungi. It shows that plants didn't get a toe-hold on land without teaming up with fungi -- this has long been suspected, but until now not investigated. It will require us to think again about the crucial role of cooperation between organisms that drove fundamental changes in the ecology of our planet."

Martin Bidartondo from the Jodrell Laboratory at the Royal Botanic Gardens, Kew, said: "Fungi are present in every type of habitat throughout the world and are essential for many plants to grow. It is exciting that we are now beginning to discover the fungi associated with 'lower' plants, and that many more still remain to be investigated."

Story Source:

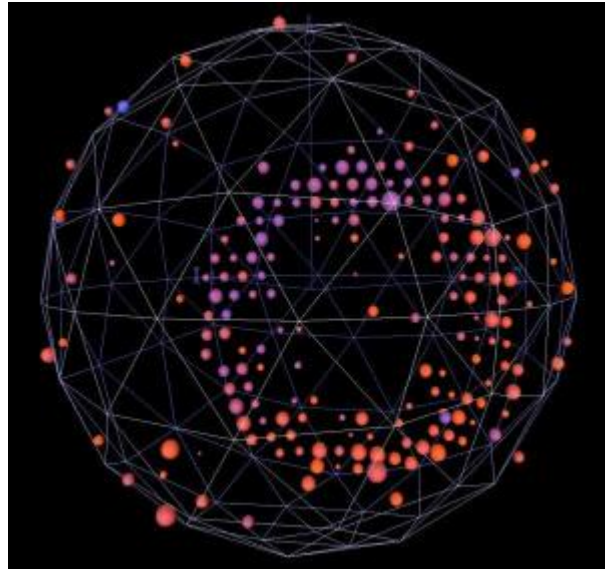
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<http://www.sciencedaily.com/releases/2010/11/101102130137.htm>

Fourth Flavor of Neutrino? Physics Experiment Suggests Existence of New Elementary Particle



The MiniBooNE experiment records a neutrino event, in this 2002 image from Fermilab. The ring of light, registered by some of more than one thousand light sensors inside the detector, indicates the collision of a muon neutrino with an atomic nuclei. (Credit: Fermilab)

ScienceDaily (Nov. 3, 2010) — The results of a high-profile Fermilab physics experiment appear to confirm strange 20-year-old findings that poke holes in the standard model, suggesting the existence of a new elementary particle: a fourth flavor of neutrino.

The new results go further to describe a violation of a fundamental symmetry of the universe asserting that particles of antimatter behave in the same way as their matter counterparts.

Neutrinos are neutral elementary particles born in the radioactive decay of other particles. The known "flavors" of neutrinos are the neutral counterparts of electrons and their heavier cousins, muons and taus. Regardless of a neutrino's original flavor, the particles constantly flip from one type to another in a phenomenon called "neutrino flavor oscillation."

An electron neutrino might become a muon neutrino, and then later an electron neutrino again. Scientists previously believed three flavors of neutrino exist. In this Mini Booster Neutrino Experiment, dubbed MiniBooNE, researchers detected more oscillations than would be possible if there were only three flavors. "These results imply that there are either new particles or forces we had not previously imagined," said Byron Roe, professor emeritus in the University of Michigan's Department of Physics, and an author of a paper on the results newly published online in *Physical Review Letters*.

"The simplest explanation involves adding new neutrino-like particles, or sterile neutrinos, which do not have the normal weak interactions."

The three known types of neutrino interact with matter primarily through the weak nuclear force, which makes them difficult to detect. It is hypothesized that this fourth flavor would not interact through the weak force, making it even harder to find.

The existence of sterile neutrinos could help explain the composition of the universe, said William Louis, a scientist at Los Alamos National Laboratory who was a doctoral student of Roe's at U-M and is involved in the MiniBooNE experiment.

"Physicists and astronomers are looking for sterile neutrinos because they could explain some or even all of the dark matter of the universe," Louis said. "Sterile neutrinos could also possibly help explain the matter asymmetry of the universe, or why the universe is primarily composed of matter, rather than antimatter."

The MiniBooNE experiment, a collaboration among some 60 researchers at several institutions, was conducted at Fermilab to check the results of the Liquid Scintillator Neutrino Detector (LSND) experiment at Los Alamos National Laboratory, which started in 1990. The LSND was the first to detect more neutrino oscillations than the standard model predicted.

MiniBooNE's initial results several years ago, based on data from a neutrino beam (as opposed to an antineutrino beam), did not support the LSND results. The LSND experiment was conducted using an antineutrino beam, though, so that was the next step for MiniBooNE.

These new results are based on the first three years of data from an antineutrino beam, and they tell a different story than the earlier results. MiniBooNE's antineutrino beam data does support the LSND findings. And the fact that the MiniBooNE experiments produced different results for antineutrinos than for neutrinos especially astounds physicists.

"The fact that we see this effect in antineutrinos and not in neutrinos makes it even more strange," Roe said. "This result means even more serious additions to our standard model would be necessary than had been thought from the first LSND result."

The result seems to violate the "charge-parity symmetry" of the universe, which asserts that the laws of physics apply in the same ways to particles and their counterpart antiparticles. Violations of this symmetry have been seen in some rare decays, but not with neutrinos, Roe said.

While these results are statistically significant and do support the LSND findings, the researchers caution that they need results over longer periods of time, or additional experiments before physicists can rule out the predictions of the standard model.

The paper is called "Event Excess in the MiniBooNE Search for $\bar{\nu}_\mu \rightarrow \bar{\nu}_e$ Oscillations." It will be published in an upcoming edition of *Physical Review Letters*.

This research is funded by Fermilab, the Department of Energy and the National Science Foundation.

Story Source:

The above story is reprinted (with editorial adaptations by *ScienceDaily* staff) from materials provided by **University of Michigan**.

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Bees Reveal Nature-Nurture Secrets: Extensive Molecular Differences in Brains of Workers and Queen



In a new study, researchers uncovered extensive molecular differences in the brains of worker bees and queen bees which develop along very different paths when put on different diets. (Credit: iStockphoto/Florin Tirlea) ScienceDaily (Nov. 3, 2010) — The nature-nurture debate is a "giant step" closer to being resolved after scientists studying bees documented how environmental inputs can modify our genetic hardware. The researchers uncovered extensive molecular differences in the brains of worker bees and queen bees which develop along very different paths when put on different diets.

The research was led by Professor Ryszard Maleszka of The Australian National University's College of Medicine, Biology and Environment, working with colleagues from the German Cancer Institute in Heidelberg, Germany and is published in the online, open access journal *PLoS Biology*.

Their work reveals for the first time the intricacies of the environmentally-influenced chemical 'marking of DNA' called DNA methylation, which has the capacity to alter gene expression without affecting the genetic code -- a process referred to as 'epigenetic', or above the genome.

"This marking determines which genes are to be fine-tuned in the brains of workers and queens to produce their extraordinarily different behaviours. This finding is not only crucial, but far reaching, because the enzymes that mark DNA in the bee are also the enzymes that mark DNA in human brains," said Professor Maleszka.

"In the bees, more than 550 genes are differentially marked between the brain of the queen and the brain of the worker, which contributes to their profound divergence in behaviour. This study provides the first documentation of extensive molecular differences that may allow honey bees to generate different reproductive and behavioural outcomes as a result of differential feeding with royal jelly."

Professor Maleszka said that the work goes a long way to answering one of life's biggest questions.

"This study represents a giant step towards answering one of the big questions in the nature-nurture debate, because it shows how the outside world is linked to DNA via diet, and how environmental inputs can transiently modify our genetic hardware," he said.



"Similar studies are impossible to do on human brains, so the humble honey bees are the pioneers in this fascinating area."

Story Source:

The above story is reprinted (with editorial adaptations by ScienceDaily staff) from materials provided by **Public Library of Science**, via EurekAlert!, a service of AAAS.

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Workers Hold Key to Power in Nature's Oldest Societies, Ant Study Shows



Three workers are with a queen (center) while a fourth worker looks on (center back). (Credit: Richard Gill, University of Leicester)

ScienceDaily (Nov. 3, 2010) — A new study analysing how complex, highly-evolved societies are organised in nature has found that it is workers that play a pivotal role in creating well-ordered societies where conflict is minimised. For when it comes to determining who reproduces in ants, University of Leicester biologists have found the humble worker is queenmaker -- it is they who choose their queen.

This information is key to understanding the evolution of complex interdependent societies -- over 100 millions years old -- that have evolved mechanisms ensuring stable cohabitation and conflict resolution.

What the Leicester team discovered surprised them: While Spanish worker ants were ruthless in determining who became their queen -- and hence acquired the right to reproduce -- the same species of ants in France, Germany and the UK are known to be more 'apathetic'.

While Spanish workers bullied or even killed rival queens in order to choose their queen, UK workers are not aggressive at all and were loyal subjects to any number of queens.

The research by Dr Robert Hammond and Dr Richard Gill of the University of Leicester Department of Biology is published in *Proceedings of the Royal Society B*. The study was funded by the Natural Environment Research Council.

The finding could have important applications. Dr Hammond said: "Some ants are pests, and in particular invasive ants -- that have colonized new countries and continents -- are very destructive causing many millions of pounds of damage. In a number of important cases ants have invaded because of a shift in their social organisation. So understanding the reason for differences in social organisation in a non invasive species is likely to help understand these problem species."

The four-year study reveals that Spanish ant societies are composed of single family units where only one queen rules the roost -but UK ant societies are a more complex mixture of family units where lots of queens are having offspring

Spanish worker ants are truly revolutionary, the research found, while UK worker ants are more 'apathetic'.

Dr Gill said: "Many animals -- including humans -- live in social groups and, as we all know, the interests of group members are often in conflict and 'arguments' often break out. Ants have some of the most integrated and complex societies found in nature and it is of great interest to understand if there are conflicts within their societies and how they are resolved. Because ants have been living in complex societies for many millions of years, and cooperation is highly important to their success, mechanisms that resolve such arguments should have evolved."

"We sought to find out how the argument over who heads ant colonies is settled. This argument about who reproduces is not just confined to the ants we study, but is a general issue in socially living animals. In

meerkats, only a few females reproduce, likewise in naked mole rats only a single 'queen' mole rat reproduces, yet in lions all females reproduce in a social group. The aim of this work is to help explain why we see such variation in who reproduces in socially living animals."

The Leicester researchers studied the 'twig ant' -- *Leptothorax acervorum* -- that have more than one queen per nest (this is actually quite common in ants). However, in the Spanish population only one queen reproduces -- even though other queens in the nest are capable.

"We found evidence that workers do indeed hold the power -- and, like revolting peasants -- the masses are ferocious with workers beating up -- even killing -- all but one queen who they preferentially groom and who ends up reproducing" Dr Hammond said.

But this 'worker power' is not found in all populations of twig ants. In fact in twig ant colonies from the UK, France and Germany and many other places -- workers are not aggressive to queens at all and multiple queens end up reproducing. The colony in these cases is an assemblage of multiple families, rather than a single family as found in Spain.

Dr Hammond said: "Worker ants are known to be important players in various arguments that happen within the colony, but this is the first time worker ants have been shown to be so influential over which queens reproduce. Also, the contrast in worker power between the aggressive Spanish twig ant workers and the apathetic twig ant workers found in the UK and elsewhere is intriguing.

"The role of workers has been overlooked in the argument over who determines which queens reproduce. Also, a particular species is often thought to have fixed social organisation. This work shows that species can vary in fundamental aspects of how their societies are organised."

While this study has established that in Spanish colonies of this ant it is worker behaviour that determines which queens reproduce researchers have yet to determine the ultimate reason why workers behave like this, and also why worker behaviour varies.

"We need to establish to what extent it is nature (genes) and nurture (environment) that is responsible for the difference in behaviour between Spanish and UK ants."

Story Source:

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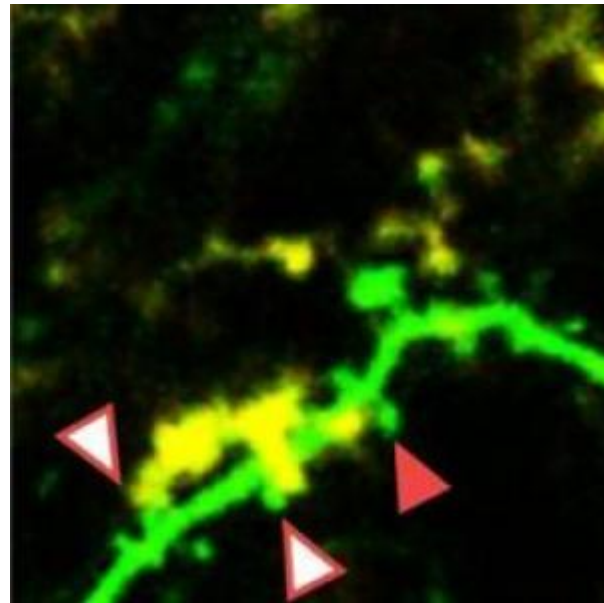
Journal Reference:

1. Richard J. Gill, Robert L. Hammond. **Workers influence royal reproduction**. *Proceedings of the Royal Society B*, 2010; DOI: [10.1098/rspb.2010.1774](https://doi.org/10.1098/rspb.2010.1774)

<http://www.sciencedaily.com/releases/2010/11/101102191839.htm>

How Some Brain Cells Hook Up Surprises Researchers: The Untold Secret Life of the Humble Microglia

This two-photon image shows dynamic interaction between a microglial cell (yellow) and a neuron's dendritic spines (green points) in the living brain. The spines with white arrows are being touched by the microglia; the red arrow points to a spine that had been touched by the microglia just five minutes earlier. (Credit: Image courtesy of University of Rochester Medical Center)



ScienceDaily (Nov. 3, 2010) — Immune cells known as microglia, long thought to be activated in the brain only when fighting infection or injury, are constantly active and likely play a central role in one of the most basic, central phenomena in the brain -- the creation and elimination of synapses. The finding, reported in the Nov. 2 issue of *PLoS Biology*, catapults the humble microglia cell from its well-recognized duty of protecting the brain to direct involvement in creating the cellular networks at the core of brain behavior. Its apparent role as an

architect of synapses -- junctions between brain cells called neurons -- comes as a surprise to researchers long accustomed to thinking of microglia as cells focused exclusively on keeping the brain safe from threats.

"When scientists talk about microglia, the talk is almost always about disease. Our work suggests that microglia may actively contribute to learning and memory in the healthy brain, which is something that no one expected," said Ania Majewska, Ph.D., the neuroscientist at the University of Rochester Medical Center who led the work.

The group's paper is a remarkably detailed look at how brain cells interact with each other and react to their environment swiftly, reaching out constantly to form new links or abolish connections.

First author Marie-Ève Tremblay, Ph.D., a post-doctoral associate in Majewska's lab, used two sophisticated imaging techniques to get an unprecedented look at microglia in the brain. She used immunoelectron microscopy and two-photon microscopy to look at how microglia interact with synapses in the brains of healthy mice as their environment changed. In the experiments, the scientists looked into the brain while the mice were on a normal cycle of light and dark; while the mice were in the dark for several days; and again when the mice went back to a normal light/dark cycle.

The Rochester team found a high level of activity among microglia in response to the visual changes that the mice experienced. Even though scientists often say that microglia which are not actively fighting an injury or infection are "at rest," scientists found that even under normal circumstances, there is no rest for microglia.

"Why are microglia so dynamic? What are they contacting, and why, even when there is no injury?" asked Tremblay. "The idea that immune cells are always active in our brain, contributing to the ongoing process of learning and memory, really challenges current views of the brain."

Most notably, the scientists found that microglia changed their activity in response to the environment. When the lights were off, microglia contacted more synapses, were more likely to reach toward a particular type of synapse, tended to be larger, and were more likely to appear to be poised to destroy a synapse. When the lights came back on, most of those activities reversed.

"The fact that microglia change their behavior based on visual input is a remarkable feat for a cell whose role supposedly is all about brain injury and disease. Just the fact that microglia can sense that something has changed in the environment is a novel idea," said Majewska, who is assistant professor in the Department of Neurobiology and Anatomy.

The team showed how microglia send out their extensions, which are like tentacles, constantly, oftentimes targeting synapses. In time-lapse video of their experiments, microglia literally dance across the screen, sending their extensions this way and that throughout the brain constantly. The cells also are known to travel remarkably quickly through the very dense and convoluted environment of the brain, traveling perhaps two millionths of a meter in a minute -- remarkably fast on a molecular scale.

Tremblay and Majewska showed that microglia touch and wrap around synapses constantly and may have some say in deciding which synapses will survive and which will disappear. Microglia also appear key to creating or changing the extracellular space around synapses, a factor that would profoundly affect synapse function.

The team even found indications that microglia may be involved in destroying synapses through a process known as phagocytosis. Microglia had extensive interactions with tiny lollipop-shaped structures called dendritic spines, which are essential for a neuron's ability to connect with other nerve cells that transmit excitatory signals. Eliminating dendritic spines is one way to destroy synapses.

The scientists found that dendritic spines that were touched by microglial processes during Tremblay's first imaging session were more than three times as likely to be eliminated within the next two days compared to spines that were not. And microglia interacted more often with smaller dendritic spines, which generally indicate synapses that are either in the early stage of formation or that can easily be broken.

The research helps move microglia up into the pantheon of brain cells known to affect brain signaling. Years ago, brain signaling was thought to be the exclusive domain of neurons. During the last two decades, scientists have found that astrocytes also have vast signaling networks. Now, microglia also seem to be an important player in the brain's ability to adapt immediately and constantly to the environment and to shift its resources accordingly.

The findings are timely for scientists who are increasingly studying links between the nervous and immune systems, Tremblay said. The role of microglial cells themselves is being looked at in an array of conditions, including Parkinson's and Alzheimer's diseases, schizophrenia, obsessive-compulsive disorder and even autism.

Former technician Rebecca Lowery is also an author of the paper. Also contributing were Gayle Schneider and Karen Bentley of the Electron Microscope Research Core Facility. The work was funded by the National Eye Institute, the Whitehall Foundation, the Alfred P. Sloan Foundation, and a Career Award from the Burroughs Wellcome Fund. Tremblay has also been supported by a Fonds de la recherche en santé du Québec postdoctoral training award.

Editor's Note: *This article is not intended to provide medical advice, diagnosis or treatment.*

Story Source:

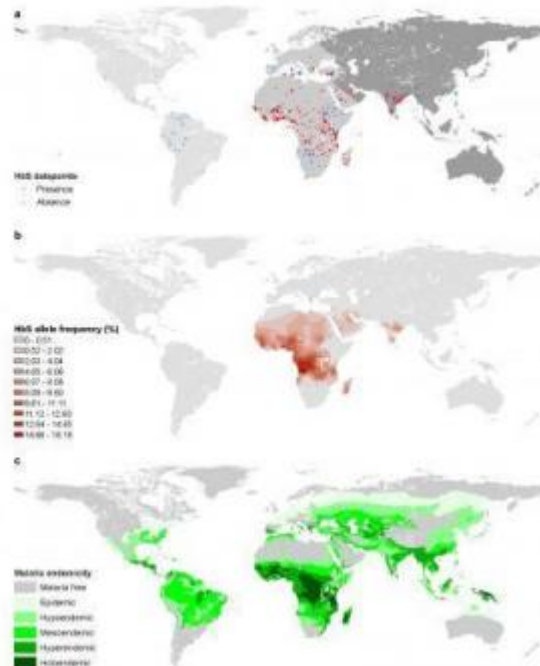
The above story is reprinted (with editorial adaptations by ScienceDaily staff) from materials provided by **University of Rochester Medical Center**.

Journal Reference:

1. Tremblay M-E, Lowery RL, Majewska AK. **Microglial Interactions with Synapses Are Modulated by Visual Experience.** *PLoS Biology*, 2010; 8 (11): e1000527 DOI: [10.1371/journal.pbio.1000527](https://doi.org/10.1371/journal.pbio.1000527)

<http://www.sciencedaily.com/releases/2010/11/101102171608.htm>

Global Map of the Sickle Cell Gene Supports 'Malaria Hypothesis'



These are maps showing the distribution of the HbS "sickle cell gene" and the endemicity of malaria. (Credit: Malaria Atlas Project)

ScienceDaily (Nov. 2, 2010) — At a global scale, the sickle cell gene is most commonly found in areas with historically high levels of malaria, adding geographical support to the hypothesis that the gene, while potentially deadly, avoids disappearing through natural selection by providing protection against malaria. In a study funded by the Wellcome Trust, geographers, biologists and statisticians at the University of Oxford, together with colleagues from the KEMRI-Wellcome Trust Programme in Kenya, have produced the first detailed global map showing the distribution of the sickle cell gene. The results are published in the journal *Nature Communications*.

Haemoglobin S (HbS) is known to cause sickle cell disease, which is usually fatal if untreated. Natural selection suggests that such a disadvantageous gene should not survive, yet it is common in people of African, Mediterranean and Indian origin.

More than sixty years ago, researchers observed that the sickle cell gene tended to be more common in populations living in, or originating from, areas of high malaria prevalence. This led to the 'malaria hypothesis', which suggested that, although deadly when inherited from both parents, the gene provided a degree of protection from malaria in children inheriting it from just one parent. This protective advantage was strong enough in areas of intense malaria transmission for the gene to survive.

The malaria hypothesis has since been supported by both population and laboratory studies, but the original observations of a geographical overlap between frequency of the gene and malaria prevalence have never been tested beyond simple visual comparisons at the global scale.

To address this, Dr Fred Piel and colleagues collated all the information currently accessible on the occurrence of the sickle cell gene in native populations worldwide and, using modern mapping techniques, created a map of the global frequency of this gene. The map was then compared with the distribution and intensity of malaria before widespread malaria control.



The study showed that the sickle cell gene is most common in sub-Saharan Africa, the Middle East and India, and that the areas of high frequency of this gene are coincident with historically high levels of malaria, thus confirming that the malaria hypothesis is correct at the global scale.

"This study highlights the first steps in our efforts to create an open-access, online database of the frequency of various inherited blood disorders," says lead author Dr Piel, from the University of Oxford. "Such databases will help improving estimates of their public health burden and guide where resources would be best applied."

Co-author Dr Simon Hay adds: "The malaria hypothesis is the text-book example of a natural selection 'balancing act', where selection against an unfavourable mutation is weighed against selection in favour of a protective gene.

The sickle frequency map was created as part of the activities of the Malaria Atlas Project, a multinational research collaboration funded primarily by the Wellcome Trust. Further information about the Malaria Atlas Project can be found at www.map.ox.ac.uk.

Editor's Note: *This article is not intended to provide medical advice, diagnosis or treatment.*

Story Source:

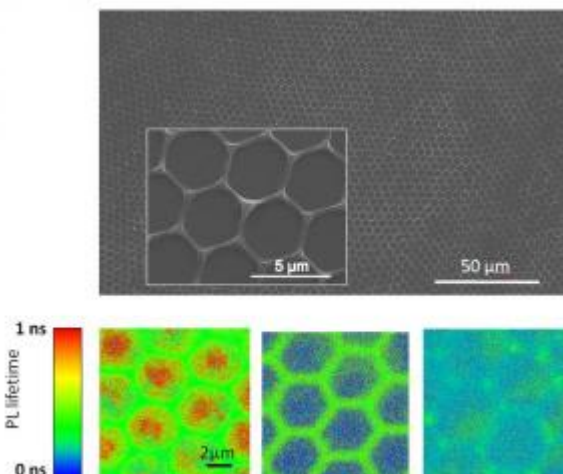
The above story is reprinted (with editorial adaptations by ScienceDaily staff) from materials provided by **Wellcome Trust**, via EurekAlert!, a service of AAAS.

Journal Reference:

1. Frédéric B. Piel, Anand P. Patil, Rosalind E. Howes, Oscar A. Nyangiri, Peter W. Gething, Thomas N. Williams, David J. Weatherall, Simon I. Hay. **Global distribution of the sickle cell gene and geographical confirmation of the malaria hypothesis.** *Nature Communications*, 2010; 1 (8): 104 DOI: [10.1038/ncomms1104](https://doi.org/10.1038/ncomms1104)

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Transparent Conductive Material Could Lead to Power-Generating Windows



Top: Scanning electron microscopy image and zoom of conjugated polymer (PPV) honeycomb. Bottom (left-to-right): Confocal fluorescence lifetime images of conjugated honeycomb, of polymer/fullerene honeycomb double layer and of polymer/fullerene honeycomb blend. Efficient charge transfer within the whole framework is observed in the case of polymer/fullerene honeycomb blend as a dramatic reduction in the fluorescence lifetime. (Credit: Image courtesy of DOE/Brookhaven National Laboratory)

ScienceDaily (Nov. 3, 2010) — Scientists at the U.S. Department of Energy's (DOE) Brookhaven National Laboratory and Los Alamos National Laboratory have fabricated transparent thin films capable of absorbing light and generating electric charge over a relatively large area. The material, described in the journal *Chemistry of Materials*, could be used to develop transparent solar panels or even windows that absorb solar energy to generate electricity.

The material consists of a semiconducting polymer doped with carbon-rich fullerenes. Under carefully controlled conditions, the material self-assembles to form a reproducible pattern of micron-size hexagonal-shaped cells over a relatively large area (up to several millimeters).

"Though such honeycomb-patterned thin films have previously been made using conventional polymers like polystyrene, this is the first report of such a material that blends semiconductors and fullerenes to absorb light *and* efficiently generate charge and charge separation," said lead scientist Mircea Cotlet, a physical chemist at Brookhaven's Center for Functional Nanomaterials (CFN).

Furthermore, the material remains largely transparent because the polymer chains pack densely only at the edges of the hexagons, while remaining loosely packed and spread very thin across the centers. "The densely packed edges strongly absorb light and may also facilitate conducting electricity," Cotlet explained, "while the centers do not absorb much light and are relatively transparent."

"Combining these traits and achieving large-scale patterning could enable a wide range of practical applications, such as energy-generating solar windows, transparent solar panels, and new kinds of optical displays," said co-author Zhihua Xu, a materials scientist at the CFN.

"Imagine a house with windows made of this kind of material, which, combined with a solar roof, would cut its electricity costs significantly. This is pretty exciting," Cotlet said.

The scientists fabricated the honeycomb thin films by creating a flow of micrometer-size water droplets across a thin layer of the polymer/fullerene blend solution. These water droplets self-assembled into large arrays within the polymer solution. As the solvent completely evaporates, the polymer forms a hexagonal honeycomb pattern over a large area.

"This is a cost-effective method, with potential to be scaled up from the laboratory to industrial-scale production," Xu said.

The scientists verified the uniformity of the honeycomb structure with various scanning probe and electron microscopy techniques, and tested the optical properties and charge generation at various parts of the honeycomb structure (edges, centers, and nodes where individual cells connect) using time-resolved confocal fluorescence microscopy.

The scientists also found that the degree of polymer packing was determined by the rate of solvent evaporation, which in turn determines the rate of charge transport through the material.

"The slower the solvent evaporates, the more tightly packed the polymer, and the better the charge transport," Cotlet said.

"Our work provides a deeper understanding of the optical properties of the honeycomb structure. The next step will be to use these honeycomb thin films to fabricate transparent and flexible organic solar cells and other devices," he said.

The research was supported at Los Alamos by the DOE Office of Science. The work was also carried out in part at the CFN and the Center for Integrated Nanotechnologies Gateway to Los Alamos facility. The Brookhaven team included Mircea Cotlet, Zhihua Xu, and Ranjith Krishna Pai. Collaborators from Los Alamos include Hsing-Lin Wang and Hsinhan Tsai, who are both users of the CFN facilities at Brookhaven, Andrew Dattelbaum from the Center for Integrated Nanotechnologies Gateway to Los Alamos facility, and project leader Andrew Shreve of the Materials Physics and Applications Division.

Story Source:

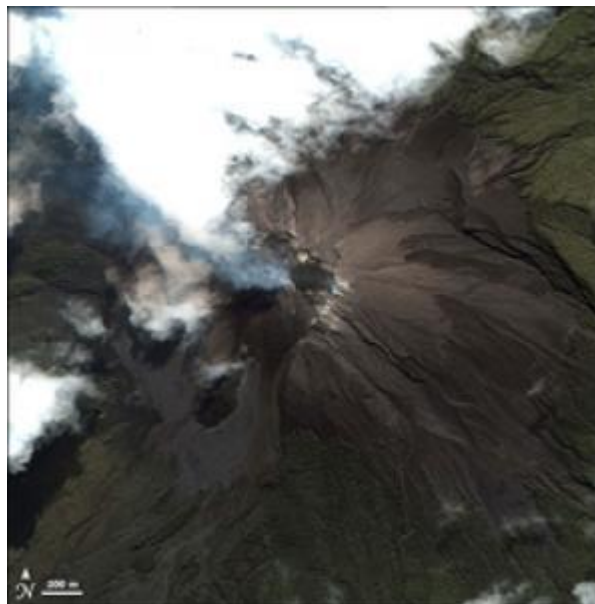
The above story is reprinted (with editorial adaptations by ScienceDaily staff) from materials provided by **DOE/Brookhaven National Laboratory**.

Journal Reference:

1. Hsinhan Tsai, Zhihua Xu, Ranjith Krishna Pai, Leeyih Wang, Andrew M. Dattelbaum, Andrew P. Shreve, Hsing-Lin Wang, Mircea Cotlet. **Structural dynamics and charge transfer via complexation with fullerene in large area conjugated polymer honeycomb thin films**†. *Chemistry of Materials*, 2010; : 101101122610090 DOI: [10.1021/cm102160m](https://doi.org/10.1021/cm102160m)

<http://www.sciencedaily.com/releases/2010/11/101103135354.htm>

Volcanoes Have Shifted Asian Rainfall



Explosive volcanoes such as Indonesia's Merapi (erupting here in 2006) have the potential to shift rain patterns. (Credit: NASA Earth Observatory)

ScienceDaily (Nov. 3, 2010) — Scientists have long known that large volcanic explosions can affect the weather by spewing particles that block solar energy and cool the air. Some suspect that extended "volcanic winters" from gigantic blowups helped kill off dinosaurs and Neanderthals. In the summer following Indonesia's 1815 Tambora eruption, frost wrecked crops as far off as New England, and the 1991 blowout of the Philippines' Mount Pinatubo lowered average global temperatures by 0.7 degrees F -- enough to mask the effects of manmade greenhouse gases for a year or so.

Now, scientists have shown that eruptions also affect rainfall over the Asian monsoon region, where seasonal storms water crops for nearly half of earth's population. Tree-ring researchers at Columbia University's Lamont-Doherty Earth Observatory showed that big eruptions tend to dry up much of central Asia, but bring more rain to southeast Asian countries including Vietnam, Laos, Cambodia, Thailand and Myanmar -- the opposite of what many climate models predict. Their paper appears in an advance online version of the journal *Geophysical Research Letters*.

The growth rings of some tree species can be correlated with rainfall, and the observatory's Tree Ring Lab used rings from some 300 sites across Asia to measure the effects of 54 eruptions going back about 800 years. The data came from Lamont's new 1,000-year tree-ring atlas of Asian weather, which has already produced evidence of long, devastating droughts; the researchers also have done a prior study of volcanic cooling in the tropics. "We might think of the study of the solid earth and the atmosphere as two different things, but really everything in the system is interconnected," said Kevin Anchukaitis, the study's lead author. "Volcanoes can be important players in climate over time."

Large explosive eruptions send up sulfur compounds that turn into tiny sulfate particles high into the atmosphere, where they deflect solar radiation. Resulting cooling on earth's surface can last for months or years. (Not all eruptions will do it; for instance, the continuing eruption of Indonesia's Merapi this fall has killed dozens, but this latest episode is probably not big enough by itself to effect large-scale weather changes.) As for rainfall, in the simplest models, lowered temperatures decrease evaporation of water from the surface into the air; and less water vapor translates to less rain. But matters are greatly complicated by atmospheric circulation patterns, cyclic changes in temperatures over the oceans, and the shapes of land masses. Up to now, most climate models incorporating known forces such as changes in the sun and

atmosphere have predicted that volcanic explosions would disrupt the monsoon by bringing less rain to southeast Asia--but the researchers found the opposite.

The researchers studied eruptions including one in 1258 from an unknown tropical site, thought to be the largest of the last millennium; the 1600-1601 eruption of Peru's Huaynaputina; Tambora in 1815; the 1883 explosion of Indonesia's Krakatau; Mexico's El Chichón, in 1982; and Pinatubo. The tree rings showed that huge swaths of southern China, Mongolia and surrounding areas consistently dried up in the year or two following big events, while mainland southeast Asia got increased rain. The researchers say there are many possible factors involved, and it would be speculative at this point to say exactly why it works this way.

"The data only recently became available to test the models," said Rosanne D'Arrigo, one of the study's coauthors. "Now, it's obvious there's a lot of work to be done to understand how all these different forces interact." For instance, in some episodes pinpointed by the study, it appears that strong cycles of the El Niño-Southern Oscillation, which drives temperatures over the Pacific and Indian oceans and is thought to strongly affect the Asian monsoon, might have counteracted eruptions, lessening their drying or moistening effects. But it could work the other way, too, said Anchukaitis; if atmospheric dynamics and volcanic eruptions come together with the right timing, they could reinforce one another, with drastic results. "Then you get flooding or drought, and neither flooding nor drought is good for the people living in those regions," he said. The study also raises questions whether proposed "geoengineering" schemes to counteract manmade climate change with huge artificial releases of volcanism-like particles might have complex unintended consequences. Ultimately, said Anchukaitis, such studies should help scientists refine models of how natural and manmade forces might act together to in the future to shift weather patterns -- a vital question for all areas of the world.

Story Source:

The above story is reprinted (with editorial adaptations by ScienceDaily staff) from materials provided by **The Earth Institute at Columbia University**.

Journal Reference:

1. Anchukaitis, K. J., B. M. Buckley, E. R. Cook, B. I. Cook, R. D. D'Arrigo, and C. M. Ammann. **The Influence of Volcanic Eruptions on the Climate of the Asian Monsoon Region.** *Geophysical Research Letters*, 2010 DOI: [10.1029/2010GL044843](https://doi.org/10.1029/2010GL044843)

<http://www.sciencedaily.com/releases/2010/11/101103135251.htm>

Exposure of Humans to Cosmetic UV Filters Is Widespread, Study Finds

ScienceDaily (Nov. 2, 2010) — An investigation conducted in the context of the Swiss National Research Programme (NRP50), *Endocrine Disrupters: Relevance to Humans, Animals and Ecosystems*, demonstrates for the first time that internal exposure of humans to cosmetic UV filters is widespread.

In the course of the Summer and Fall 2004, 2005 and 2006 (3 cohorts), human milk was sampled by mothers who had given birth at the University Women's Hospital in Basel. The participants filled out a detailed questionnaire with general questions and, as special feature, in depth questions on use of different types of cosmetic products.

Chemicals out of a large range of products including "modern" chemicals and classical persistent organic pollutants (POPs) were analyzed in the same human milk sample by analytical laboratories in Freiburg, Erlangen and Baden. The list comprised cosmetic UV filters, synthetic musk fragrances, pesticides, phthalates, parabens, flame retardants (polybrominated diphenylethers), and polychlorinated biphenyls (PCBs); in total 89 analyses per milk sample. The chemical analytical data of milk samples of individual mothers were then compared with the information obtained through the questionnaire.

The investigation revealed that one and the same human milk sample contained a large range of chemical contaminants, most of which are known to interact with endocrine systems. Individual exposure patterns differed between different types of chemicals. The study demonstrates for the first time that internal exposure of humans to cosmetic UV filters is widespread. Cosmetic UV filters were present in 85% of human milk samples, at concentrations comparable to PCBs. Synthetic musk fragrances were also present in the milk samples. The presence of UV filters in human milk was significantly correlated with the use of cosmetic products containing these UV filters. As a result, exposure patterns differed between individuals.

It seems plausible that exposure to other cosmetic constituents such as synthetic fragrances is also linked to the use of the corresponding products. However, this could not be investigated because musk fragrances are not declared. In contrast, classical contaminants such as PCBs, DDT and metabolites of DDT as well as some other persistent organochlor pesticides represented a rather uniform background exposure. Their levels were in part correlated with each other and also with fat-rich nutrition.

A total daily intake of each individual chemical was calculated for each individual infant from their individual levels in human milk. Calculation included fat content of individual milk samples, total daily milk intake per infant and body weight of the infant. Some infants exhibited values of daily intake of PCBs and several organochlor pesticides that were above US EPA reference dose values.

Margret Schlumpf and Walter Lichtensteiger, who lead the research said, "Research on the effects of endocrine disrupters (chemicals interfering with hormone actions) has shown that it is of utmost importance to obtain information on simultaneous exposure of humans to different types of chemicals because endocrine active chemicals can act in concert. Information on exposure is particularly important for the developing organism at its most sensitive early life stages. Human milk was chosen because it provides direct information on exposure of the suckling infant and indirect information on exposure of the mother during pregnancy."

An important question during the research was: To what extent lifestyle can influence the presence of chemicals in breast milk? This question was the foundation for the preparation of the questionnaire. The questions were focused particularly on the use of cosmetic products; information on the relationship between the exposure of human populations to constituents of cosmetics and the presence of these constituents in the human body was limited and, in the case of UV filters, absent.

Gert-Jan Geraeds, Executive Publisher of Chemosphere commented, "This study once again emphasizes the importance of global research on the impact of contaminants in the human environment and the need for continuous critical assessment of our priorities in environmental health and consumer habits. I am sure that

this investigation will also spark debate at the upcoming first Environmental Health conference in Brazil, February 2011."

The three year study involved toxicologists from GREENTOX and collaboration from personnel of the University of Zürich, University Women's Hospital Basel, University in Lausanne, and analytical chemists from Freiburg, Erlangen (Germany) and from Baden bei Wien (Austria).

Editor's Note: *This article is not intended to provide medical advice, diagnosis or treatment.*

Story Source:

The above story is reprinted (with editorial adaptations by ScienceDaily staff) from materials provided by **Elsevier**, via **AlphaGalileo**.

Journal Reference:

1. Margret Schlumpf, Karin Kypke, Matthias Wittassek, Juergen Angerer, Hermann Mascher, Daniel Mascher, Cora Vökt, Monika Birchler, Walter Lichtensteiger. **Exposure patterns of UV filters, fragrances, parabens, phthalates, organochlor pesticides, PBDEs, and PCBs in human milk: Correlation of UV filters with use of cosmetics.** *Chemosphere*, 2010; DOI: [10.1016/j.chemosphere.2010.09.079](https://doi.org/10.1016/j.chemosphere.2010.09.079)

<http://www.sciencedaily.com/releases/2010/11/101102124426.htm>

Most River Flows Across the US Are Altered by Land and Water Management



Potomac River near Washington D.C. The amount of water flowing in streams and rivers has been significantly altered in nearly 90 percent of waters that were assessed in a new nationwide USGS study. Flow alterations are a primary contributor to degraded river ecosystems and loss of native species. (Credit: Copyright Michele Hogan)

ScienceDaily (Nov. 3, 2010) — The amount of water flowing in streams and rivers has been significantly altered in nearly 90 percent of waters that were assessed in a new nationwide USGS study. Flow alterations are a primary contributor to degraded river ecosystems and loss of native species.

"This USGS assessment provides the most geographically extensive analysis to date of stream flow alteration," said Bill Werkheiser, USGS Associate Director for Water. "Findings show the pervasiveness of stream flow alteration resulting from land and water management, the significant impact of altered stream flow on aquatic organisms, and the importance of considering this factor for sustaining and restoring the health of the Nation's streams and ecosystems."

Flows are altered by a variety of land- and water-management activities, including reservoirs, diversions, subsurface tile drains, groundwater withdrawals, wastewater inputs, and impervious surfaces, such as parking lots, sidewalks and roads.

"Altered river flows lead to the loss of native fish and invertebrate species whose survival and reproduction are tightly linked to specific flow conditions," said Daren Carlisle, USGS ecologist and lead scientist on this study. "These consequences can also affect water quality, recreational opportunities and the maintenance of sport fish populations."

For example, in streams with severely diminished flow, native trout, a popular sport fish that requires fast-flowing streams with gravel bottoms, are replaced by less desirable non-native species, such as carp. Overall, the USGS study indicated that streams with diminished flow contained aquatic communities that prefer slow moving currents more characteristic of lake or pond habitats.

"Management practices related to water demand continue to alter stream flows in many places," said Jeff Ostermiller, Water Quality Manager with the Utah Division of Water Quality. "Understanding the ecological effects of these flow alterations helps water managers develop effective strategies to ensure that water remains sufficiently clean and abundant to support fisheries and recreation opportunities, while simultaneously supporting economic development."

Annual and seasonal cycles of water flows -- particularly the low and high flows -- shape ecological processes in rivers and streams. An adequate minimum flow is important to maintain suitable water conditions and habitat for fish and other aquatic life. High flows are important because they replenish floodplains and flush out accumulated sediment that can degrade habitat.

"While this study provided the first, national assessment of flow alteration, focused studies within specific geographic regions will provide a better understanding of the ecological effects of altered stream flows, which can be more effectively applied to local water management challenges," said Carlisle.

The severity and type of stream flow alteration varies among regions, due to natural landscape features, land practices, degree of development, and water demand. Differences are especially large between arid and wet climates. In wet climates, watershed management is often focused on flood control, which can result in lower maximum flows and higher minimum flows. Extremely low flows are the greatest concern in arid climates, in large part due to groundwater withdrawals and high water use for irrigation.

The study identified over 1,000 unimpaired streams to use as reference points to create stream flow models. The models were applied to estimate expected flows for 2,888 additional streams where the USGS had flow monitoring gauges from 1980-2007. The estimated values for the 2,888 streams were compared to actual, measured flows to determine the degree to which streams have been altered.

This study was conducted by the USGS National Water-Quality Assessment Program.

Story Source:

The above story is reprinted (with editorial adaptations by ScienceDaily staff) from materials provided by **United States Geological Survey**.

Journal Reference:

1. Daren M Carlisle, David M Wolock, Michael R Meador. **Alteration of streamflow magnitudes and potential ecological consequences: a multiregional assessment.** *Frontiers in Ecology and the Environment*, 2010; : 101025105601059 DOI: [10.1890/100053](https://doi.org/10.1890/100053)

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Moving Animals Not a Panacea for Habitat Loss



Gopher tortoises are federally listed as a threatened species in the western part of their range and prefer open-canopied longleaf pine forests, which now cover only two percent of their historic range. (Credit: Tracey Tuberville/University of Georgia)

ScienceDaily (Nov. 3, 2010) — New University of Georgia research suggests moving threatened animals to protected habitats may not always be an effective conservation technique if the breeding patterns of the species are influenced by a social hierarchy.

Research, published in the early online edition of the journal *Biological Conservation*, found an initial group of gopher tortoises released on St. Catherine's Island, Ga. were three times more likely to produce offspring than a later-introduced group, although the initial group had a much smaller proportion of reproduction-aged males.

"There definitely appeared to be an advantage to the order that the tortoises were released," said lead author Tracey Tuberville, an assistant research scientist at UGA's Savannah River Ecology Laboratory. "The earlier the males were released, the more likely they were to be successful fathering offspring for the next generation."

Moving multiple groups of gopher tortoises at different times may disrupt their social structure, explained Tuberville, resulting in differential success in reproduction among potential breeders. Introducing a specific number of males to reach a target population size may not achieve the desired results if all of the males are not reproducing.

"We found that females released later were not excluded from reproduction," she said. "If you need to augment a population, you might consider targeting females as opposed to males or introducing more females than males, because females produce the eggs, and they also seem to be incorporated into the breeding and social structure faster than males."

Gopher tortoises are federally listed as a threatened species in the western part of their range, though not in Georgia and Florida, where much of the destruction of their habitat has occurred.

Gopher tortoises are highly social and live in sandy burrows. They prefer open-canopied longleaf pine forests, which now cover only two percent of their historic range. Gopher tortoise habitats are ideal sites for human development, and Tuberville said that in the past, land developers were required to do little to protect their habitats at development sites.

Gopher tortoises from various locations were first introduced to St. Catherine's in the 1980s. A second group from a single population was later introduced in 1994. Biologists and veterinarians working on the island recorded health and survivorship data on the tortoises, each of which were permanently and uniquely marked to be easily identifiable. The researchers sought to identify which tortoises from each group were successfully reproducing after release. After a site-wide capture of all the potential breeders, researchers collected DNA samples. Once the eggs hatched, they also tested the DNA of the young to determine the parents.

"If we find that the pattern of differential mating success is consistent, or if it is observed in other places, it will inform us whether or not we want to establish populations through multiple releases and also whether or not we want to augment an existing population," said Tuberville.

Study co-author Travis Glenn, associate professor in the department of environmental health science in the UGA College of Public Health, said that new DNA technologies increasingly are being used in conservation and environmental health efforts. "We're trying to use these techniques in new and interesting ways," said Glenn. "That requires partnerships between a greater variety of people."

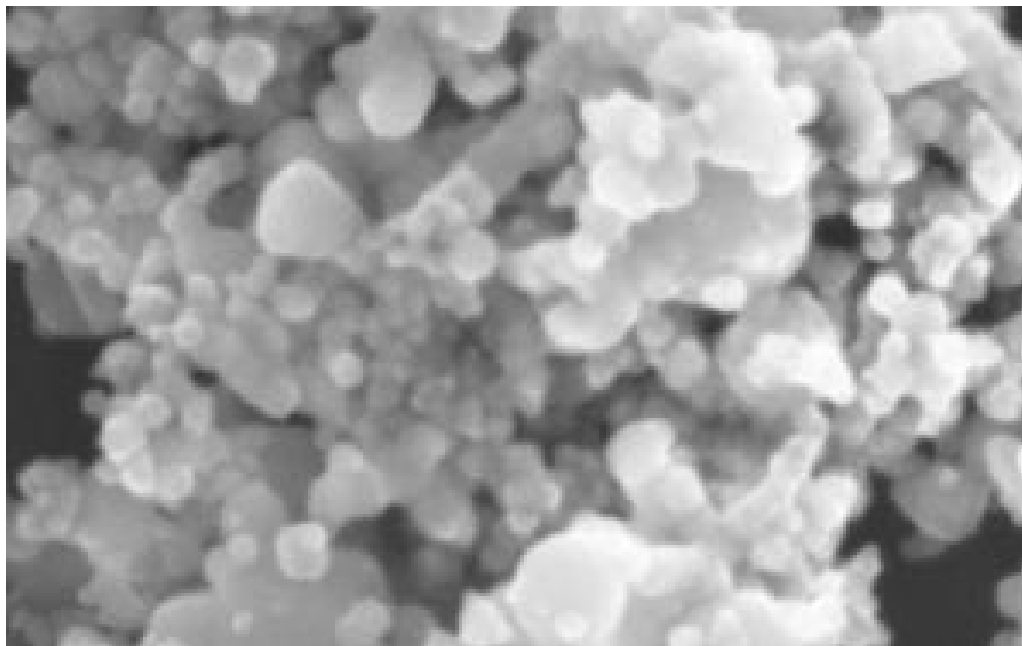
"The technology is getting better and better, so the answers will be better and more informative," Glenn added. "The ability to address conservation concerns will be faster, cheaper and more accurate."

Story Source:

The above story is reprinted (with editorial adaptations by *ScienceDaily* staff) from materials provided by **University of Georgia**. The original article was written by Kirk McAlpin.

<http://www.sciencedaily.com/releases/2010/11/101103111212.htm>

New Approaches Needed to Gauge Safety of Nanotech-Based Pesticides, Researchers Urge



These titanium dioxide nanoparticles, seen through a scanning electron microscope, are the type of extraordinarily small particles studied in a program at Oregon State University on the safety of nanotechnology. (Credit: Image courtesy of Oregon State University)

ScienceDaily (Nov. 3, 2010) — Nanotechnology is about to emerge in the world of pesticides and pest control, and a range of new approaches are needed to understand the implications for public health, ensure that this is done safely, maximize the potential benefits and prevent possible risks, researchers say in a new report.

In a study published October 4 in the *International Journal of Occupational and Environmental Health*, scientists from Oregon State University and the European Union outline six regulatory and educational issues that should be considered whenever nanoparticles are going to be used in pesticides.

"If we do it right, it should be possible to design nanoparticles with safety as a primary consideration, so they can help create pesticides that work better or are actually safer," said Stacey Harper, an assistant professor of nanotoxicology at Oregon State University. Harper is a national leader in the safety and environmental impacts of this science that deals with particles so extraordinarily small they can have novel and useful characteristics.

"Unlike some other applications of nanotechnology, which are further along in development, applications for pesticides are in their infancy," Harper said. "There are risks and a lot of uncertainties, however, so we need to understand exactly what's going on, what a particular nanoparticle might do, and work to eliminate use of any that do pose dangers."

A program is already addressing that at OSU, as part of the Oregon Nanoscience and Microtechnologies Institute.

The positive aspect of nanotechnology use with pesticides, researchers say, is that it might allow better control and delivery of active ingredients, less environmental drift, formulations that will most effectively reach the desired pest, and perhaps better protection for agricultural workers.

"If you could use less pesticide and still accomplish the same goal, that's a concept worth pursuing," Harper said.

But researchers need to be equally realistic about the dangers, she said. OSU labs have tested more than 200 nanomaterials, and very few posed any toxic concerns -- but a few did. In one biomedical application, where

nanoparticles were being studied as a better way to deliver a cancer drug, six out of 40 evoked a toxic response, most of which was linked to a specific surface chemistry that scientists now know to avoid. "The emergence of nanotechnology in the pesticide industry has already begun, this isn't just theoretical," said David Stone, an assistant professor in the OSU Department of Environmental and Molecular Toxicology. "But pesticides are already one of the most rigorously tested and regulated class of compounds, so we should be able to modify the existing infrastructure." One important concern, the researchers said, will be for manufacturers to disclose exactly what nanoparticles are involved in their products and what their characteristics are. Another issue is to ensure that compounds are tested in the same way humans would be exposed in the real world. "You can't use oral ingestion of a pesticide by a laboratory rat and assume that will tell you what happens when a human inhales the same substance," Stone said. "Exposure of the respiratory tract to nanoparticles is one of our key concerns, and we have to test compounds that way." Future regulations also need to acknowledge the additional level of uncertainty that will exist for nano-based pesticides with inadequate data, the scientists said in their report. Tests should be done using the commercial form of the pesticides, a health surveillance program should be initiated, and other public educational programs developed. Special assessments may also need to be developed for nanoparticle exposure to sensitive populations, such as infants, the elderly, or fetal exposure. And new methodologies may be required to understand nanoparticle effects, which are different from most traditional chemical tests. "These measures will require a coordinated effort between governmental, industry, academic and public entities to effectively deal with a revolutionary class of novel pesticides," the researchers concluded in their report.

Story Source:

The above story is reprinted (with editorial adaptations by *ScienceDaily* staff) from materials provided by **Oregon State University**, via EurekAlert!, a service of AAAS.

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Quantum Simulator and Supercomputer at the Crossroads



Matter-wave interference patterns across the BEC transition in the lattice: The image shows interference patterns of ultracold atoms released from an optical lattice at temperatures ranging from 10nK to 50nK (increasing from left to right). The experimental results (front row) perfectly match numerical quantum Monte Carlo simulations (back row) performed without free parameters. As the sample becomes colder sharp interference peaks appear (center), indicating the transition from a normal gas to a so-called superfluid. (Credit: MPQ)

ScienceDaily (Oct. 4, 2010) — MPQ-LMU scientists in an international collaboration measure for the first time a many-body phase diagram with ultracold atoms in optical lattices at finite temperatures.

Transitions between different phases of matter are a phenomenon occurring in everyday life. For example water -- depending on its temperature -- can take the form of a solid, a liquid or a gas. The circumstances that lead to the phase-transition of a substance are of fundamental interest in understanding emergent quantum phenomena of a many-particle system. In this respect, the ability to study phase transition between novel states of matter with ultracold atoms in optical lattices has raised the hope to answer open questions in condensed matter physics. MPQ-LMU scientists around Prof. Immanuel Bloch in collaboration with physicists in Switzerland, France, the United States and Russia have now for the first time determined the phase-diagram of an interacting many-particle system at finite temperatures.

Employing state-of-the art numerical quantum "Monte Carlo" methods implemented on a supercomputer, it was possible to validate the measurements and the strategies used to extract the relevant information from them. This exemplary benchmarking provides an important milestone on the way towards quantum simulations with ultracold atoms in optical lattices beyond the reach of numerical methods and present day super computers.

In the experiments, a sample of up to 300.000 "bosonic" rubidium atoms was cooled down to a temperature close to absolute zero -- approximately minus 273°C. At such low temperatures, all atoms in the ultracold gas tend to behave exactly the same, forming a new state of matter known as Bose-Einstein condensate (BEC). Once this state is reached, the researchers "shake" the atoms to intentionally heat them up again, thereby controlling the temperature of the gas to better than one hundredth of a millionth of a degree. The so-prepared ultracold -- yet not as cold -- gas is then loaded into a three-dimensional optical lattice. Such a lattice is created by three mutually orthogonal standing waves of laser light, forming "a crystal of light" in which the atoms are trapped. Much like electrons in a real solid body, they can move within the lattice and interact with each other repulsively. It is this analogy that has sparked a vast interest in this field, since it allows for the study of complex condensed matter phenomena in a tunable system without defects.

When being loaded into the optical lattice, the atoms can arrange in three different phases depending on their temperature, their mobility and the strength of the repulsion between them. If the strength of the repulsion between the atoms is much larger than their mobility, a so-called Mott-insulator will form at zero temperature in which the atoms are pinned to their lattice sites. If the mobility increases, a quantum phase transition is crossed towards a superfluid phase in which the wave functions of the atoms are delocalized over the whole lattice. The superfluid phase exists up to a transition temperature above which a normal gas is formed. This temperature tends to absolute zero as the phase transition between the superfluid and the Mott-insulator is approached -- a feature which is typical in the vicinity of a quantum phase transition.

In order to determine the phase of the atoms in the experiments, they are instantaneously released from the optical lattice. Now, according to the laws of quantum mechanics, a matter wave expands from each of the lattice sites, much like electromagnetic waves expanding from an array of light sources. And as in the latter case, an interference pattern emerges that reflects the coherence properties of the array of sources. It is this information of the coherence properties that the scientists are looking at in order to read out the many-body phase of the atoms in the artificial crystal: The normal gas in the lattice shows little coherence and almost no interference pattern would be visible after releasing the atoms. The superfluid, however, does exhibit long-range phase coherence which results in sharp interference peaks. By determining the temperature of the onset of these defined structures for various ratios of interaction strength and mobility, the researchers could map out the complete phase boundary between the superfluid and the normal gas.

Given the large number of particles and the size of the artificial crystal, it is extremely demanding to simulate the physics of the present systems on a classical computer. Only recently, suitable quantum Monte Carlo methods have been developed, that allow for the direct simulation of the experiments on up to ten billion lattice sites without significant simplification of the problem. They have been implemented at the ETH in Zurich on the "Brutus" computer cluster. With the simulation results, it was for the first time possible to directly determine the temperature of the lattice gas, to quantify heating rates in the optical lattice and to validate the strategies employed to determine the phase diagram. The numerical calculations, however, could last several days, up to weeks, where the experiments could be performed within one or two hours. This difference in the timescales shows the value of the experimental setup as a "quantum simulator" of numerous, more complex problems beyond the reach of state-of-the-art numerical methods.

Story Source:

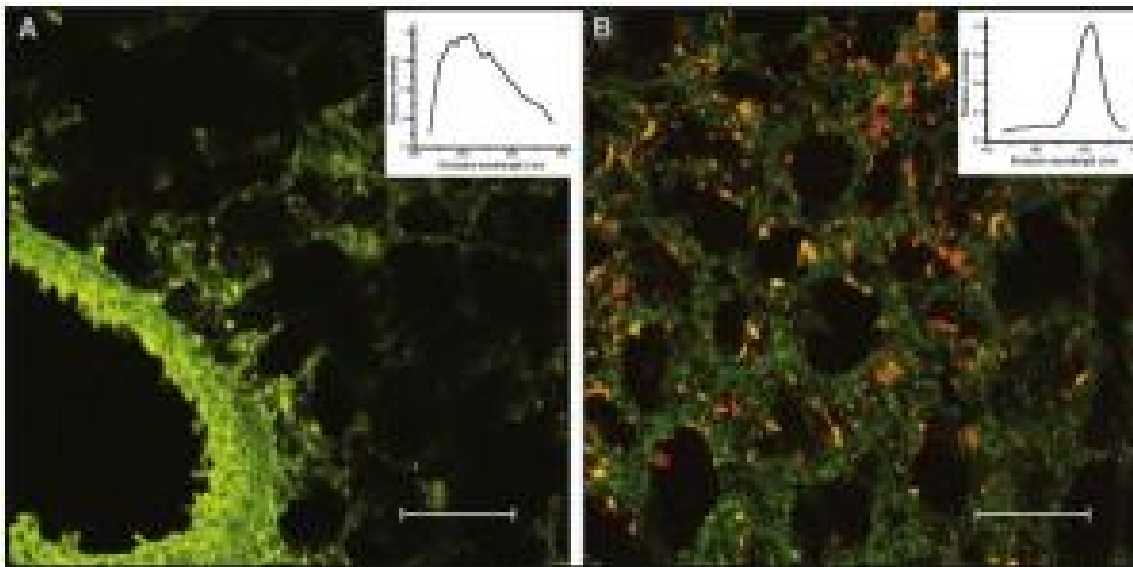
The above story is reprinted (with editorial adaptations by *ScienceDaily* staff) from materials provided by **Max Planck Institute of Quantum Optics**.

Journal Reference:

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<http://www.sciencedaily.com/releases/2010/10/101004101437.htm>

Cancer Drug Linked to Quantum Dots Increases Drug Uptake, Reduces Inflammation



The left image shows lung tissue injected with doxorubicin alone, while the image on the right (yellow dots) indicates the increased uptake of the quantum-dot delivered drug. (Credit: Image courtesy of University at Buffalo)

ScienceDaily (Nov. 3, 2010) — Researchers at the University at Buffalo have developed a novel technology using quantum dots that is expected to have major implications for research and treatment of tuberculosis, as well as other inflammatory lung diseases.

A paper appearing online in *Nanomedicine: Nanotechnology, Biology and Medicine* as an article-in-prepress describes specific delivery of a chemotherapeutic drug to specific cells in the lung, particularly the alveolar white cell, without causing acute inflammation.

Quantum dots are tiny semiconductor particles generally no larger than 10 nanometers that can be made to fluoresce in different colors depending on their size. Scientists are interested in quantum dots because they are a superb carrier and last much longer than conventional dyes used to tag molecules, which usually stop emitting light in seconds.

"The ability to target specific cells in the lung without exposing surrounding cells and tissue or distant organs to the detrimental effects of drugs is an exciting avenue to explore," says Krishnan V. Chakravarthy, PhD, a research fellow in the UB School of Medicine and Biomedical Sciences joint MD/PhD program and lead author on the paper.

"We have been able to prove this in both cultured cells and in animals," he continues. "The technology is still in its infancy, but being able to conduct these experiments in the whole animal makes it more promising as a clinical application. The long-term goal would be to do targeted drug delivery through aerosolized techniques, making it suitable for clinical use."

Researchers in UB's Institute of Lasers, Photonics and Biophotonics have made major advancements in the use of quantum dots, sometimes called artificial atoms, to build new devices for biological and environmental sensing.

In this research, quantum dots were linked with doxorubicin, an anti-cancer chemotherapy drug, to target specific lung cells, known as alveolar macrophages (aMØ) which play a critical role in the pathogenesis of various inflammatory lung injuries.

"The aMØ is the sentinel cell involved in directing the host innate and adaptive immune responses involved in infectious and non-infectious lung diseases such as COPD," notes Chakravarthy. "The aMØ's central role in

response to environmental influences makes these cells an ideal candidate for targeted drug delivery to modulate the immune/inflammatory response."

To test the ability of linked quantum dot-doxorubicin (QD-DOX) to decrease lung inflammation, the researchers delivered QD-DOX or doxorubicin alone to rats and mice and assessed the damage to the lung. Doxorubicin, a frequently used cancer drug, is known to cause a variety of damaging immune responses in cancer patients.

Results showed that QD-DOX increased uptake of the drug compared with doxorubicin alone, and did not cause as significant a pro-inflammatory response as doxorubicin alone. The researchers also demonstrated that the drug is released from the QD-DOX formulation once it is delivered into the targeted cell and still retains its bioactivity.

"Based on these results, we believe that linking quantum dots with therapeutic drugs may have tremendous potential for diagnosis and treatment of lung injury compared to other nanoparticle formulations, and should be further developed for lung pharmacotherapy applications," says Chakravarthy.

Additional authors on the paper, all from UB, are Bruce A. Davidson, PhD; Jadwiga D. Helinski; Hong Ding, PhD; Wing-Cheung Law; Ken-Tye Yong, PhD; Paras N. Prasad, PhD; and Paul Knight, MD, PhD.

The research is supported by grants from the National Institutes of Health to Chakravarthy, Knight and Prasad, and by a grant from John Oishei Foundation to Prasad.

Editor's Note: This article is not intended to provide medical advice, diagnosis or treatment.

Story Source:

The above story is reprinted (with editorial adaptations by ScienceDaily staff) from materials provided by [University at Buffalo](#).

Journal Reference:

1. Krishnan V. Chakravarthy, Bruce A. Davidson, Jadwiga D. Helinski, Hong Ding, Wing-Cheung Law, Ken-Tye Yong, Paras N. Prasad, Paul R. Knight. **Doxorubin-conjugated quantum dots to target alveolar macrophages and inflammation.** *Nanomedicine: Nanotechnology, Biology and Medicine*, 2010; DOI: [10.1016/j.nano.2010.09.001](https://doi.org/10.1016/j.nano.2010.09.001)

<http://www.sciencedaily.com/releases/2010/11/101101171238.htm>

Phenomenal Fabric: How Can a Cloth Clean Up Toxic Waste?



Activated carbon cloth. (Credit: Image courtesy of University of Abertay Dundee)

ScienceDaily (Nov. 3, 2010) — Ordinary-looking fabric can be used to filter out and destroy incredibly toxic materials, even when they're only present in tiny amounts, according to new research at the University of Abertay Dundee.

The research team found that activated carbon cloth -- which was originally developed at the Porton Down military research facility -- can be used to create extremely reactive chemicals called hydroxyl radicals. These are so unstable they instantly react with any pollutants, even at tiny concentrations of just a few parts per million.

This inexpensive material could be used on a small-scale in hospitals to filter out waste, or on a massive industrial scale to remove hard-to-detect chemicals that kill essential bacteria in our water system and risk human health.

Professor David Bremner, Chair of Applied Environmental Science at Abertay University, said: "There's been a lot of research into how activated carbon in powder or grain form can be used, but what we found is that using it as a fabric has a number of real advantages.

"There are many applications -- from a hospital to an industrial chemical plant -- where activated carbon cloth could be used to make incredibly sensitive filters, removing dangerous or unpleasant molecules even at very low concentrations.

"We also discovered that using activated carbon cloth in conjunction with the gas ozone (O₃) removes even more potentially dangerous organic content. This really is a step forward for the safety of waste treatment, and we're now working on developing more practical applications for this fascinating fabric."

The initial work was carried out as a knowledge-transfer partnership (KTP) with Carbon Filter Technology, a Kirriemuir-based company which produces different versions of the material which may be used for medical clean rooms, air and water filtration, and highly advanced wound dressings.

Company Director Ian Johnson explained the science behind the research: "Activated carbon cloth can effectively remove contaminants from the air, gas or liquids such as waste water.

"The fabric has countless tiny pores which adsorb the organic molecules onto the surface via weak Van der Waals forces. The pollutants then react with the oxidant (ozone) on the surface of the carbon cloth, converting them into smaller molecules or even carbon dioxide and water. The carbon cloth is really acting as a catalyst, promoting the decomposition of the pollutants."

He added: "The applications we're developing with Abertay University are very exciting, and it's great to be involved with a university that prides itself on working directly with businesses in real-world, applied settings. Hospital patients and industrial companies could both really benefit from this important research."



The original work on activated carbon cloth at Porton Down in the 1980s was focussed on developing a material that could protect soldiers from chemical attacks. Today one of the more recognisable uses for the fabric is the inside of chemical, biological and radiological warfare (CBR) suits for the military. Some of the other problems that could be solved using this technology include removing drugs like antibiotics from waste before they enter the sewage system, removing unpleasant odours from ostomy bags in hospitals and care homes, or for use as highly absorbent material to protect sensitive equipment. The research was recently published in the journal *Water Science & Technology*.

Story Source:

The above story is reprinted (with editorial adaptations by *ScienceDaily* staff) from materials provided by **University of Abertay Dundee**.

Journal Reference:

1. Rashmi Chand, Raul Molina, Ian Johnson, Anna Hans, David H Bremner. **Activated carbon cloth: a potential adsorbing/oxidizing catalyst for phenolic wastewater.** *Water Science & Technology*, 2010; 61 (11): 2817 DOI: [10.2166/wst.2010.091](https://doi.org/10.2166/wst.2010.091)

<http://www.sciencedaily.com/releases/2010/11/101102124424.htm>

Mediterranean Diet Helps Control Cholesterol: Adding Monounsaturated Fats to a Low-Cholesterol Diet Can Further Improve Levels

Plate with baked stuffed eggplants. The addition of dietary monounsaturated fat, common in the Mediterranean diet, is a current approach to raising HDL-C levels. (Credit: iStockphoto)

ScienceDaily (Nov. 3, 2010) — The addition of monounsaturated fat (MUFA) to a cholesterol-lowering dietary portfolio in patients with mild to moderate elevated cholesterol levels increased HDL by 12.5% and lowered LDL levels by 35%, found a study published in *CMAJ (Canadian Medical Association Journal)*.

Low HDL-C levels and high LDL-C levels are a risk factor for cardiovascular disease. The addition of dietary monounsaturated fat, common in the Mediterranean diet, is a current approach to raising HDL-C levels.

The study included 24 patients (17 men and 7 postmenopausal women) who completed a very low saturated fat diet before being randomly assigned to either a high-MUFA diet or a low- MUFA diet. Both groups of patients were assigned to a specific vegetarian diet which included oats, barley, psyllium, eggplant, okra, soy, almonds and a plant sterol enriched margarine. In the high-MUFA group, the researchers substituted 13% of calories from carbohydrates with a high-MUFA sunflower oil, with the option of a partial exchange with avocado oil.

They found significant reductions in blood cholesterol levels over the two month study period for participants. "The replacement of 13% of total calories from carbohydrate by monounsaturated fats in the dietary portfolio resulted in a 12.5% greater increase in HDL-C over the four weeks, while not altering the substantial LDL-C reduction," writes Dr. David Jenkins, Clinical Nutrition and Risk Factor Modification Centre, St. Michael's Hospital, Toronto, with coauthors.

Other strategies to raise HDL-C include exercise and moderate consumption of alcohol as well as weight loss and smoking cessation.

"The addition of MUFA increased HDL-C and therefore may further enhance the cardioprotective effect of the cholesterol-lowering dietary portfolio without diminishing its cholesterol-lowering effect," state the authors.

However, they state that the long-term effect on diets that are self-directed by patients needs to be determined as do cardiovascular outcomes.

Editor's Note: *This article is not intended to provide medical advice, diagnosis or treatment.*

Story Source:

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<http://www.sciencedaily.com/releases/2010/11/101101125939.htm>

Algae for Biofuels: Moving from Promise to Reality, but How Fast?

Algae is considered a prime candidate to serve as feedstock for biofuels because of its high energy content and yield, rapid growth and ability to thrive in seawater or wastewater. Oil from algae can be refined into gasoline, biodiesel or jet fuel. (Credit: Photo courtesy of Sandia National Laboratories)

ScienceDaily (Nov. 3, 2010) — A new report from the Energy Biosciences Institute (EBI) in Berkeley projects that development of cost-competitive algae biofuel production will require much more long-term research, development and demonstration. In the meantime, several non-fuel applications of algae could serve to advance the nascent industry.

"Even with relatively favorable and forward-looking process assumptions (from cultivation to harvesting to processing), algae oil production with microalgae cultures will be expensive and, at least in the near-to-mid-term, will require additional income streams to be economically viable," write authors Nigel Quinn and Tryg Lundquist of Lawrence Berkeley National Laboratory (Berkeley Lab), which is a partner in the BP-funded institute. Their conclusions stem from a detailed techno-economic analysis of algal biofuels production. The project is one of the over 70 studies on bioenergy now being pursued by the EBI and its scientists at the University of California at Berkeley, the University of Illinois in Urbana-Champaign, and Berkeley Lab.

The algae biofuels industry is still in its early gestation stage, the new report notes. Although well over 100 companies in the U.S. and abroad are now working to produce algal biomass and oil for transportation fuels, most are small and none has yet operated a pilot plant with multiple acres of algae production systems. However, several companies recently initiated such scale-up projects, including several major oil companies such as ExxonMobil (which a year ago announced a \$600 million commitment to algae biofuels technology), Shell (with a joint venture project, "Cellana," in Hawaii), and Eni (the Italian oil company, with a pre-pilot plant in Sicily).

The U.S. Department of Energy has funded several R&D consortia and pilot projects, and one 300-acre demonstration project in New Mexico, by Sapphire Energy, Inc. The U.S. Department of Defense is supporting several fast-track projects. In the United Kingdom, the Carbon Trust has initiated a 10-year effort to develop algae oil production, engaging a dozen universities and research laboratories, while the European Union recently funded three 25-acre pilot projects.

Most of these projects use the raceway, open pond-based algal production technologies, which were analyzed in the EBI Report. These projects hope to show that it is possible to mass culture algae with current or near-term technology within the technical and economic constraints required for biofuel production.





Once the technologies are developed, global resource availability will be a major controller of algae production, the report states. Four key resources (suitable climate, water, flat land and carbon dioxide) must all be available in one location for optimal algal biomass production. The authors state that despite the need for all four resources, algal oil production technology has the potential to produce several billion gallons annually of renewable fuel in the U.S. However, achieving this goal, particularly at competitive capital and operating costs, will require further research and development.

The EBI report focuses on algal biofuels produced in conjunction with wastewater treatment as a promising cost-effective strategy to fast-track development of a practical production process. Besides providing the needed water and nutrients, use of wastewater in algae production provides the potential for income from the treatment service provided.

The areas the study identified as essential for R&D are in both the biology and engineering fields. The ability to cultivate stable cultures under outdoor conditions, while achieving both high productivities and oil content, is still to be developed. Despite the well-known rapid growth rate of algae, increasing the volume of algae oil produced per unit of surface area per year is a crucial goal. Oil-rich algae strains that are biologically competitive with contaminating wild species and that consistently grow well in various climates are needed. Other key steps to be improved are low-cost harvesting of microscopic algae cells and the extraction of their oil content, as well as dealing with the biomass residue remaining after oil extraction.

The report's analysis includes five conceptual facilities for algae pond biofuel production, four of them 250 acres in size and one of 1,000 acres. All used municipal wastewater as the source of both water and nutrients, with some emphasizing production of oil, while others have wastewater treatment as their main priorities. Biofuel products included either biogas and oil or just biogas production, with the biogas used for electricity generation. The hypothetical location was the Imperial Valley in southern California, where the only major microalgae farms in the continental U.S. are presently located. In the scenarios, productivity peaks in the summer months but is essentially nil in the coldest winter months, with light and temperature being the main limiting factors.

Engineering designs and cost analysis for the various cases were based on projecting current commercial microalgae production and wastewater treatment processes at much larger scales. They assumed higher productivities due to plausible technological advances. The estimated capital costs for a 250-acre biofuel production system emphasizing oil production were about \$21 million, with annual operating costs at around \$1.5 million, to produce about 12,300 barrels of oil, giving a break-even price per barrel of oil of \$330 (based on an 8 percent capital charge). Increasing the scale of the system to 1,000 acres reduced the break-even price to about \$240 per barrel. These prices considered wastewater treatment credits, which reduced costs about 20 percent. Other facilities that maximized wastewater treatment produced fuel at lower cost due to greater treatment revenue. However, the availability of wastewater would greatly limit the national scale of this lower-cost fuel production.

Other co-products, specifically animal feeds, could help offset costs, but these products are of relatively low value or have very limited markets. "Wastewater treatment is the only realistic co-product for (algal) biofuels production," the report states. "Only through intensive, continuous, large-scale research with outdoor ponds can we hope to progress in a reasonable time frame."

The EBI scientists conclude that "algal oil production will be neither quick nor plentiful -- 10 years is a reasonable projection for the R, D & D (research, development and demonstration) to allow a conclusion about the ability to achieve, at least for specific locations, relatively low-cost algal biomass and oil production."

Story Source:

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<http://www.sciencedaily.com/releases/2010/11/101102131110.htm>

Positive Well-Being to Higher Telomerase: Psychological Changes from Meditation Training Linked to Cellular Health



New research shows that positive psychological changes that occur during meditation training are associated with greater telomerase activity. (Credit: iStockphoto/Inga Ivanova)

ScienceDaily (Nov. 3, 2010) — Positive psychological changes that occur during meditation training are associated with greater telomerase activity, according to researchers at the University of California, Davis, and the University of California, San Francisco. The study is the first to link positive well-being to higher telomerase, an enzyme important for the long-term health of cells in the body.

The effect appears to be attributable to psychological changes that increase a person's ability to cope with stress and maintain feelings of well-being.

"We have found that meditation promotes positive psychological changes, and that meditators showing the greatest improvement on various psychological measures had the highest levels of telomerase," said Clifford Saron, associate research scientist at the UC Davis Center for Mind and Brain.

"The take-home message from this work is not that meditation directly increases telomerase activity and therefore a person's health and longevity," Saron said. "Rather, meditation may improve a person's psychological well-being and in turn these changes are related to telomerase activity in immune cells, which has the potential to promote longevity in those cells. Activities that increase a person's sense of well-being may have a profound effect on the most fundamental aspects of their physiology."

The study, with UC Davis postdoctoral scholar Tonya Jacobs as lead author, was published online Oct. 29 in the journal *Psychoneuroendocrinology* and will soon appear in print. It is a product of the UC Davis-based Shamatha Project, led by Saron, one of the first long-term, detailed, matched control-group studies of the effects of intensive meditation training on mind and body.

"This work is among the first to show a relation between positive psychological change and telomerase activity. Because the finding is new, it should serve to inspire future studies to replicate and extend what we found," Jacobs said.

Elizabeth Blackburn, professor of biology and physiology at UCSF, is a co-author of the paper. Blackburn shared the 2009 Nobel Prize for physiology or medicine for discovering telomeres and telomerase. Other co-authors include UCSF colleagues Elissa Epel, associate professor of psychiatry; assistant research biochemist Jue Lin; and Owen Wolkowitz, professor of psychiatry.

Telomeres are sequences of DNA at the end of chromosomes that tend to get shorter every time a cell divides. When telomeres drop below a critical length, the cell can no longer divide properly and eventually dies.

Telomerase is an enzyme that can rebuild and lengthen telomeres. Other studies suggest that telomerase activity may be a link between psychological stress and physical health.

The research team measured telomerase activity in participants in the Shamatha Project at the end of a three-month intensive meditation retreat.

Telomerase activity was about one-third higher in the white blood cells of participants who had completed the retreat than in a matched group of controls.

The retreat participants also showed increases in such beneficial psychological qualities as perceived control (over one's life and surroundings), mindfulness (being able to observe one's experience in a nonreactive manner) and purpose in life (viewing one's life as meaningful, worthwhile and aligned with long-term goals and values). In addition, they experienced decreased neuroticism, or negative emotionality.

Using statistical modeling techniques, the researchers concluded that high telomerase activity was due to the beneficial effects of meditation on perceived control and neuroticism, which in turn were due to changes in mindfulness and sense of purpose.

The Shamatha Project is the most comprehensive longitudinal study of intensive meditation yet undertaken. The intensive meditation retreat took place at the Shambhala Mountain Center in Red Feather Lakes, Colo. The study included 30 participants each in the retreat and control groups. Participants received ongoing instruction in meditation techniques from Buddhist scholar, author and teacher B. Alan Wallace of the Santa Barbara Institute for Consciousness Studies. They attended group meditation sessions twice a day and engaged in individual practice for about six hours a day.

A control group of 30 people matched for age, sex, education, ethnicity and meditation experience was assessed at the same time and in the same place, but did not otherwise attend meditation training at that time. The Shamatha Project has drawn the attention of scientists and Buddhist scholars alike, including the Dalai Lama, who has endorsed the project.

Saron and his colleagues are now analyzing and publishing other findings from the project. In a paper published this summer in *Psychological Science*, Katherine MacLean, a recent UC Davis Ph.D. graduate now at Johns Hopkins University, reported that meditators were better at making fine visual distinctions and sustaining attention over a long period.

The group's next research article, currently in press in the journal *Emotion*, will describe a meditation-related reduction in impulsive reactions, which was linked in turn to enhancement in positive psychological functioning. UC Davis postdoctoral researcher Baljinder Sahdra is the lead author on that paper.

Additional co-authors on the current paper are: UC Davis graduate students Stephen Aichele, Anthony Zanesco and Brandon King; Sahdra, Associate Professor Emilio Ferrer and Distinguished Professor Phillip Shaver from the UC Davis Department of Psychology; consulting scientist Erika Rosenberg from the UC Davis Center for Mind and Brain; and from UC Irvine, graduate student David Bridwell of the Department of Cognitive Science.

Major support for the Shamatha Project comes from the Fetzer Institute and the Hershey Family Foundation. Additional support comes from numerous private foundations including the Baumann Foundation; the Tan Teo Charitable Foundation; the Yoga Research and Education Foundation; and individual donors. Individual researchers also received fellowship and other support from the National Science Foundation; the Social Sciences, Humanities Research Council of Canada; and the Barney and Barbro Fund.

Editor's Note: *This article is not intended to provide medical advice, diagnosis or treatment.*

Story Source:

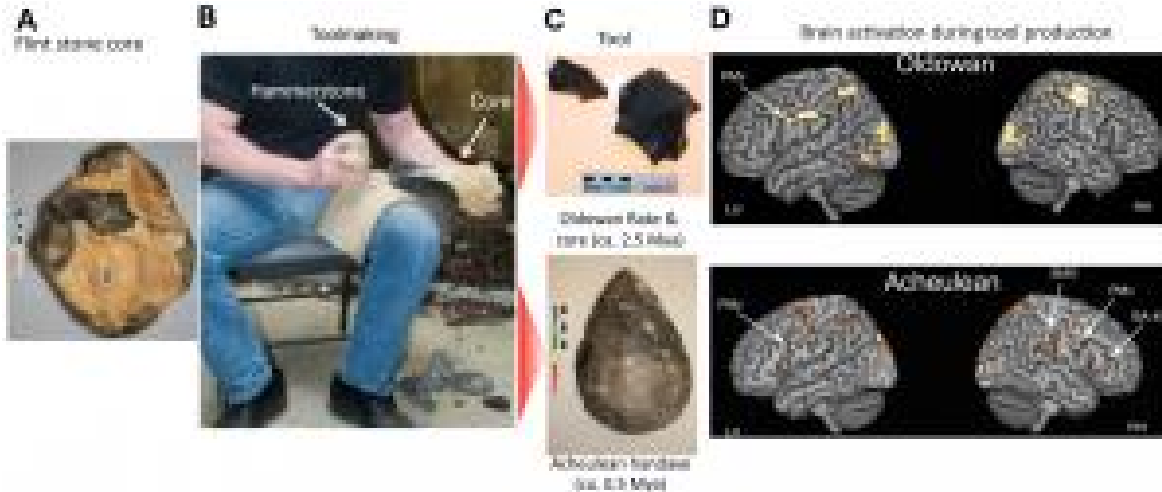
The above story is reprinted (with editorial adaptations by *ScienceDaily* staff) from materials provided by **University of California - Davis**.

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<http://www.sciencedaily.com/releases/2010/11/101103171642.htm>

Stone Age Humans Needed More Brain Power to Make Big Leap in Tool Design



A stone 'core' (A) is struck with a hammerstone (B) in order to detach sharp stone 'flakes'. In Oldowan toolmaking (C, top) the detached flakes (left in photo) are used as simple cutting tools and the core (right in photo) is waste. In Acheulean toolmaking (C, bottom), strategic flake detachments are used to shape the core into a desired form, such as a handaxe. Both forms of toolmaking are associated with activation of left ventral premotor cortex (PMv), Acheulean toolmaking activates additional regions in the right hemisphere, including the supramarginal gyrus (SMG) of the inferior parietal lobule, right PMv, and the right hemisphere homolog of anterior Broca's area: Brodmann area 45 (BA 45) (Imaging data adapted from [6]). (Credit: Image from Aldo Faisal, Dietrich Stout, Jan Apel, Bruce Bradley. *The Manipulative Complexity of Lower Paleolithic Stone Toolmaking*. *PLoS ONE*, 2010; 5 (11): e13718 DOI: 10.1371/journal.pone.0013718)

ScienceDaily (Nov. 3, 2010) — Stone Age humans were only able to develop relatively advanced tools after their brains evolved a greater capacity for complex thought, according to a new study that investigates why it took early humans almost two million years to move from razor-sharp stones to a hand-held stone axe.

Researchers used computer modelling and tiny sensors embedded in gloves to assess the complex hand skills that early humans needed in order to make two types of tools during the Lower Palaeolithic period, which began around 2.5 million years ago. The cross-disciplinary team, involving researchers from Imperial College London, employed a craftsman called a flintnapper to faithfully replicate ancient tool-making techniques. Reporting in the online journal *PLoS ONE*, the team say that comparing the manufacturing techniques used for both Stone Age tools provides evidence of how the human brain and human behaviour evolved during the Lower Palaeolithic period.

Neuroscientist Dr Aldo Faisal, the lead author of the study from the Departments of Bioengineering and Computing at Imperial College London, says: "The advance from crude stone tools to elegant hand-held axes was a massive technological leap for our early human ancestors. Hand-held axes were a more useful tool for defence, hunting and routine work. Interestingly, our study reinforces the idea that tool making and language evolved together as both required more complex thought, making the end of the Lower Palaeolithic a pivotal time in our history. After this period, early humans left Africa and began to colonise other parts of the world." Prior to this latest study, researchers have had different theories about why it took early humans more than 2 million years to develop stone axes. Some have suggested that early humans may have had underdeveloped motor skills or abilities, while others have suggested that it took human brains this time to develop more complex thoughts, in order to dream up better tool designs or think about better manufacturing techniques.

The researchers behind the study say that their evidence, from studying both tool-making techniques, confirms that the evolution of the early human brain was behind the development of the hand-held axe. Furthermore, the team suggest that the advancement of hand-held axe production may have also coincided with the development of language, as these functions overlap in the same regions of the modern and early human brains.

The flintnapper who participated in the study created two types tools including the razor-sharp flakes and hand-held axes. He wore a data glove with sensors enmeshed into its fabric to record hand and arm movements during the production of these tools.

After analysing this data, the researchers discovered that both flake and hand-held axe manufacturing techniques were equally complex, requiring the same kind of hand and arm dexterity. This enabled the scientists to rule out motor skills as the principal factor for holding up stone tool development.

The team deduced from their results that the axe-tool required a high level of brain processing in overlapping areas of the brain that are responsible for a range of different functions including vocal cords and complex hand gestures.

This is the first time that neuroscientists, archaeologists, anthropologists and flintnappers have teamed together, using cutting edge technology including data glove sensors and advanced modelling, to develop a deeper understanding of early human evolution.

In the future, the team plan to use their technology to compare tools made by Neanderthals, an extinct ancestor of humans, to glean insights into their brain development.

The study also included researchers from the Department of Anthropology, from Emory University; Department of Archaeology and Osteology, Gotland University College; and the Department of Archaeology, Exeter University.

Editor's Note: This article is not intended to provide medical advice, diagnosis or treatment.

Story Source:

The above story is reprinted (with editorial adaptations by ScienceDaily staff) from materials provided by **Imperial College London**, via EurekAlert!, a service of AAAS.

Journal Reference:

1. Aldo Faisal, Dietrich Stout, Jan Apel, Bruce Bradley. **The Manipulative Complexity of Lower Paleolithic Stone Toolmaking**. *PLoS ONE*, 2010; 5 (11): e13718 DOI: [10.1371/journal.pone.0013718](https://doi.org/10.1371/journal.pone.0013718)

<http://www.sciencedaily.com/releases/2010/11/101103171451.htm>

Current Global Warming May Reverse Circulation in Atlantic Ocean, as It Did 20,000 Years Ago



Drake Passage, South Atlantic Ocean. (Credit: iStockphoto)

ScienceDaily (Nov. 3, 2010) — Universitat Autònoma de Barcelona scientists researched how ocean currents in the Atlantic were affected by climate change in the past. The study shows that there was a period when the flow of deep waters in the Atlantic was reversed. The results are relevant for the near future since similar changes are expected to occur in the course of climate warming over the next 100 years.

The Atlantic Ocean circulation (termed meridional overturning circulation, MOC) is an important component of the climate system. Warm currents, such as the Gulf Stream, transport energy from the tropics to the subpolar North Atlantic and influence regional weather and climate patterns. Once they arrive in the North the currents cool, their waters sink and with them they transfer carbon from the atmosphere to the abyss. These processes are important for climate but the way the Atlantic MOC responds to climate change is not well known yet.

An international team of investigators under the leadership of two researchers from the UAB now demonstrates the response of the Atlantic MOC to climate change in the past. The new research results will be published on 4 November 2010 in the journal *Nature*. The research project was led by Rainer Zahn (ICREA researcher) and Pere Masque, both of the UAB at the Institut de Ciència i Tecnologia Ambientals (ICTA) and Department of Physics. With collaborators at the universities of Seville, Oxford and Cardiff (UK) they investigated the distribution of isotopes in the Atlantic Ocean that are generated from the natural decay of uranium in seawater and are distributed with the flow of deep waters across the Atlantic basin. The young investigator Cesar Negre studied the natural abundance of these isotopes in the seafloor sediments 2.5 km deep in the South Atlantic and achieved a PhD degree in the Environmental Science and Technology doctoral programme at ICTA.

The study shows that the ocean circulation was very different in the past and that there was a period when the flow of deep waters in the Atlantic was reversed. This happened when the climate of the North Atlantic region was substantially colder and deep convection was weakened. At that time the balance of seawater density between the North and South Atlantic was shifted in such a way that deep water convection was stronger in

the South Polar Ocean. Recent computer models simulate a reversal of the deep Atlantic circulation under such conditions while it is only now with the new data generated by UAB scientists and their colleagues from Seville and the UK that the details of the circulation reversal become apparent.

This situation occurred during the ice age 20,000 years ago. Although this was far back in time the results are relevant for our climate today and in the near future. The new study shows that the Atlantic MOC in the past was very sensitive to changes in the salt balance of Atlantic Ocean currents. Similar changes in seawater salt concentration are expected to occur in the North Atlantic in the course of climate warming over the next 100 years. Therefore the data to be published in *Nature* offer the climate modelling community the opportunity to calibrate their models and improve their capacity to predict reliably future ocean and climate changes. The research has been funded by the Spanish Ministry for Science and Innovation (MICINN).

Story Source:

The above story is reprinted (with editorial adaptations by *ScienceDaily* staff) from materials provided by **Universitat Autònoma de Barcelona**.

Journal Reference:

1. César Negre, Rainer Zahn, Alexander L. Thomas, Pere Masqué, Gideon M. Henderson, Gema Martínez-Méndez, Ian R. Hall, José L. Mas. **Reversed flow of Atlantic deep water during the Last Glacial Maximum.** *Nature*, 2010; 468 (7320): 84 DOI: [10.1038/nature09508](https://doi.org/10.1038/nature09508)

<http://www.sciencedaily.com/releases/2010/11/101103141541.htm>

Neutron Stars May Be Too Weak to Power Some Gamma-Ray Bursts; Black Holes May Be Power Source

This is an illustration of the collapse of a massive star in which the large envelope forms a rotationally supported disk and may even lead to a relativistic jet. This "collapsar" picture may explain at least one class of gamma-ray bursts, cosmic explosions that are a million trillion times as bright as the sun! Gamma-ray bursts last for anywhere from a few milliseconds to several minutes, and for that time they are the brightest source of gamma-rays in the entire observable Universe. The energy from one event is enough to supply the entire world's electrical energy needs for approximately a hundred million billion billion years. (Credit: Tony Piro/Caltech)

ScienceDaily (Nov. 3, 2010) — A gamma-ray burst is an immensely powerful blast of high-energy light thought to be generated by a collapsing star in a distant galaxy, but what this collapse leaves behind has been a matter of debate. A new analysis of four extremely bright bursts observed by NASA's Fermi satellite suggests that the remnant from a long-duration gamma-ray burst is most likely a black hole -- not a rapidly spinning, highly magnetized neutron star, or magnetar since such a burst emits more energy than is theoretically possible from a magnetar.

"Some of the events we have been finding seem to be pushing right up against this total limit for a neutron star progenitor system," said S. Bradley Cenko, a post-doctoral fellow from the University of California, Berkeley.

Cenko is presenting these findings Nov. 3 at the Nov. 1-4 Gamma Ray Bursts 2010 conference in Annapolis, Md. Cenko is a member of an international team that includes astronomers from UC Berkeley and the National Radio Astronomy Observatory (NRAO) in New Mexico.

The group has submitted a paper detailing its analysis to *The Astrophysical Journal*.

Long-duration gamma-ray bursts (GRBs) are presumed to be created by the explosive collapse in distant galaxies of massive stars. The explosion is visible from Earth because the light is emitted in a narrow cone, like a beam from a lighthouse. First discovered in 1967 by satellites looking for nuclear blasts on Earth, gamma-ray bursts have been the focus of several satellite missions, most recently NASA's Fermi gamma-ray space telescope, launched in 2008, and NASA's Swift satellite, launched in 2004.

With accumulating observations, astronomers have been able to create models of how the collapse of a rapidly rotating, massive star can accelerate matter to nearly the speed of light and collimate it into two oppositely directed, tightly focused beams along the spin axis. They have also studied how these particles generate gamma rays and other emissions.

The two leading candidates for powering these long-duration bursts are a magnetar and a black hole, sometimes referred to as a collapsar. In both cases, material from the star falls inward and is catapulted out by the spinning neutron star or black hole. What distinguishes these models is that magnetar-powered bursts cannot be as powerful as black hole-powered bursts.





"The question we have been trying to answer is: What is the true energy release from these events?" Cenko said. "We can measure all the light emitted -- very high energy gamma rays, and, at later times, X-ray, optical and radio afterglow emissions -- but that doesn't provide a very good estimate, because GRBs emit in relatively narrow jets. We have to get an idea of the geometry of this outflow, that is, how collimated the jets are."

Previous studies have shown that light measured in the afterglow begins to drop steeply at a certain point, and the sooner this drop-off, called a jet break, the narrower the jet. Typically, the gamma-ray burst itself lasts from a few seconds to as long as 100 seconds, but the afterglow, produced when the jets interact with gas and dust surrounding the star, emits visible light for a couple of weeks and radio radiation for several months. While Swift has observed hundreds of bursts in the past five years and notified astronomers within seconds of detection, the instruments aboard the satellite detect mostly medium-sized bursts that are not as highly collimated and that have a jet break many days or weeks after the burst.

Fermi's Large Area Telescope, however, is sensitive to very bright bursts with jet breaks within several days of the burst, making follow-up observations easier with Swift's X-ray and ultraviolet-optical telescopes and the ground-based Very Large Array, a radio telescope operated by NRAO.

Fermi detects few extremely bright bursts, however -- only four in 2009, Cenko said -- and does not notify astronomers for nearly a day afterward. Once alerted, however, Cenko's team was able to observe the optical, X-ray and radio afterglow of these four events, find the jet break and use this information, along with the star's distance calculated from its redshift, to estimate the total energy output.

If the energy from these bright bursts were emitted in all directions, it would be equivalent to the mass of the sun being converted instantaneously into pure energy. Because the gamma-ray burst was focused in a cone only a few degrees wide, however, the energies for all four bursts were about 100-1,000 times less than this. Theoretical models of how these beams are produced place a limit on how much energy a magnetar can generate in one of these explosive bursts: about 100 times less than if one converted the sun entirely into energy. Several of these bright bursts exceed this limit.

"The magnetar model is in serious trouble for such incredibly powerful events," noted coauthor Alex Filippenko, UC Berkeley professor of astronomy. "Even if the magnetar energy limit is not strictly violated, the tremendous efficiency required by this process strains credulity."

"In the future, we will be trying to make more precise measurements and be looking for more events to rule out a neutron star model," Cenko said.

Cenko and Filippenko's colleagues are post-doctoral fellows Nat R. Butler and Bethany E. Cobb, astronomy professor Joshua S. Bloom and graduate students Daniel A. Perley and Adam N. Morgan of UC Berkeley; Dale A. Frail of NRAO; Fiona A. Harrison, Mansi M. Kasliwal, Shrinivas R. Kulkarni and Vikram R. Rana of the California Institute of Technology; Joshua B. Haislip, Daniel E. Reichart, Aaron P. LaCluyze and Kevin M. Ivarsen of the University of North Carolina, Chapel Hill; Antonio Cucchiara and Derek B. Fox of Pennsylvania State University in University Park; Edo Berger of the Harvard-Smithsonian Center for Astrophysics in Cambridge, Mass.; Poonam Chandra of the Royal Military College of Canada in Kingston, Ontario; Jason X. Prochaska of the UCO/Lick Observatory at UC Santa Cruz; Karl Glazebrook of the Swinburne University of Technology in Victoria, Australia; Sebastian Lopez of the Universidad de Chile in Santiago; and Max Pettini of the University of Western Australia in Crawley.

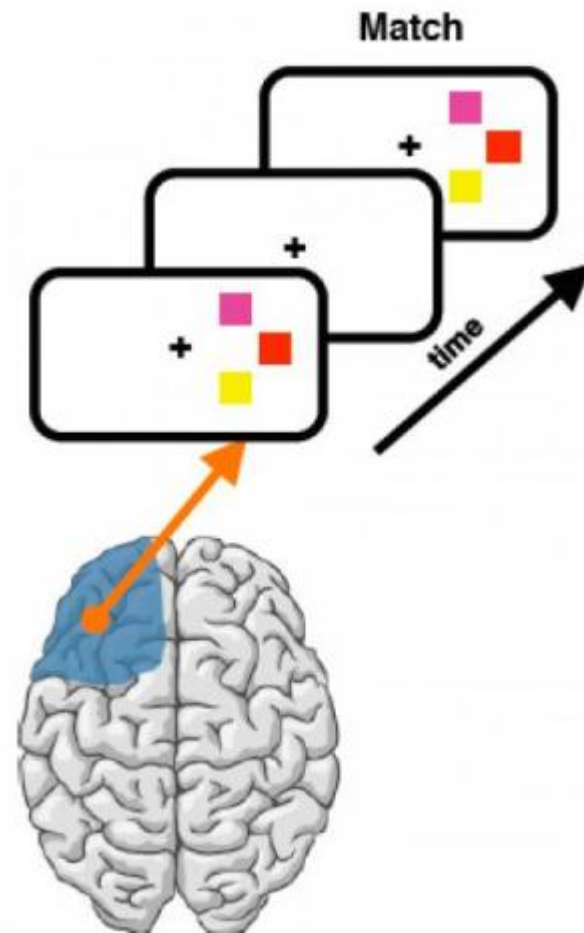
The work of Cenko and Filippenko is supported by Gary and Cynthia Bengier, the Richard and Rhoda Goldman Fund, NASA and the National Science Foundation.

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<http://www.sciencedaily.com/releases/2010/11/101103135247.htm>

Damage to Prefrontal Cortex Compensated by Intact Areas; 'Phantom' Images Stored in Flexible Network Throughout Brain



When images are presented to the right eye of a stroke patient with a lesion in the left prefrontal cortex, visual working memory is impaired. These patients perform poorly in a test requiring that they hold a "phantom image" of a screen display in their mind for up to a second in order to match a subsequent image. The intact right prefrontal cortex picked up some of the slack, however, showing that the brain can compensate for some memory loss. (Credit: Bradley Voytek, Robert Knight/UC Berkeley)

ScienceDaily (Nov. 3, 2010) — Brain research over the past 30 years has shown that if a part of the brain controlling movement or sensation or language is lost because of a stroke or injury, other parts of the brain can take over the lost function -- often as well as the region that was lost.

New research at the University of California, Berkeley, shows that this holds true for memory and attention as well, though -- at least for memory -- the intact brain helps out only when needed and conducts business as usual when it's not.

These results support the hypothesis that memory is not stored in one place, but rather, is distributed in many regions of the brain, which means that damage to one storage area is easier to compensate for.

"It's not just specific regions, but a whole network, that's supporting memory," said Bradley Voytek, a UC Berkeley postdoctoral fellow in the Helen Wills Neuroscience Institute and first author of two recent journal

articles describing EEG (electroencephalogram) studies of people with strokes. Voytek recently completed his Ph.D. in neuroscience at UC Berkeley.

"The view has always been, if you lose point A, point B will be on all the time to take over," said co-author Dr. Robert Knight, UC Berkeley professor of psychology and head of the Wills Institute. "Brad has shown that's not true. It actually only comes on if it's needed.

"Most of the time, it acts like a normal piece of brain tissue. It only kicks into hyperdrive when the bad part of the brain is particularly challenged, and it does it in less than a second. This is a remarkably fluid neural plasticity, but it isn't the standard 'B took over for A,' it's really 'B will take over if and when needed.'"

One of the papers, published Nov. 3 in the online edition of *Neuron* and scheduled for the Nov. 4 print issue of the journal, describes a study of stroke patients who have lost partial function in their prefrontal cortex, the area at the top front of each hemisphere of the brain that governs memory and attention.

Voytek put electrodes on the scalps of six stroke patients as well as six controls with normal prefrontal cortex function, and showed each patient a series of pictures to test his or her ability to remember images for a brief time, so-called visual working memory. Visual working memory is what allows us to compare two objects, keeping one in memory while we look at another, as when we choose the ripest of two bananas.

"We presented each subject with a really quick flash of a visual stimulus and then showed them a second one a little while later, and they had to say whether it was the same as the first," Voytek explained. "The idea is that you're building a representation of your visual world somehow in your brain -- and we don't know how that happens -- so that later you can compare this internal phantom representation you're holding in your mind to a real world visual stimulus, something you actually see. These patients can't do that as well."

EEGs provide millisecond measurements of brain activity, though they do not pinpoint active areas as precisely as other techniques, such as functional magnetic resonance imaging (fMRI). On the other hand, fMRI averages brain activity over seconds, making it impossible to distinguish split-second brain processes or even tell which occur first.

The neuroscientists discovered that when images were shown to the eye opposite the lesion (output of the left eye goes to the right hemisphere, and vice versa), the damaged prefrontal cortex did not respond, but the intact prefrontal cortex on the same side as the image responded within 300 to 600 milliseconds.

"EEG, which is very good for looking at the timing of activity in the brain, showed that part of the brain is compensating on a subsecond basis," Voytek said. "It is very rapid compensation: Within a second of challenging the bad side, the intact side of the brain is coming online to pick up the slack."

"This has implications for what physicians measure to see if there's effective recovery after stroke," Knight said, "and suggests that you can take advantage of this to train the area you would like to take over from a damaged area instead of just globally training the brain."

In a second paper that appeared online Oct. 4 in the journal *Proceedings of the National Academy of Sciences*, Voytek and Knight looked at visual working memory in patients with damage not only to the prefrontal cortex, but also to the basal ganglia. The basal ganglia are a pair of regions directly below the brain's cortex that are involved in motor control and learning and that are impaired in patients with Parkinson's disease.

The patients with stroke damage to the prefrontal cortex had, as suspected, problems when images were presented to the eye on the side opposite the lesion. Those with basal ganglia damage, however, had problems with visual working memory no matter which part of the visual field was shown the image.

"The *PNAS* paper shows that the basal ganglia lesions cause a more broad network deficit, whereas the prefrontal cortex lesions cause a more within-hemisphere deficit in memory," Voytek said. "This demonstrates, again, that memory is a network phenomenon rather than a specifically regional phenomenon."

"If you take out one basal ganglia, the logic would be that you would be Parkinsonian on half your body. But you're not," Knight said. "One basal ganglia on one side is able to somehow control fluid movement on both sides."

"Brad's data show that for cognitive control, it's just the opposite. One small basal ganglia lesion on one side has global effects on both sides of your body," he added. "This really points out that for this deep subcortical basal ganglia area, you need all of it to function normally. I don't think anybody would have really suspected that."

Knight hopes to conduct follow up studies using direct recordings from electrodes in the brain to further explore the various brain regions involved in visual memory and other types of memory and attention governed by the prefrontal cortex.

"Cognition and memory are the highest forms of human behavior," Knight said. "It is not just about raising or lowering your hand, or whether you can or cannot see. These are the things that make us human, and that is what makes it so interesting for us."

Other coauthors of the *Neuron* paper are Matar Davis and Elena Yago of UC Berkeley's Helen Wills Neuroscience Institute; Francisco Barceló of the Institut Universitari d'Investigació en Ciències de la Salut at the Universitat de les Illes Balears in Palma de Mallorca, Spain; and Edward K. Vogel of the University of Oregon in Eugene.

The work was supported by the National Institute of Neurological Disorders and Stroke of the National Institutes of Health, and by an American Psychological Association Diversity Program in Neuroscience grant to Voytek.

Editor's Note: *This article is not intended to provide medical advice, diagnosis or treatment.*

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Journal Reference:

1. Bradley Voytek, Matar Davis, Elena Yago, Francisco Barceló, Edward K. Vogel, Robert T. Knight. **Dynamic Neuroplasticity after Human Prefrontal Cortex Damage.** *Neuron*, 2010; 68 (3): 401-408
DOI: [10.1016/j.neuron.2010.09.018](https://doi.org/10.1016/j.neuron.2010.09.018)

<http://www.sciencedaily.com/releases/2010/11/101103135241.htm>

Hard Work Improves the Taste of Food, Study Shows



It's commonly accepted that we appreciate something more if we have to work hard to get it, and a Johns Hopkins University study bears that out, at least when it comes to food. (Credit: iStockphoto/Kai Zhang) ScienceDaily (Nov. 5, 2010) — It's commonly accepted that we appreciate something more if we have to work hard to get it, and a Johns Hopkins University study bears that out, at least when it comes to food. The study seems to suggest that hard work can even enhance our appreciation for fare we might not favor, such as the low-fat, low calorie variety. At least in theory, this means that if we had to navigate an obstacle course to get to a plate of baby carrots, we might come to prefer those crunchy crudités over sweet, gooey candy bars more easily accessible via the office vending machine.

"Basically, what we have shown is that if you have to expend more effort to get a certain food, not only will you value that food more, but it might even taste better to you," explained Alexander Johnson, an associate research scientist in the Department of Psychological and Brain Sciences at the Krieger School of Arts and Sciences at Johns Hopkins. "At present, we don't know why effort seems to boost the taste of food, but we know that it does, and this effect lasts for at least 24 hours after the act of working hard to get the food." The study, titled "Greater effort boosts the affective taste properties of food," appears in this week's issue of the *Proceedings of the Royal Society B*.

The study results are significant not only because they hold out hope that people who struggle to maintain a healthy weight could be conditioned to consume lower calorie foods, but because they also might provide insight into methods of altering other less-than-optimal behavior, according to Johnson, who led the study. Johnson teamed up on the project with Michela Gallagher, the Krieger-Eisenhower Professor of Psychological and Brain Sciences and Neuroscience and vice provost for academic affairs at Johns Hopkins. Using ordinary laboratory mice, the team conducted two experiments.

In the first, mice were trained to respond to two levers. If the mice pressed one lever once, they were rewarded with a sugary treat. Another lever had to be pressed 15 times to deliver a similar snack. Later, when given free access to both tidbits, the rodents clearly preferred "the food that they worked harder for," Johnson said.

In the second experiment, the team wanted to ascertain whether the animals' preference for the harder-to-obtain food would hold if those morsels were low-calorie. So half the mice received lower calorie goodies from a high-effort lever, and half got them from a low-effort lever. When both groups of mice were given free access to the low-calorie food later, those who had used the high-effort lever ate more of it and even seemed to enjoy it more than did the other group.

"We then analyzed the way in which the mice consumed the food," Johnson explained. "Why did we do this? Because food intake can be driven by a variety of factors, including how it tastes, how hungry the mice were beforehand, and how 'sated' or full the food made them feel."

Johnson and Gallagher used licking behavior as a measure of the rodents' enjoyment of their treats, and found that the mice that had to work harder for their low-cal rewards did, in fact, savor them more.



"Our basic conclusion is that under these conditions, having to work harder to get a certain food changes how much that food is valued, and it does that by changing how good that food tastes," Johnson said. "This suggests that, down the road, obese individuals might be able to alter their eating habits so as to prefer healthier, low calorie food by manipulating the amount of work required to obtain the food. Of course, our study didn't delve into that aspect. But the implications certainly are there."

The study was funded by grants from the National Institute of Diabetes and Digestive and Kidney Diseases and the National Institute of Mental Health.

Editor's Note: *This article is not intended to provide medical advice, diagnosis or treatment.*

Story Source:

The above story is reprinted (with editorial adaptations by ScienceDaily staff) from materials provided by **Johns Hopkins University**.

Journal Reference:

1. A. W. Johnson, M. Gallagher. **Greater effort boosts the affective taste properties of food.** *Proceedings of the Royal Society B: Biological Sciences*, 2010; DOI: [10.1098/rspb.2010.1581](https://doi.org/10.1098/rspb.2010.1581)

<http://www.sciencedaily.com/releases/2010/11/101104154344.htm>

Evolution by Religious Selection: Mexican Cavefish Develop Resistance to Toxin



Top: Atlantic molly. Bottom: Ceremony in the Cueva del Azufre. (Credit: Michael Tobler (top); Mona Lisa Productions (bottom))

ScienceDaily (Nov. 5, 2010) — A centuries-old religious ceremony of an indigenous people in southern Mexico has led to small evolutionary changes in a local species of fish, according to researchers from Texas A&M University.

Since before the arrival of Christopher Columbus to the New World, the Zoque people of southern Mexico would venture each year during the Easter season deep into the sulfuric cave Cueva del Azufre to implore their deities for a bountiful rain season. As part of the annual ritual, they release into the cave's waters a distinctive, leaf-bound paste made of lime and the ground-up root of the barbasco plant, a natural fish toxin. Believing the cave's fish to be gifts from their gods, they scoop up their poisoned prey to feed upon until their crops are ready to harvest.

However, a team of researchers led by Dr. Michael Tobler, an evolutionary ecologist at Oklahoma State University, and Dr. Gil Rosenthal, a biology professor at Texas A&M, has discovered that some of these fish have managed not only to develop a resistance to the plant's powerful toxin, but also to pass on their tolerant genes to their offspring, enabling them to survive in the face of otherwise certain death for their non-evolved brethren.

Their findings recently were published in the online journal *Biology Letters*.

Tobler has been studying the small, cave-dwelling fish species known as the Atlantic molly or *Poecilia mexicana* and its uncanny ability to survive in the toxic sulfur environment of Cueva del Azufre since 2004. He earned his Ph.D. from the University of Zurich in 2008 and spent the next two years as a postdoctoral research associate at Texas A&M, studying under Rosenthal and Dr. Kirk Winemiller, a professor in wildlife and fisheries science, as part of a two-year, \$79,000 Swiss National Science Foundation Postdoctoral Fellowship.

After learning about the Zoque people's sacred ritual and witnessing the event firsthand in 2007, Tobler and Rosenthal decided to investigate the effects of this peculiar ceremony on the mollies and their habitat. Ironically, it was the last ceremony ever held, as the Zoques ended the practice that year due to political pressure from the government, which sought to preserve the cave as a hotbed for tourism and potential revenue.

"We wanted to do a lab experiment where we exposed fish from different parts of the creek to barbasco," Tobler says. "Some of these fish had been more exposed than others."

In March 2010, the team collected molly specimens from two different areas of the cave annually exposed to the barbasco toxin as well as from two different areas upstream, further away from the Zoque's ritual. With both groups of fish in a single tank, they then introduced the barbasco root to determine how both groups would react.

They found that the mollies annually exposed to the barbasco indeed were more resistant than the fish further upstream -- to the extent that they were able to swim in the noxious water nearly 50 percent longer. Tobler and Rosenthal's group concluded that human beings had, over time, not only affected molly population dynamics, but also inadvertently kick-started the evolutionary process of natural selection as well. Mollies able to tolerate the poisonous conditions survived and passed those traits to their offspring, resigning those that perished to their fate of serving as a ceremonial feast for the Zoque.

"The cool thing is that this ceremony has gone on a long time and that the fish responded to it evolutionarily," Tobler says. "Lots of species couldn't live with these changes. It highlights how nature is affected by human activity."

Rosenthal contends that the idea of imposing evolutionary divergence on a species at an extremely localized spatial scale is not a new concept. In fact, he says, it's been happening since the beginning of humankind and that the idea of the "noble savage" is passé.

"We tend to have this wonderful Pocahontas idea that before Europeans came in, everything was pristine and in harmony with nature and that all of the changes in our environment have been post-industrialization," he explains. "No. People have been changing the environment forever." Moreover, Rosenthal says, once a species has become genetically adapted to human presence, it is not very easy to suddenly reverse.

Their ritual since banned, the Zoques still perform a mock ceremony each Easter season. Tobler, however, would like to see the Zoque's original ceremony resume, but in a way that is sustainable to nature as well as other cave inhabitants. The key, he and Rosenthal believe, is to find a balance between human activity and their environment. In the case of the Zoques, it may mean a few limitations on barbasco usage for their ritual, such as releasing the toxin only 50-to-60 meters into the cave rather than 100 meters.

Pending further resolution, Tobler will continue his research with the mollies at Oklahoma State, where they are housed in a special tank built to safely imitate their sulfuric living conditions in Cueva del Azufre.

"We need to understand what the impact really is on these fish rather than eliminate the ceremony completely," Tobler says. "We want to hopefully find a balance between the cultural practices of these people and the ecosystem."

Story Source:

The above story is reprinted (with editorial adaptations by ScienceDaily staff) from materials provided by [**Texas A&M University**](#).

Journal Reference:

1. M. Tobler, Z. W. Culumber, M. Plath, K. O. Winemiller, G. G. Rosenthal. **An indigenous religious ritual selects for resistance to a toxicant in a livebearing fish.** *Biology Letters*, 2010; DOI: [10.1098/rsbl.2010.0663](https://doi.org/10.1098/rsbl.2010.0663)

<http://www.sciencedaily.com/releases/2010/11/101105091811.htm>

Neanderthals Were More Promiscuous Than Modern Humans, Fossil Finger Bones Suggest



Fossilised hands of an early modern human (left) and Neanderthal (right). (Credit: Image courtesy of E. Trinkaus and the Israel Antiquities Authority)

ScienceDaily (Nov. 5, 2010) — Fossil finger bones of early human ancestors suggest that Neanderthals were more promiscuous than human populations today, researchers at the universities of Liverpool and Oxford have found.

Scientists, in collaboration with researchers at the universities of Southampton and Calgary, used finger ratios from fossilised skeletal remains of early apes and extinct hominins, as indicators of the levels of exposure species had to prenatal androgens -- a group of hormones that is important in the development of masculine characteristics such as aggression and promiscuity.

It is thought that androgens, such as testosterone, affect finger length during development in the womb. High levels of the hormones increase the length of the fourth finger in comparison to the second finger, resulting in a low index to ring finger ratio. Researchers analysed the fossil finger bone ratios of Neanderthals and early apes, as well as hominins, *Ardipithecus ramidus* and *Australopithecus afarensis*, to further understanding of their social behaviour.

The team found that the fossil finger ratios of Neanderthals, and early members of the human species, were lower than most living humans, which suggests that they had been exposed to high levels of prenatal androgens. This indicates that early humans were likely to be more competitive and promiscuous than people today.

The results also suggest that early hominin, *Australopithecus* -- dating from approximately three to four million years ago -- was likely to be monogamous, whereas the earlier *Ardipithecus* appears to have been highly promiscuous and more similar to living great apes. The research suggests that more fossils are needed to fully understand the social behaviour of these two groups.

Emma Nelson, from the University of Liverpool's School of Archaeology, Classics and Egyptology, explains: "It is believed that prenatal androgens affect the genes responsible for the development of fingers, toes and the reproductive system. We have recently shown that promiscuous primate species have low index to ring finger ratios, while monogamous species have high ratios. We used this information to estimate the social behaviour of extinct apes and hominins. Although the fossil record is limited for this period, and more fossils are needed to confirm our findings, this method could prove to be an exciting new way of understanding how our social behaviour has evolved."

Dr Susanne Shultz, from the Institute of Cognitive and Evolutionary Anthropology at the University of Oxford said: "Social behaviours are notoriously difficult to identify in the fossil record. Developing novel approaches, such as finger ratios, can help inform the current debate surrounding the social systems of the earliest human ancestors."



The research is supported by the British Academy Centenary Research Project, Lucy to Language and published in *Proceedings of the Royal Society B*.

Story Source:

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1. Emma Nelson, Campbell Rolian, Lisa Cashmore, Susanne Shultz. **Digit ratios predict polygyny in early apes, Ardipithecus, Neanderthals and early modern humans but not in Australopithecus.** *Proceedings of the Royal Society B*, 2010; DOI: [10.1098/rspb.2010.1740](https://doi.org/10.1098/rspb.2010.1740)

<http://www.sciencedaily.com/releases/2010/11/101103081915.htm>

For Bats, All Smooth, Horizontal Surfaces Are Water -- Even When They Look, Smell and Feel Differently



A Schreiber's bat (*Miniopterus schreibersii*), trying to drink from a smooth metal plate. (Credit: Image by Stefan Greif)

ScienceDaily (Nov. 4, 2010) — For bats, any smooth, horizontal surface is water. That's true even if vision, olfaction or touch tells them that the surface is actually a metal, plastic or wooden plate. Bats therefore rely more on their ears than on any other sensory system. This is due to how smooth surfaces reflect the echolocation calls of bats: they act just like mirrors. In nature there are no other extended, smooth surfaces, so these mirror properties prove to be a reliable feature for recognition of water surfaces.

Scientists from the Max Planck Institute for Ornithology in Seewiesen investigated this phenomenon in 15 different species from three big bat families and found that all tried to drink from smooth plates. In addition they found that this acoustic recognition of water is innate. The research appears in the journal *Nature Communications*.

Water is important for bats to get a drink. But many species also use rivers, lakes or ponds for foraging as water insects are soft and easily digestible. In addition prey is easily detectable with echolocation as the water surface acts like a mirror, reflecting the calls almost completely away. Only if there is an insect on the surface, it reflects back an echo.

In their study, Stefan Greif and Björn Siemers from the Max Planck Institute for Ornithology simulated water surfaces in a large flight room and offered the bats a smooth and a structured plate each from either metal, wood or plastic. In weak red illumination the researchers observed whether the bats would fall for this trick and try to drink from the smooth plate. They hardly couldn't believe what they saw: "The Schreiber's bat for example tried to drink up to a hundred times in ten minutes from the smooth plate," says Stefan Greif. Three different species, the greater mouse-eared bat, the Daubenton's bat and the greater horseshoe bat showed the same results on all three materials. Only from the wooden plates some bats tried to drink a bit less. To test how widespread this behaviour is, the scientists tested 11 additional species with one individual each on the metal plate -- likewise with a positive result. At least with the insect eating bats this behaviour thus seems to be widely spread.

The researchers were astonished that the animals did not learn that these artificial, acoustic mirrors are no water surfaces. They observed bats that accidentally landed on the smooth plate, took off again and after a few rounds flying resumed their drinking attempts. Even when the scientists placed the plate on a garden table, the bats flew partly underneath the table and then tried to drink, although this certainly is not a natural situation for a pond.

Echolocation dominates other sensory systems

The association of a smooth, horizontal surface with water seems to be very hardwired in a bat's brain. But how do they process the contradictory information coming from other sensory systems? Only in the world of echolocation the metal plate corresponds to water, other sensory systems like vision, olfaction and touch

surely tell the bat otherwise. The researchers repeated their experiment in darkness, thereby eliminating the input of vision. The result: the number of drinking attempts increased from 100 to 160 in ten minutes. "So it seems like the bats integrate and weigh up their sensory information, but echolocation dominates all the others," explains Stefan Greif.

Finally the scientists wanted to know if the acoustic information on water is fixed already in the animals' genes. They repeated the experiment with juveniles who had never seen a lake or a river before. Flightless juveniles were captured in a cave together with their mothers and were raised until they were able to fly. These young bats likewise tried to drink on first contact in their life with a smooth surface. The behaviour therefore seems to be not learned but innate.

In nature all smooth, horizontal surfaces might be bodies of water, but what about all those man-made smooth surfaces like skylights, car roofs or winter gardens? If bats so persistently take horizontal mirrors for water, do they also try to drink from these artificial surfaces until exhausted? This question remains unanswered so far. "We think that bats in nature have other possibilities. They show high site fidelity and probably have their established water surfaces. Maybe they try new surfaces, but eventually they will move on," speculates Stefan Greif. But future studies are needed to evaluate the occurrence, extent and potential ecological consequences of such a scenario.

Story Source:

The above story is reprinted (with editorial adaptations by *ScienceDaily* staff) from materials provided by **Max Planck Institute for Ornithology**, via [AlphaGalileo](#).

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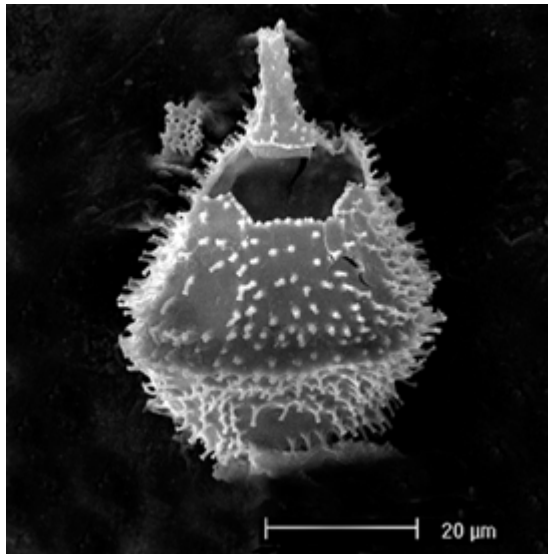
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The Heat Was On: Atmospheric CO₂ Triggered a Global Warming Event 40 Million Years Ago

In a new study scientists used "paleothermometers" to gauge CO₂ and temperatures that prevailed during a long-lived primordial global warming event, and found CO₂ to be the culprit

By [Mike Orcutt](#) November 4, 2010



HOT TIMES: Electron microscopic picture of microfossils found in the drill cores. By studying the remains of such marine plankton, scientists gain an accurate perspective of past climate change. Image: Appy Sluijs Atmospheric CO₂ was the primary driver of a 400,000-year [global warming](#) event, known as the middle Eocene climatic optimum (MECO), according to a new study. The finding, which could help climatologists better understand the precise relationship between CO₂ concentration and climate change today, is described in the November 5 issue of *Science*.

The climate trend across the entire [Eocene](#), an epoch between 55 million and 34 million years ago, was actually characterized by long and gradual cooling. Much of that activity took place during the middle Eocene, when the planet transitioned from a warmer climate to a cooler one. But the MECO (about 40 million years ago) interrupted that trend, representing the last major temperature increase before the end of the epoch, which was marked by Antarctic glaciation. In order to investigate the role of CO₂ during this warming episode, researchers analyzed sediment taken from deep beneath the ocean floor off the eastern coast of Tasmania. The core contained a record of fossils that spanned the relevant time interval.

The researchers relied on two separate organic proxies, also called paleothermometers, to reconstruct changes in sea-surface temperature during the MECO. Both are based on variation—due to temperature change—in structural characteristics of the molecular remains of specific microorganisms. In other words, the team analyzed specific molecules in which certain variations are known to be reflective of temperature change.

The MECO has for a long time been enigmatic to climate researchers, says study co-author Alexander Houben, a paleoecologist at Utrecht University in the Netherlands. Although there is lots of evidence for a large-scale temperature increase during this time, so far it's all been based on a different proxy: the occurrence of a specific oxygen isotope in ancient carbonate samples. Oxygen isotope values, however, are influenced not only by temperature, but also by seawater composition and changes in ocean ice flow. This study for the first time employs two independent proxies that "can clearly differentiate between temperature changes and other factors," Houben says. The authors report that the paleothermometers indicated a warming of the sea surface during the MECO, at least in the southwestern Pacific, by 3 to 6 degrees Celsius.

To figure out how much atmospheric CO₂ increased during the MECO, the researchers reconstructed the changes in its concentration by determining the ratio of stable carbon isotopes in organic molecules called alkenones. Variation in the composition of these molecules, produced by algae, can serve as an indicator of atmospheric CO₂. Isotopic proportions are also influenced by the growth rate of the algae, which is proportional to the available food and nutrients in the water. So the authors considered multiple scenarios to account for variations in nutrient availability, concluding that CO₂ concentration increased by a factor of two to three during the MECO.

James Zachos, a professor of Earth and planetary sciences at the University of California, Santa Cruz, who specializes in the time period and methodology used the study, said in an e-mail to Scientific American that apart from what may be an overestimation of the mean partial pressure of CO₂, and the magnitude of its rise, "the data look reasonable." The study adds value, he says, because "the application of multiple proxy records in one core to reconstruct climate is unique, at least for this time interval."

The MECO makes for a useful "historical laboratory," Houben says, within which climate dynamics can be studied over a much longer timescale compared with other historical warming events of interest to climate researchers. By investigating CO₂ variations and temperature dynamics over longer periods, researchers can obtain a clearer understanding of the still partly unknown role played by long-term climate feedbacks, such as changes in the ocean's carbon chemistry and/or large-scale changes in vegetation.

Currently, climatologists have a much better understanding of the role short-term feedbacks, such as changes in water vapor or sea ice. Incidentally, there were no glaciers at the time of the MECO, so Houben's group could look exclusively at the relationship between CO₂ and temperature without having to account for the fact that changes in the amount of sea ice can increase temperature, too. "We've shown that if you include those long-term factors, then CO₂ might very well be the leading factor for temperature increase, especially in a world without a major ice sheet," Houben says.

The result, he says, will help climatologists get a better grip on the concept of climate sensitivity—the degree to which a global temperature increase is entirely dependent on an accompanying rise in CO₂. The authors conclude that the climate sensitivity during the MECO led to a 2- to 5-degree C increase per doubling of atmospheric CO₂.

The study does leave one big question outstanding: Where did all the MECO CO₂ come from? This remains an area of speculation, Houben says, although scientists are fairly sure the source was not organic. However the CO₂ got there, the takeaway from this study is simple: "In the past," Zachos says, "whenever atmospheric carbon dioxide levels rise, the climate warms."

<http://www.scientificamerican.com/article.cfm?id=the-heat-was-on-atmospheric>

Architects Vie to Design the City of the Future--On the Moon

The Moon Capital competition brought out new visions of lunar living, circa 2069

By Cynthia Graber November 4, 2010



Image: SHIFTBoston

BOSTON—The moon has long loomed large as the next logical site for human expansion, a frontier land still lightly explored but visible to all throughout human history. With the recent discovery of a significant volume of water on the lunar surface, the idea of the moon as a livable habitat has become just that much more plausible. A new competition, Moon Capital, turned the question of what that habitat will look like over to the imagination of architects, engineers and artists. Let's say it is the year 2069, exactly a century after the first lunar landing. The colony has finally been built. What does it look like? What do the moon-dwellers need both to survive and to enjoy their new surroundings?

The competition was sponsored by SHIFTBoston, an organization dedicated to the future of the urban environment, together with the Google Lunar X PRIZE and the NASA Johnson Space Center (JSC), to name a few.

The call for ideas encouraged applicants to propose submissions ranging from the practical—what will people need to live, and how will they do so?—to radical, creative solutions for the moon as a travel destination. More than 100 designs poured in from around the world. Some planners built entire cities with detailed descriptions of how to fulfill the inhabitants' living needs. Others took a more fantastical approach, designing whimsical sports venues or suggesting the modification of DNA to create organisms better able to function in an extraterrestrial environment.

The goal, say the sponsors and jurors, was to inspire a new generation to turn their creativity to the heavens, and perhaps, in the process, to arrive at visions that might inspire current space engineers and architects. "It's a great opportunity to dream," says juror Guillermo Trotti, an architect who has worked extensively with NASA on projects such as the International Space Station. "Missions start with dreams, and the whole future of NASA is in the dreams of the people."

The winning designs, awarded October 21, will become part of a Moon Capital exhibit at JSC and at a location to be decided in Boston.

<http://www.scientificamerican.com/article.cfm?id=moon-capital>

Ain't That a Shame?

By **ERIC FELTEN**

Last year, seniors at Dartmouth and Cornell found themselves getting strong-armed to contribute to their parting "class gifts." The student fund raisers were given lists of those who had donated—and of those who had yet to. As the Chronicle of Higher Education recently reported, the eager young rainmakers then set about using the obligatory social-networking tools to shame their peers into ponying up.

It soon got ugly. At Dartmouth, when one holdout remained, a columnist for the student newspaper denounced her—though not by name. That happened the next day on a student blog, where a writer called her a "parasite," posted her name and picture, and sneered, "You're not even worth the one measly dollar that you wouldn't give."

[View Full Image](#)



The Art Archive/Alamy

Tommaso Masaccio's 'The Expulsion of Adam and Eve From Eden.'

Welcome to the new world of shaming, in which the ancient fear of public humiliation and ostracism (once a homely, low-tech business of the stocks and pillories) has become a high-tech tool to motivate and incentivize. Where once such tactics were used to enforce a traditional moral code, today they have found new life in nudging us to conform to "prosocial" behavior, be it philanthropy or strict adherence to the expansive pieties of our reigning civic religion, environmentalism.

America has a long (and many have argued, shameful) history of shaming. Things got going in earnest in 1639 when Plymouth colonist Mary Mendame was found to have committed "the act of uncleanness" with

an Indian named Tinsin. The judge sentenced her "to be whipt at a carte tayle through the townes streete, and to weare a badge upon her left sleeve." And if the proto-Prynne failed to wear her scarlet letter, she was "to be burned in the face with a hott iron."

Today, the tradition lives on. Several northeastern states "name and shame"—usually by means of online lists—citizens behind on their taxes. For some officials, though, even that approach is too discreet. Last Sunday, the city of Holyoke, Mass., publicized the names of delinquent taxpayers in the local newspaper. The goal, explained City Treasurer Jon D. Lumbra, was to shame those people into paying what they owed. (Mr. Lumbra did not say whether the city will seek to have the scofflaws wear a scarlet "T.")

Such efforts are ham-fisted. The advocates of bringing social pressure to bear on modern ne'er-do-wells generally push for more subtle forms of public pressure. Earlier this year, the District of Columbia instituted a tax on disposable shopping bags. Supermarkets in Washington now charge five cents for every plastic bag, and you have to specifically request one. But the expected revenues have not materialized because the number of bags used by shoppers has plummeted. Environmental advocates are delighted, but note that the tax alone can't account for the dramatic drop in revenues. It's unlikely that the average Washingtonian is deterred by the small tax incurred on a dozen bags when paying a \$300 grocery bill. They argue that shaming gets the credit. Shoppers are hesitant to expose their lack of eco-virtue to the withering stares of the good citizens behind them in the checkout line. As Councilman Tommy Wells, the District's prime bag-tax cheerleader, recently told the *Journal*, "It's more important to get in their heads than in their pocketbooks."

When it comes to the criminal code, shaming can be a lot cheaper than incarceration. The last decade saw something of a fad for shame-based punishments, among them fitting "humility tags" to the cars of convicted drunk drivers, and making petty thieves wear signs proclaiming their offenses. The "communitarian" thinkers behind shaming argue that the practice not only encourages public decency but allows society to make unambiguous moral statements about what behaviors are beyond the pale. In practice, the behaviors that warrant such a response seem to be such things as insufficient effort to reduce one's carbon footprint.

The Internet has done much to promote our peculiarly modern sort of shaming. Annoy the wrong person, behave in a way some blogger disdains, and you will soon find yourself locked in the digital pillory, exposed to snark and ridicule. These are supposed to be salubrious incentives to civil public behavior, but I haven't seen much evidence that a Web-armed society is a polite one.

The most odious aspect of these online humiliations is that they don't go away. As law professor Daniel J. Solove notes in his book *"The Future of Reputation,"* the Internet saddles us with permanent digital baggage: "Internet shaming creates an indelible blemish on a person's identity. Being shamed in cyberspace is akin to being marked for life."

The old colonists eventually thought better of the practice. Even as hanging remained a common punishment, shaming was deemed inhumane and eventually abandoned.

As efforts to prod us with the threat of shame grow, it's worth keeping in mind that the tactic only works if we go along. The Dartmouth student who chose not to donate to the school didn't back down, publicly stating "I resent the pressure that was applied to me." Soon it was the college that was backtracking: A Dartmouth fund-raising official said they "deeply regret" the violation of the student's privacy and that changes would be made to the way class gifts are solicited. Cornell is also re-emphasizing respect for privacy in asking for donations. The British philosopher-politician Edmund Burke urged "adherence to principle," and warned against succumbing to threats of humiliation: "It is a power of resisting false shame and frivolous fear, that assert our good faith and honor, and assure to us the confidence of mankind."

Then again, he never had to ask for a disposable plastic grocery bag.

—Write me at EricFelten@wsjpostmodern.com

<http://online.wsj.com/article/SB10001424052748703805704575594502531418866.html#>

University Of Greenwich Project To Create 'Living' Buildings

05 November 2010 [Greenwich, University of](#)

The University of Greenwich's School of Architecture & Construction is poised to use ethical synthetic biology to create 'living' materials that could be used to clad buildings and help combat the effects of climate change.

Researchers from the University of Greenwich are collaborating with others at the University of Southern Denmark, University of Glasgow and University College London (UCL) to develop materials that could eventually produce water in desert environments or harvest sunlight to produce biofuels.

In collaboration with an architectural practice and a building materials' manufacturer, the idea is to use protocells - bubbles of oil in an aqueous fluid sensitive to light or different chemicals – to fix carbon from the atmosphere or to create a coral-like skin, which could protect buildings.

Professor Neil Spiller, an architect and the new head of the University of Greenwich's School of Architecture & Construction, said the research team was looking at methods of using responsive protocells to clad cities in an ethical, green and sustainable way.

“We want to use ethical synthetic biology to create large-scale, real world applications for buildings,” he says.

Protocells made from oil droplets in water allow soluble chemicals to be exchanged between the drops and their surrounding solution.

The Center for Fundamental Living Technology at the University of Southern Denmark has managed to get cells to capture carbon dioxide from solution and convert it into carbon-containing materials. Such cells could be used to fix carbon to create ways of building carbon-negative architecture.

An installation displayed in the Canadian Pavilion in the Venice Biennale 2010, *Hylozoic Ground*, created by Canadian architect Philip Beesley, provides an example of how protocells may be used to create carbon-negative architectures. Protocells situated within the installation designed by Dr Rachel Armstrong, Teaching Fellow at UCL's Bartlett School of Architecture, recycle carbon dioxide exhaled by visitors into carbon-containing solids. Similar deposits could be used to stabilise the city's foundations by growing an artificial limestone reef beneath it.

“We want to use protocell bubbles to fix carbon or precipitate skin that we can then develop into a coral-like architecture, which could petrify the piles that support Venice to spread the structural weight-load of the city,” Professor Spiller said.

Under Professor Spiller's leadership, Greenwich's School of Architecture & Construction is bringing a host of new technologies – such as nano, digital and synthetic biology technologies – into architectural practice.



<http://www.alphagalileo.org/ViewItem.aspx?ItemId=89075&CultureCode=en>