Infoteca's E-Journal

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Effect of music on cognitive function

Playing an instrument seems to make learning math and foreign languages easier, but researchers aren't sure why.

By Melissa Healy

March 1, 2010

Taylor Bredberg is an ardent fan of the indie band Grizzly Bear and the TV series "Lost," an amateur filmmaker and a doodler of figures that bring to mind Tim Burton's kinetic grostesques.
But if those interests make him a pretty normal teenager, Bredberg's eight-year relationship with the piano may have made him a little more unusual: He is a kid with the attention span of an anesthesiologist, the persistence and discipline of an Olympic athlete and the emotional range of an artist.
"Piano has shaped me, yeah," says Bredberg, who began taking lessons after his family discovered him, at 7, plinking out on his own the pieces his older sister was learning in lessons. "In terms of discipline and creativity, I'd have been a much different person if I hadn't played piano."
Once a week, Bredberg studies the instrument at the elite Colburn School for Performing Arts in Los Angeles. And he practices for several hours a day, favoring pieces by the Russian composers who are his favorites: Rachmaninoff, Prokofiev, Shostakovich and Stravinsky. When he feels more delicate, he favors Debussy.
As a freshman, Bredberg has been learning to speak Russian as well, and he finds Algebra 2 a cinch. "It's always been pretty understandable to me. It's very logical," he says. He recognizes the challenge of learning math as one that requires the same methodical patience it takes to learn Prokofiev's 3rd Sonata in A minor, his current project: "I've just gotten used to repeating one phrase until I can play it at the proper speed, and well, and musically," he says. "I guess that can contribute to not getting frustrated after having to repeat so many [math] problems."
Kids like Taylor Bredberg underscore a key problem that researchers have in understanding the link between music-making and cognitive performance. Bredberg hails from the kind of educated family in which music instruction is more common to begin with — an environmental advantage that may account for his particular mental strengths. To truly learn what music-making can do for academic skills, researchers say they must pluck kids from a wider range of family environments and offer them music lessons, rather than just study kids whose families have sought out musical instruction for them. That's the only way they will be able to disentangle the effects of early environment from those of musical instruction, they say.

http://www.latimes.com/features/health/la-he-0301-brain-music-kids-20100301,0,3845859.story

Internet 'threatens' rare species

Conservationists say the internet has emerged as one of the biggest threats to endangered species.

Campaigners say it is easier than ever before to buy and sell anything from live baby lions to polar bear pelts on online auction sites and chatrooms.

The findings were presented at the 175-nation Convention on International Trade in Endangered Species (Cites), which is meeting in Doha, Qatar.

Several proposals to give endangered species more protection were defeated.

Delegates will vote on changes to the trade in ivory later this week.

Web effect

"The internet is becoming the dominant factor overall in the global trade in protected species," said Paul Todd of the International Fund for Animal Welfare.

He said thousands of endangered species are regularly traded on the internet, as buyers and sellers take advantage of the anonymity - and vast global market - the world wide web can offer.

Those trying to police illegal sales say the size of problem is almost impossible to estimate. They say the US is the biggest market, but that Europe, China, Russia and Australia also play a large part.

On Sunday, delegates voted to ban all international trade in a rare type of Iranian salamander, the Kaiser's Spotted Newt, which the World Wildlife Fund says has been devastated by the internet trade.

However, more high-profile attempts to ban trade in polar bears, bluefin tuna and rare corals have all failed, leaving environmental activists dismayed, the BBC's Stephanie Hancock reports from Doha.

A proposal from the US and Sweden to regulate the trade in red and pink coral - which is crafted into expensive jewellery and sold extensively on the web - was defeated.

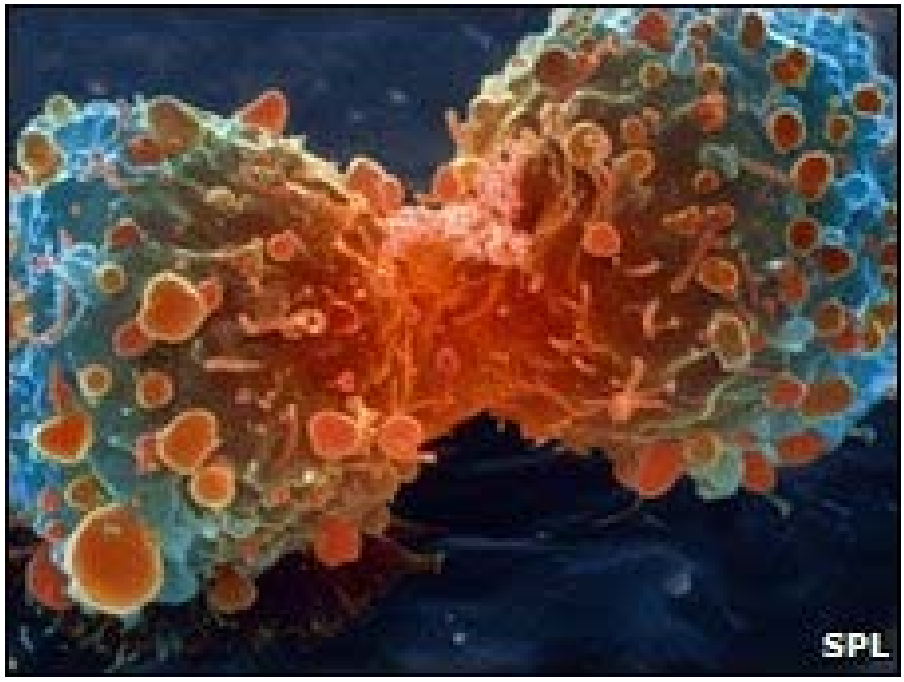
Delegates voted the idea down mostly over concerns the increased regulations might impact poor fishing communities.

Story from BBC NEWS:
http://news.bbc.co.uk/go/pr/fr/-/2/hi/science/nature/8579310.stm

Published: 2010/03/21 23:56:57 GMT

Non-smokers lung cancer gene clue

A gene that could help explain why some non-smokers develop lung cancer has been pinpointed by US researchers.



It is hoped that further research into the GPC5 gene could open the way for new targeted treatments as well as picking out those at high risk.

But Cancer Research UK said more work was needed to work out the exact reason for the link.

A quarter of lung cancers globally occur in people who have never smoked, The Lancet Oncology reports.

" **Smoking causes 90% of lung cancers, but there is still a significant number of non-smokers who develop the disease** "
Dr Kat Arney, Cancer Research UK

In the UK, 10% of lung cancers develop in people who do not smoke.

The researchers said lung cancer in non-smokers was an increasing problem but the causes were not well understood.

DNA samples from 754 people who had smoked fewer than 100 cigarettes in their lifetime were scanned to find the genetic differences that seemed most likely to affect the risk of lung cancer.

When chronic respiratory disease, exposure to second-hand smoke and family history of lung cancer were taken into account, two sections of the genome seemed to be key.

Confirmation

The team then took the 44 most common genetic alterations seen in the first part of the study and studied them in two other groups of non-smokers - half of whom had been diagnosed with lung cancer.

The same two genetic marks were significant.

A third study of 530 patients confirmed the result.

Closer analysis showed that these two bits of the genome were responsible for switching on and off the GPC5 gene.

Further tests showed that activity of the GPC5 gene was 50% lower in adenocarcinoma - the most common form of lung cancer - than in normal lung tissue.

The researchers believe that this lower activity of the gene could contribute to the development of cancer in people who do not smoke.

In a comment piece published alongside the study, Dr Ramaswamy Govindan, from Washington University School of Medicine, said "it is far from clear" how the finding could predispose people to lung cancer.

"More studies are needed to confirm these preliminary observations in the tumour samples from those with no history of tobacco smoking."

Dr Kat Arney, Cancer Research UK's science information manager, said: "Smoking causes 90% of lung cancers, but there is still a significant number of non-smokers who develop the disease.

"These new results could help to explain why, but much more work needs to be done to understand exactly how these gene variations are linked to lung cancer risk."

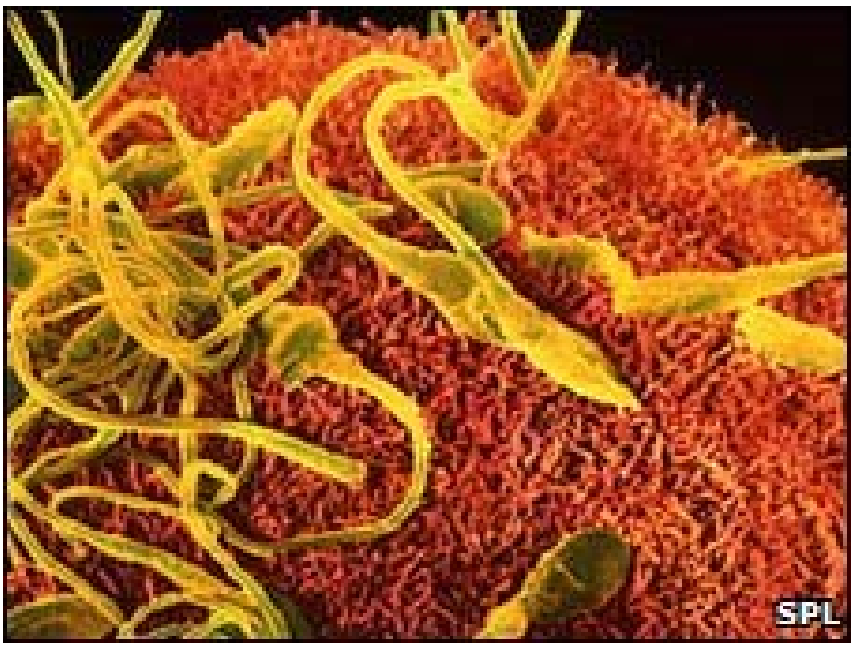
Story from BBC NEWS:
http://news.bbc.co.uk/go/pr/fr/-/2/hi/health/8576080.stm

Published: 2010/03/22 00:01:42 GMT

Infertility prostate cancer clue

By Helen Briggs
Health reporter, BBC News

Infertile men may have a higher risk of developing prostate cancer, US data suggests.



Researchers looked at the cancer records of men attending infertility clinics in California.

They found men unable to father a child were nearly three times more likely to be diagnosed with prostate cancer than normal.

The authors of the study, published in the journal Cancer, say more work must be done to confirm the possible link.

If confirmed, it might be appropriate for infertile men to be given early prostate cancer screening, they say.

" **It's unlikely that being infertile directly leads to prostate cancer.** "
Ed Yong, Cancer Research UK

Study leader, Dr Thomas Walsh of the University of Washington in Seattle said: "These are some of the first data to suggest that male reproductive health in early life may be a risk factor for serious malignant disease in later life.

"It is important for investigators and physicians to do further research to find out what might be the common underlying cause that may lead to both infertility and later the development of prostate cancer."

Risk factors

Prostate cancer is the most common cancer in men. Risk factors include age, family history and ethnicity.

SIGNS OF PROSTATE CANCER
- Having to rush to the toilet to pass urine
- Difficulty in passing urine
- Passing urine more often than usual
- Pain on passing urine
- Blood in the urine or semen

More recently, it has been suggested that fatherhood status might be linked with prostate cancer but studies have shown conflicting results.

The new study looked at the risk of prostate cancer in 22,562 men checked for infertility in 15 clinics in California between 1967 to 1998.

About 4,500 of these men were found to have male infertility - and 19 went on to develop the most aggressive form of prostate cancer.

In a similar sample of men in the general population, 16 men were diagnosed with the high risk form of the disease.

Overall, infertile men were found to be 2.6 times more likely to be diagnosed with the most aggressive form of prostate cancer.

Genetic clues

But Dr Helen Rippon, head of research management at The Prostate Cancer Charity, said with such small numbers of men affected, it is difficult to draw any firm conclusions about whether the suggested link does exist.

She said: "This potential new risk factor would need to be backed up by further, large scale studies before any recommendations can be made about targeting early screening for prostate cancer at men with fertility problems."

Ed Yong, head of health evidence and information at Cancer Research UK, said: "It's unlikely that being infertile directly leads to prostate cancer.

"Instead, both infertility and a higher risk of prostate cancer might stem from a common genetic fault, or some aspect of our lifestyle or environment."

Story from BBC NEWS:
http://news.bbc.co.uk/go/pr/fr/-/2/hi/health/8577046.stm

Published: 2010/03/22 05:44:28 GMT

Setback for cancer test hopes

By Helen Briggs
Health reporter, BBC News

Testing for human papillomavirus during cervical screening does not help doctors identify women at risk of cancer, a study suggests.

A positive HPV test does not accurately predict which women need an urgent follow-up, say doctors.

Each year, millions of UK women have a cervical screening test as part of the national programme.

The NHS is piloting add-on tests for the virus linked to cervical cancer at several UK centres.

Other studies have shown this could be a useful tool for identifying women at high risk of developing cervical cancer.

" **The most important thing is to attend for cervical cancer screening - the most effective way of preventing cervical cancer.** "
Dr Maggie Cruickshank, University of Aberdeen

Around six out of 100 women who have a test receive a borderline or mild abnormality result.

But only a tiny minority of these will go on to develop cervical cancer.

The study, funded by the Medical Research Council, looked at 4,439 women undergoing cervical screening in Grampian, Tayside and Nottingham.

Those with mild abnormalities were tested to see if they were positive for HPV, a sexually-transmitted infection linked to most cases of cervical cancer.

Early signs

But the researchers found 70% of women testing positive for HPV after a mild abnormality result did not develop early signs of cancer during a three-year follow-up.

Cervical cancer
- Around 2,800 women are diagnosed with it each year in the UK
- May not cause any symptoms at all until it has reached an advanced stage
- Abnormal bleeding is the most common symptom

Dr Maggie Cruickshank, from the Department of Obstetrics and Gynaecology at the University of Aberdeen, led the study.

She said: "The most important thing is to attend for cervical cancer screening - the most effective way of preventing cervical cancer.

"This new additional test may not add any value.

"Our study is showing that HPV is such a common infection in younger women that testing for it doesn't help decide which is the best action to take."

But in women over 40, HPV testing might be useful for ruling out further investigations, she added.

Contradictory research

Professor Jack Cuzick is an epidemiologist for Cancer Research UK.

He said other studies have shown that HPV testing is good at detecting abnormalities in women with low-grade tests and can reduce the number who need to be referred for treatment, especially in the over 35s.

He added: "The results of this study are surprising, as they're very much out of line with most other studies in the field.

"One thing to note is that the type of test used isn't commercially available, so we need to be careful when considering these results in the context of our national screening programme."

Julietta Patnick, director of the NHS Cancer Screening Programmes, said the results of the study would be reviewed.

Full details of the research are published in the British Journal of Obstetrics and Gynaecology.

Story from BBC NEWS:
http://news.bbc.co.uk/go/pr/fr/-/2/hi/health/8572993.stm

Published: 2010/03/20 00:01:13 GMT

BPA found beached and at sea

Here, leaching plastics may not be the primary source of the newfound global marine contaminant
By Janet Raloff
Web edition : Tuesday, March 23rd, 2010

The hull of this boat is painted with an epoxy and polyurethane plastic paint, a sealant that has begun breaking down — and, presumably, releasing BPA.K. Saido

SAN FRANCISCO — Chemists have been showing for years that bisphenol A, an estrogen-mimicking building block of polycarbonate plastics and food-can coatings, can leach into food and drinks. But other materials contain BPA — and leach it — such as certain resins used in nautical paint. And Katsuhiko Saido suspects those paints explain the high concentrations of BPA that his team has just found in beach sand and coastal seawater around the world.

Saido, a chemist at Nihon University's College of Pharmacy, in Chiba, Japan, reported his findings here, March 23, at the American Chemical Society's spring national meeting.

At the last ACS national meeting, Saido showed that Styrofoam and related polystyrene-based materials can degrade in seawater and taint the coastal environment with styrene, a toxic building block of the foams. When he announced his styrene findings last September, reporters asked him: What about BPA? Does this potentially toxic breakdown product of the widely used plastics also show up at the beach?

He hadn't a clue. So he went back and reanalyzed samples of seawater and sand that he had collected for the polystyrene study. And sure enough, BPA was there. Sometimes in fairly substantial quantities, he now reports. Of the 28 sites sampled, he found BPA at all, often at values in seawater at or near 100 parts per billion in Puerto Rico, Guam, Japan, Korea, Taiwan and the Philippines. Concentrations of BPA were orders of magnitude higher in sand. For instance, they exceeded 50 parts per million on a French beach and ranged closer to 100 ppm on sandy shores in East Asia, Florida and Costa Rica.

But the hot — especially boiling temperatures — shown to break down polycarbonates in many food-chem studies don't exist at the beach. So Saido went to the lab to see how low he could go and get the plastics to leach BPA. His starting materials: polycarbonate baby bottles that he purchased from around the world. He initially measured the amount of free BPA that was available to leach out of them. Values varied widely — from about 40 ppm (an Italian bottle) to 102 ppm (a Chinese bottle). The major exception: The U.S. baby bottle he assayed had a measly 11 ppm free BPA.

Saido removed this ready-to-leach BPA from the plastic in a Japanese baby bottle and discarded it. Then he put a small piece of this cleaned up polycarbonate into a flask so that he could link any BPA that emerged to its breakdown — not to unbound BPA in the starting plastic. Slowly, he heated the plastic in a bath of polyethylene glycol at any of several temperatures. All it took was cooking the plastic for five days at 50 degrees Celsius (122 degrees Fahrenheit) to begin breaking polycarbonate's chainlike structure apart, releasing individual links of BPA. It's hot but not an impossible temperature to reach outdoors.

"This study shows that at 50 °C, under the sun, polycarbonate is not stable," according to Saido (speaking through an interpreter, a California-based former grad student). Presumably it the breakdown could occur at even lower temperatures if they persisted long enough.

Up the temp to 80 °C (a not terribly environmentally relevant 176 °F), and it took only five hours to really start breaking apart the polymer plastic into its monomer building blocks of BPA.

Initially, Saido thought degrading trashed plastics, like the baby bottles, might have been a source of the marine BPA pollution. Now he's dubious. Saido says he suspects it's certain resins in ship paints. And because the BPA concentrations he's turned up in the coastal environment "concern him," he'd like to see more research done on the use of these epoxy resins in the marine world.

But there's probably a lot more polycarbonate wastes entering the environment than epoxy resins, so it makes sense to find a good way to recycle those plastic goods before they degrade, releasing BPA. Toward that end, Saido is actively developing technologies to transform polycarbonate wastes into liquid and gaseous fuels.

http://www.sciencenews.org/view/generic/id/57553/title/BPA_found_beached_and_at_sea

Better sleuthing through chemistry

New tool can tell where, when or how a chemical warfare agent originated
By Rachel Ehrenberg
Web edition : Tuesday, March 23rd, 2010

SAN FRANCISCO — Finding out whodunit in chemical warfare cases may be aided by scientists focused on the howdunit.

Researchers have developed a technique to ascertain the chemical fingerprint of compounds such as mustard gas, rat poison and nerve agents such as VX. Figuring out the details of how these compounds were created in the first place could provide vital clues to law enforcement agencies aiming to catch chemical warfare criminals and help guide first responders as they gather evidence.

Chemical forensics typically focuses on identifying the compound in question, but chemist Audrey Martin and her colleagues at Lawrence Livermore National Laboratory in California wanted to take these analyses a step further. “If we already know this was a chemical attack using mustard gas, now we want to know who made it,” said Martin, who presented the research March 22 in a poster session at a meeting of the American Chemical Society held in San Francisco. “We’re looking at the next step — where did this come from?”

The technique relies on the fact that there are often many routes to the same chemical — for example there are 12 different ways of making sulfur mustard gas. Depending on the route and the ingredients, there are various chemical by-products, impurities and unreacted ingredients in the final product. The presence and proportions of these molecules can provide clues to how the compound was made, said Martin. In some cases, such as with the rat poison tetramine, one synthetic route might be ruled out entirely by the presence of a particular ingredient. Signatures of the reaction conditions, such as temperature and pressure, may also be hidden in the final product.

So far, the Lawrence Livermore team has determined these various chemical signatures for a handful of compounds, including Sarin gas and the toxic nerve agent VX. The team is also documenting how these chemicals evolve over time, so scientists can tell if something has been sitting around for five minutes, 20 minutes or a week. Martin has developed a computer application that she can feed these signatures into, minimizing time spent manually comparing chemical profiles. The researchers are also investigating how such agents interact with food and surfaces such as tile, plastic and metal. This information could help guide first responders charged with sampling a contaminated area, said Martin.

“It’s not a smoking gun,” she cautions. But if a suspect was seen purchasing a particular ingredient, or has a telltale residue on a shirtsleeve, the method might help clinch a case.

http://www.sciencenews.org/view/generic/id/57561/title/Better_sleuthing_through_chemistry

You really can freeze hot water faster than cold*

*But only if you're a clever physicist and you bend the rules
By Laura Sanders
Web edition : Tuesday, March 23rd, 2010
Text Size

Hot water really can freeze faster than cold water, a new study finds. Sometimes. Under extremely specific conditions. With carefully chosen samples of water.New experiments provide support for a special case of the counterintuitive Mpemba effect, which holds that water at a higher temperature turns to ice faster than cooler water.

The Mpemba effect is named for a Tanzanian schoolboy, Erasto B. Mpemba, who noticed while making ice cream with his classmates that warm milk froze sooner than chilled milk. Mpemba and physicist Denis Osborne published a report of the phenomenon in *Physics Education* in 1969. Mpemba joined a distinguished group of people who had also noticed the effect: Aristotle, Francis Bacon and René Descartes had all made the same claim. On the surface, the notion seems to defy reason. A container of hot water should take longer to turn into ice than a container of cold water, because the cold water has a head start in the race to zero degrees Celsius.But under scientific scrutiny, the issue becomes murky. The new study doesn't explain the phenomenon, but it does identify special conditions under which the Mpemba effect can be seen, if it truly exists.

"All in all, the work is a nice beginning, but not systematic enough to do more than confirm it can happen," comments water expert David Auerbach, whose own experiments also suggest that the effect does occur.Papers published over the last decade, including several by Auerbach, who performed his research while at the Max Planck Institute for Flow Research in Göttingen, Germany, have documented instances of hot water freezing faster than cold, but not reproducibly, says study author James Brownridge of State University of New York at Binghamton. "No one has been able to get reproducible results on command." That's what Brownridge has done. One of his experiments, presented online, repeatedly froze a sample of hot water faster than a similar sample of cool water.Note the word *similar*. In order for the experiment to work, the cool water had to be distilled, and the hot water had to come from the tap.In the experiment, about two teaspoons of each sample were held in a copper device that completely surrounded the water, preventing evaporation and setting reasonably even temperatures. Freezing was official when sensors picked up an electrical signal created by ice formation. Brownridge heated the tap water to about 100° C, while the distilled water was cooled to 25° C or lower. When both samples were put into the freezer, the hot water froze before the cold water. Brownridge then thawed the samples and repeated the experiment 27 times. Each time, the hot tap water froze first. The experiment worked because the two types of water have different freezing points, Brownridge says. Differences in the shape, location and composition of impurities can all cause water's freezing temperature — which in many cases is below zero degrees C — to vary widely. With a higher freezing point, the tap water had an edge that outweighed the distilled water's lower temperature.

Because the experiment didn't compare two identical samples of water, the mystery of the Mpemba effect is not really solved. "I'm not arrogant enough to say I've solved this," Brownridge says. But he has set some guidelines about when the effect can be seen. Physical chemist Christoph Salzmann of the University of Durham in England says he's not convinced the Mpemba effect really exists, because there are innumerable things that influence the timing of freezing, making it impossible to completely control.Predicting how long it will take for a water sample to crystallize "is a bit like trying to predict when the next earthquake or crash of the stock market will happen," he says. "I would not want to say that the Mpemba effect does not exist. But I have still not been convinced of its existence."

http://www.sciencenews.org/view/generic/id/57551/title/You_really_can_freeze_hot_water_faster_than_cold*

The Tree That Changed the World

By: John Perlin | March 29, 2010 | 05:00 AM (PDT) |

Two planets diverged in a solar system, and the successful one took a path more wooded.

The author of A Forest Journey: The Story of Wood and Civilization, *begins a series of articles on the world's first energy crisis: peak wood.*

Astronomers for the longest time have regarded Venus as the planet most resembling Earth. Having almost the exact size as Earth and being almost as close to the sun has led many to call it Earth's twin.

The clouds always covering the Venusian landscape are another compelling example of Venus' affinity to Earth. Pioneering astronomer Svante Arrhenius hypothesized great rains pouring from these clouds nurtured lush rain forests below. But when various space probes penetrated the Venusian atmosphere, this belief burst. Astronomers found an inferno rather than a tropical paradise.

Here they discovered the ultimate greenhouse effect: Although the carbon dioxide-laden atmosphere allowed sunlight to pass through, when the solar rays hit the surface of Venus and changed into heat waves, they could not escape the carbon dioxide cover. So the heat had nowhere to go and accumulated at the surface, where temperatures exceed 800 degrees Fahrenheit.

Earth has as much carbon dioxide as Venus. But instead of the gas blanketing the sky as happened on Venus, much of the carbon dioxide on Earth has been locked up inside and on the surface. This has made all the difference in the story of the two planets — one, a heaven bountiful with life, the other a hellish place where nothing animate as we understand it can survive.

Credit much of this carbon dioxide transfer from the atmosphere to the land to the rapid global spread 400 million years ago of the first (or among the first) true trees, Archaeopteris.

Its dense canopy photosynthetically absorbed carbon dioxide. As its fernlike leaves shed, they would have given back the carbon dioxide to the air — had the tree's deep and powerful root system not broken down

rock through which it dug into soil, where chemical reactions eventually locked the carbon dioxide into sediment. Mud buried much of the remaining dead leaves, branches, twigs, trunks and roots.

With the passing of millions of years under great pressure deep in the bowels of the earth, the plant material ended up as rich beds of fossils and coal. Once again, natural forces denied returning to the atmosphere what the trees had devoured.

Archaeopteris prepared the soil for smaller plants to flourish and assist in removing carbon dioxide from the air. Its root system turned rock into rich, soft earth. Their leaves shielded the newly formed soil from erosive rain and wind, and fertilized it as they fell and decomposed. Debris from the growing number of plants filled waterways, promoting plankton, which also feeds on atmospheric carbon dioxide.

Buried by sediments these consumers of carbon dioxide could not release this greenhouse gas to the air. The plunging carbon dioxide levels in the atmosphere caused temperatures on land to drop. The change made it possible for large creatures to amble about the land without overheating. They no longer had to remain immersed in water — which heats more slowly than land surfaces, and which also better conducts heat away from animals than does air — to maintain healthy body temperatures.

At the same time, declining amounts of atmospheric carbon dioxide enlarged the ozone layer above the Earth. Such protection shields land animals from lethal doses of ultraviolet radiation. Previously, creatures of any significant size had to remain underwater for protection from the unfiltered sun's harmful rays. Of equal importance, the injection of more oxygen into the air by Archaeopteris and smaller plants provided enough of the life-giving gas to make it possible for animals to breathe.

Scientists find charcoal for the first time during the reign of Archaeopteris, suggesting that with the trees' appearance came sufficient amounts of oxygen to support combustion.

As logs and large branches started to clutter the bottom of shallow waterways, fishlike creatures with limbs could better propel themselves through the plant debris than those with fins. The increasing organic debris finding its way into waterways would rob them of their oxygen as it decomposed. Creatures that could breathe as well as walk could escape sure death by making their ascent to land where a relatively mild climate, sufficient oxygen, protection from ultraviolet radiation, and plenty of food provided by plants made survival possible.

So began the chain of events that has permitted vertebrates to flourish on land so that 400 million years later I can write this, and you can read it.

While Archaeopteris is now extinct, nature kept buried the remains of ancient organic debris of algae, plankton, plants and trees. Their entombment helped keep the carbon dioxide they captured through photosynthesis out of the atmosphere.

But people started to dig up and burn the early trees, ancient plants and plankton first as coal and then as oil and natural gas. The seemingly unlimited availability of long-buried organic material, aptly named fossil fuels, ushered in a new technological era qualitatively separating those living since the middle of the 19th century from the rest of history. This new age of unprecedented growth, the Industrial Revolution, also accelerated the rate of deforestation as growing markets and population require more and more clearing for agriculture, livestock and biofuels, and the consumption of trees for fuel and for timber.

True, deforestation has occurred throughout world history. Plato, for example, saw deforestation turn a fertile piece of Attica into rock. He compared this butchered slice of earth to a carcass stripped of all its meat with only the bones remaining.

"What now remains compared with what then existed is like the skeleton of a sick man, all fat and soft earth having wasted away, and only the bare framework of the land being left," he wrote in *Critias*. "… There are some mountains which have nothing but food for bees, but they had trees not very long ago …"

Since the beginning of the Industrial Revolution, Plato's compelling description of a particular place in Greece has become universal.

The growing loss of trees has allowed ever increasing amounts of carbon dioxide to return the to atmosphere. So have the engines of commerce and industry by burning fossil fuels. Scientific investigations have proven that since the beginning of the industrial revolution carbon dioxide levels have increased as well as the temperature of the Earth.

Unless drastic changes occur socially and technologically, increasing amounts of carbon dioxide will enter the atmosphere as the burning of fossil fuels continues to accelerate along with deforestation. Deforestation alone accounts for the release of more greenhouse gases than do all the vehicles throughout the world!

Bad forestry practices help hasten the pace of carbon released into the atmosphere. Following a clear-cut, for example, the formerly forested soil releases tremendous amounts of carbon dioxide into the atmosphere.

In North America, for example, 60 percent of all carbon resides within the earth of the forest floor. Replanting does capture carbon dioxide as new organic matter grows. The losses of carbon dioxide to the atmosphere continue to exceed the removal of carbon in the replanted clear-cut for 15 to 25 years depending on the type of tree, climate and soil. Then the trees and the soil underneath start to store more carbon dioxide than released.

Conversely, forests can become a weapon in our arsenal to break global warming if foresters practice enlightened stewardship. Sustainable forestry will need to become the standard on all forest lands globally. Replanting formerly forested land helps if trees are not selectively harvested until the seedlings reach an age where they have taken in more carbon dioxide than has been exhaled. Trees cut down in cycles of 50, 75 and 100 years store only 38 percent, 44 percent and 51 percent, respectively, of the carbon that an old-growth stand retains.

Indeed, trees can play a vital role in reducing atmospheric carbon dioxide. A recent study shows that saving the Amazon can be a cheaper and faster way to mitigate the consequences of global warming than replacing coal-fired power plants with renewable energy.

http://www.miller-mccune.com/science-environment/the-tree-that-changed-the-world-11656/?utm_source=Newsletter102&utm_medium=email&utm_content=0330&utm_campaign=newsletters

Make Solar Light, Not War

By: John Perlin | March 26, 2010 | 05:00 AM (PDT) |

It's better to light a single solar-powered streetlight than curse the insurgency.

In 2004, the streets of the Iraqi city of Fallujah erupted into the worst fear the American forces had: house-to-house fighting. The urban battle resulted in the bloodiest battle of the Iraq war with at least 800 civilians dead, much of the city's infrastructure destroyed or damaged, and a city of more than 200,000 deserted.

As Fallujah's residents returned, they were angry with the occupiers for the carnage, destruction and "collateral damage." To keep the peace, the American military realized guns, grenades and other threats of violence had to give way to improving day-to-day life. Something dramatic and visible had to be done quickly.

The answer, at least in part: solar-powered street lighting.

This wasn't some peacenik's dream.

Word had come from Afghanistan about the turnaround solar had made in a province on the Pakistan border that serves as a funnel for Taliban sympathizers. To win hearts and minds, the U.S. Army tried rebuilding the war-torn town of Orgun-e with improvements ranging from cobblestone streets to solar-powered street lights and audio speakers for the local mosque.

The solar lights in this Afghan town helped develop and maintain strong relations with the local community and local leaders as they viewed the installations as the Combined Forces Command's commitment to the city's development. Commerce quickly improved as a result, and commerce signals increased stability. The Coalition Forces also credited the installation with citizens turning in weapons' caches.

"They can see it. It's visible and it's tangible. It makes them feel like they are getting on with progress or getting on with life," Lt. Col. Chris Toner told Voice of America's Benjamin Sand in 2006. As Sand wrote then, "Inside the American camp in Orgun-E, officials say basic development projects like this one are not just the best way, but probably the only way to beat the insurgency."

Could the experience be replicated at Fallujah? It was worth a try. What could be more visible to the population than street lamps lighting darkened streets and roadways? Of course, wired electricity could have done the job, but both Iraq and Afghanistan lack reliable grids. They do have plenty of sunshine, though. So if a panel of sufficient size is attached to batteries, the lights will burn the whole night through.

It wasn't the first time the Coalition Forces had tapped the sun for a Fallujah infrastructure project. In 2008, U.S. Marines helped install solar water purification units along the Euphrates River to provide clean water to Fallujah. Elsewhere in Iraq, school children also use solar-powered laptops and milk-producers use solar-powered refrigerators, according to the U.S. Embassy.

The U.S. Army Corps of Engineers began the $2.9 million solar lighting project for Fallujah in 2007. Workers dug holes, cemented 30-foot steel poles in concrete and bolted on the solar modules and lights. By January, more than a thousand solar-powered lamps lit 22 miles of streets and roadway.

Employment rose. Coalition forces feel more secure while patrolling at night. People go out after dark. Shops stay open after the sun sets. In addition, Iraqis now run the project. Early on, the Solar Electric Power Company, the Florida-based solar firm that has provided the technology, trained a local electrical contractor in assembling the devices.

Solar street lighting is not just confined to Fallujah. By the end of this year more than 27,000 lights will line the streets and roadway in the rest of Iraq.

When someone shot out two of the lights and their panels, the military learned how much the citizens of Fallujah valued them. A town meeting was called. The people requested their replacement. "We will guard them ourselves," the people promised.

http://www.miller-mccune.com/science-environment/make-solar-light-not-war-10654/

There's No Brewsky in the Food Pyramid

By: Elisabeth Best | March 31, 2010 | 12:44 PM (PDT) |

This just in: Drinkers more likely to pair potato chips than apple slices with beer.

Not-all-that-groundbreaking new research from the National Institute on Alcohol Abuse and Alcoholism, National Cancer Institute and the U.S. Department of Agriculture may have drinkers rethinking their diets.

A study of more than 15,000 adults in the United States, published in the April issue of the *Journal of the American Dietetic Association*, found that people who drink more also eat worse. More specifically, the more men and women drink, the less likely they are to eat fruit, and they consume more calories from alcohol and unhealthy foods. Among men, increased alcoholic beverage consumption also meant a decreased intake of whole grains and milk.

Using data from the National Health and Nutrition Survey, researchers examined alcohol consumption information and Healthy Eating Index-2005 scores. The Healthy Eating Index-2005 scores measure how closely diets adhere to the 2005 U.S. Dietary Guidelines for Americans, which define moderate drinking as no more than one drink per day for women and two per day for men. These guidelines advise people to consume nutrient-dense, low-calorie foods, like whole grains, fruits and vegetables and limit consumption of alcohol, unhealthy fats and added sugars.

The scientists found that as consumption of alcoholic beverages increased, Healthy Eating Index scores decreased, which indicates that individuals who are drinking more are making worse food choices.First author *Journal of the American Dietetic Association*, who works for the National Institute on Alcohol Abuse and Alcoholism, cautions that the study did not determine the cause of the association. In other words, the decreased diet quality could be due to the perfection of a potato-chip-IPA pairing or the hangover-healing properties of french fries.

Previous research by Breslow and her colleagues found that the people who drink the most have the lowest-quality diets. Because both heavy drinking and poor diet quality have been associated with cardiovascular disease, cancers and other health problems, the findings raise concerns that alcohol consumption is a double-whammy for health."Our findings underscore the importance of moderation for individuals who choose to consume alcoholic beverages, and a greater awareness of healthy food choices among such individuals," Breslow observed.

Perhaps well-intentioned fake-ID providers should give their customers copies of the dietary guidelines.

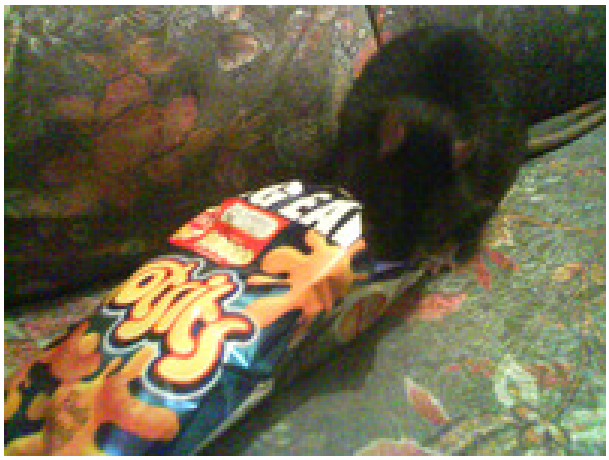
http://www.miller-mccune.com/health/theres-no-brewsky-in-the-food-pyramid-12683/

Junk Food Jones Is Wired In Your Brain

March 29, 2010

By Scott Hensley

From the science-you-always-knew-was-true file comes evidence that eating junk food is addictive, triggering the same sorts of responses in the brain that lead to drug dependence.



You going to eat that? (mush2274/Flickr)

A couple of clever researchers from the Scripps Research Institute in Florida put electrodes in rats' brains and trained the animals to give themselves a jolt of electricity to their pleasure centers.

Some rats then got just lab chow, others got access for an hour a day to a buffet of high-fat, caloric food, and 11 really lucky animals, known as the "extended-access rats" got to graze at the rodent equivalent of a fast-food cafeteria for up to 23 hours a day for 40 days.

The rats with full access to the junky stuff just loved it, gorging on bacon, cheesecake and Ho Hos. As you might expect, they got pretty fat pretty fast.

Inside their little brains, the junk-food eating rats developed a big problem. Just like drug takers, the rats needed a bigger fix of junk food over time to maintain their pleasure. So they kept on eating, and kept on getting fatter. As the scientists explained in their paper, "extended access to palatable high-fat food can induce addiction-like deficits in brain reward function," which can spur overeating and lead to obesity.

Or, in layman's terms, "the animals completely lost control over their eating behavior, the primary hallmark of addiction," neuroscientist Paul Kenny said in a statement describing the work.

He and a grad student did all sorts of other experiments to tease apart the connection between overeating and the pleasure response. Bottom line: eating a lot of junk food makes you want to eat more junk food.

We figured as much last night over a second bowl of ice cream just before bed. But for the scientific details, you can check out the results, which were just published online by the journal *Nature Neuroscience*.

http://www.npr.org/blogs/health/2010/03/junk_food_jones_is_wired_in_yo.html?sc=nl&cc=sh-20100403

For Cornell Library "The Time Of The Singing Of Birds Is Come"

Posted: 02 Apr 2010 12:06 AM PDT

The goal of poets is to make words sing. And so what better to inspire them than the sublime sounds, expressed so casually, so naturally, so sweetly, by the songbird? It comes as no surprise, then, that nearly every major poet has written a poem in praise of avian warblers. From Catallus to Chaucer to Keats to Collins, all are spellbound by the music of the skies. They try, with all the tools at their command, to conjure up in words the notes that flow so effortlessly from far simpler creatures.

What makes this situation far more vexing for today's aspiring poets, is that their time spent communing with nature is often short. Since they compose on a keyboard, requiring electricity or a quickly-drained battery, prolonged exposure to the melodies of the meadow may seem a distant dream. But thanks, in large part to a passionate, intrepid, and adventuresome couple, the song of the lark, and thousands and thousands of other calming coos, are just a mouse-click away. Wannabe wordsmiths, get thee (virtually) to the Macaulay Library of Sound.

Not created expressly to produce poetry, what was formerly known as the Cornell Laboratory of Ornithology's Library of Sound, has recently been renamed in honor of two of its foremost contributors, William and Linda Macaulay. The Macaulay Library of Sound is the world's largest collection of zoological sounds, featuring audio (and secondarily video) recordings of over 9,000 species of birds, mammals, and insects. All of the sounds are available online, free of charge.

Linda Macaulay has devoted 23 years of her life to recording bird songs. To date, she has captured the calls and songs of 2,668 species of birds, or nearly 30% of the known species worldwide. She has traveled

from her home in Greenwich, Connecticut to 50 countries around the globe in search of the sounds of the rarest birds in the world. And Ms. Macaulay's recordings, often obtained at great personal risk, have all been added to the Cornell University database. (Her husband William, a billionaire venture capitalist, accompanies her whenever possible. For him birding is a "quiet and relaxing" respite from the madding crowd. His monetary contributions to the Macaulay Library of Sound have been substantial.)
The globe-trotting Ms. Macaulay's passion for capturing "first cuts," the term used for the initial recording of the sounds of a particular species, has taken her to parts of the world that tourists seldom see. In Rwanda she traipsed through waist deep swamps in search of the Shoebill. On another trip to Africa, in Gabon, she spelunked several caverns seeking the Gray-necked Rockfowl. Sometimes the challenges of her travel are not just geographical: in Papua, New Guinea she was surrounded by a band of men brandishing spears. In Ethiopia she braved the modern version of the same behavior: every man who had reached his teens carried an AK-47. With typical understatement Macaulay remarks that she and her husband "have a different risk profile than most people." All of this daring-do has paid off handsomely for the Library of Sound: Ms. Macaulay believes there are at least 10 species she alone has recorded, these include the Whitehead's Trogon from Borneo, and the Rust and Yellow Tanager from Argentina.
On April 8, 2010 Linda Macaulay will be honored at the Paley Center for Media in New York City with Cornell's prestigious Arthur A. Allen Award (.pdf format), which honors ornithologists whose work specifically benefits the general public. She is particularly pleased to receive this recognition because she believes the free, online Library of Sound is a singular achievement: "A person in any country can access a bird sound digitally for free," she says. "It's like looking for a book -- you can go online and hear all the sounds... You don't have to be a scientist."
That should be music to the ears of laboratory-leery poets everywhere. And in case some versifiers still aren't sold on the poetical virtues of bird songs, (and in honor of April's status as National Poetry Month) this piece will close with a few examples of how the *Lullaby of Birdland* has freed some of our greatest writers to take wing and soar:

Stray Birds #1 **by Rabindranath Tagore**.

Stray birds of summer come to my window
to sing and fly away.
And yellow leaves of autumn,
which have no songs,
flutter and fall there with a sigh.

Excerpt from: *Mockingbirds* by Mary Oliver.

This morning
two mockingbirds
in the green field
were spinning and tossing
the white ribbons
of their songs
into the air.
I had nothing
better to do
than listen.
I mean this
seriously.

Little Bird **by An Anonymous Celtic Poet.**

Little bird! O little bird!
I wonder at what thou doest,
Thou singing merry far from me,
I in sadness all alone!

Little bird! O little bird!

I wonder at how thou art
Thou high on the tips of branching boughs,
I on the ground a-creeping!

Little bird! O little bird!
Thou art music far away,
Like the tender croon of the mother loved
In the kindly sleep of death.

Excerpt from: *Ode to Bird Watching* by Pablo Neruda.

You can hear them
like a heavenly
rustle or movement.
They converse
with precision.
They repeat
their observations.
They brag
of how much they do.
They comment
on everything that exists.

A Rufous Whistler, Another Species Recorded by Linda Macaulay For The Library Of Sound.

***For the House Sparrow, in Decline* by Paul Farley.**
Your numbers fall and it's tempting to think
you're deserting our suburbs and estates
like your cousins at Pompeii;
that when you return
to bathe in dust and build your nests again
in a roofless world where no one hears your cheeps,
only a starling's modem mimicry
will remind you of how you once supplied
the incidental music of our lives.

Excerpt From: ***Ode To A Skylark* by Percy Bysshe Shelley.**

Sound of vernal showers
On the twinkling grass,
Rain-awakened flowers,
All that ever was Joyous, and clear,
and fresh, thy music doth surpass.

Teach us, Sprite or Bird,
What sweet thoughts are thine:
I have never heard Praise of love or wine
That panted forth a flood of rapture so divine.

Excerpt from: *Caged Bird* by Maya Angelou.
The caged bird sings
with a fearful trill
of things unknown

but longed for still
and his tune is heard
on the distant hill
for the caged bird
sings of freedom.

Unknown Bird **by W.S. Merwin.**
Out of the dry days
through the dusty leaves
far across the valley
those few notes never
heard here before
one fluted phrase
floating over its
wandering secret
all at once wells up
somewhere else
and is gone before it
goes on fallen into
its own echo leaving
a hollow through the air
that is dry as before
where is it from
hardly anyone
seems to have noticed it
so far but who now
would have been listening
it is not native here
that may be the one
thing we are sure of
it came from somewhere
else perhaps alone
so keeps on calling for
no one who is here
hoping to be heard
by another of its own
unlikely origin
trying once more the same few
notes that began the song
of an oriole last heard
years ago in another
existence there
it goes again tell
no one it is here
foreign as we are
who are filling the days
with a sound of our own

Excerpt from: ***Birds Of Passage*** **by Henry Wadsworth Longfellow.**
I hear the cry
Of their voices high
Falling dreamily through the sky,
But their forms I cannot see.
O, say not so!
Those sounds that flow

In murmurs of delight and woe
Come not from wings of birds.
They are the throngs
Of the poet's songs,
Murmurs of pleasures, and pains, and wrongs,
The sound of winged words.
This is the cry
Of souls, that high
On toiling, beating pinions, fly,
Seeking a warmer clime,
From their distant flight
Through realms of light
It falls into our world of night,
With the murmuring sound of rhyme.

To The Cuckoo **by William Wordsworth.**
O Blithe New-comer! I have heard,
I hear thee and rejoice.
O Cuckoo! shall I call thee Bird,
Or but a wandering Voice?
While I am lying on the grass
Thy twofold shout I hear,
From hill to hill it seems to pass,
At once far off, and near.
Though babbling only to the Vale,
Of sunshine and of flowers,
Thou bringest unto me a tale
Of visionary hours.
Thrice welcome, darling of the Spring!
Even yet thou art to me
No bird, but an invisible thing,
A voice, a mystery;
The same whom in my school-boy days
I listened to; that Cry
Which made me look a thousand ways
In bush, and tree, and sky.
To seek thee did I often rove
Through woods and on the green;
And thou wert still a hope, a love;
Still longed for, never seen.
And I can listen to thee yet;
Can lie upon the plain
And listen, till I do beget
That golden time again.
O blessed Bird! the earth we pace
Again appears to be
An unsubstantial, faery place;
That is fit home for Thee!

http://2.bp.blogspot.com/_UN7wPjdKdmc/S7QnOMarP4I/AAAAAAAABNk/76nhpcuRAxw/s1600/Bali_Starling+2.JPG

Sleeping sickness 'breakthrough'

Scientists say they have identified a potential treatment for sleeping sickness, a killer disease that infects about 60,000 people in Africa a year.

British and Canadian experts say drugs could attack an enzyme the parasite causing the illness needs to survive.

They say the orally-administered drug could be ready for human clinical trials in about 18 months.

The disease, spread by the bite of a tsetse fly, is caused by a parasite attacking the central nervous system.

It has similar symptoms to malaria, making it difficult to diagnose. Left untreated, it moves to the spinal column and brain, resulting in mental confusion and eventual death.

Fatal side effects

The "breakthrough" came at the University of Dundee in Scotland, where scientists were funded to research diseases neglected by major drugs companies.

Professor Paul Wyatt, director of the programme, said: "This is one of the most significant findings made in recent years in terms of drug discovery and development for neglected diseases."

He said the research, published in the journal Nature, represented "significant strides" in the development of a full blown drug against the disease.

The World Health Organization estimates there are between 50,000 and 70,000 cases of the disease a year, with a further 60 million people at risk of infection.

The research in Dundee was backed by partners at the University of York in England and the Structural Genomics Consortium in Toronto, Canada.

The two drugs currently available to treat sleeping sickness both have associated problems.

One is arsenic-based with side effects that kill one in 20 patients and the other - eflornithine - is costly, only partially effective and requires prolonged hospital treatment, the scientists said.

Story from BBC NEWS:
http://news.bbc.co.uk/go/pr/fr/-/2/hi/africa/8597774.stm

Published: 2010/03/31 23:40:45 GMT

The Vietnam Wars: 'The Lotus Eaters'

By DANIELLE TRUSSONI

THE LOTUS EATERS

By Tatjana Soli

389 pp. St. Martin's Press. $24.99

It is April 1975. The North Vietnamese are marching into Saigon, the Americans are fleeing in helicopters. And in Tatjana Soli's splendid first novel, "The Lotus Eaters," a group of Western journalists sip "liberated" Champagne on the roof of the Caravelle Hotel as they reflect on all that has been lost. For Helen, a veteran photographer who made her name covering the war, the resounding absence of planes and artillery has transformed Saigon into an eerie place of "nostalgia and history and failure." Failed dreams and failed ambitions may be the very stuff from which Vietnam narratives are fashioned; but although Helen's war is over, there is no guarantee she will be on a plane home. As one of her colleagues says ominously, "The war doesn't ever have to end for us." For the interpreters of violence there will always be another war zone with new treasures of heartbreaking stories.

At the novel's opening, Helen is a 32-year-old woman "in a young man's profession" whose "ambition in the larger world had faded until there was only her and the camera and the war." She was drawn to Vietnam after her brother was killed in combat; afraid she would miss her chance to see action herself, she dropped out of college and began training as a photographer, a remarkable act of courage for a "poor little scared girl from California." Helen, in fact, is remarkable in almost every way: she learns to speak Vietnamese, shuns the company of her desk-job associates and, after a tumultuous affair with her mentor, a Pulitzer Prize-winning photographer named Darrow, she falls in love and marries her Vietnamese assistant, Linh.

While complicated love affairs are difficult to evoke in any piece of fiction, passion amid ambushes and firefights could be particularly treacherous to nail down. Helen's feelings for Darrow — who is unhappily married and emotionally unavailable — defy sense and are, thus, perfectly understandable in the upside-down logic of a war zone. While Linh is a better match, his personal tragedies have left him damaged and hesitant to fall in love. Soli portrays these love stories so thoughtfully, and with such care, that they take precedence over the fireworks of battle. In this novel, love eclipses war, at least momentarily.

With Linh's help, Helen finds that Vietnam, a place she once considered "backward," has become home. She has "slipped beneath the surface of the war and found the country" only to grow uneasy with her identity as a war photographer who has gone native. She finds it "such a cliché to expose the war, or even wanting to test one's self against it," yet she risks her life to capture images of the violence around her, sure that "the sacrifice had been worth it." Helen's restlessness and grappling, her realization that "a woman sees war differently," provide a new and fascinating perspective on Vietnam. Vivid battle scenes, sensual romantic entanglements and elegant writing add to the pleasures of "The Lotus Eaters."

Soli's hallucinatory vision of wartime Vietnam seems at once familiar and new. The details — the scorched villages, the rancid smells of Saigon — arise naturally, underpinning the novel's sharp realism and characterization. In an author's note, Soli writes that she's been an "eager reader of every book" about Vietnam she has come across, but she is never overt or heavy-handed. Nothing in this novel seems "researched." Rather, its disparate sources have been smoothed and folded into Soli's own distinct voice.

Still, readers familiar with writing about Vietnam might recognize models for Soli's characters among the flesh-and-blood photojournalists of the war — Sean Flynn, Henri Huet, Catherine Leroy and Dickey Chapelle, the first American female war correspondent to die in action. Chapelle, with her signature Australian bush hat, fatigues and pearl earrings, covered the battles of Iwo Jima and Okinawa for National Geographic, was captured and jailed for more than a month during the Hungarian uprising and arrived in Vietnam in the early '60s. In her 1962 book "What's a Woman Doing Here?" Chapelle writes of her work as a correspondent: "They were stories, yes. Telling them fed me, yes. But their substance was not innocent. I had become an interpreter of violence."

Like Chapelle, Helen is acutely ambivalent about her moral position as a war journalist. She is intent on pondering whether those who represent war — through reporting or photography — are doing anything but replicating the violence they depict. Does war journalism change public opinion, or does it merely lead, as one photojournalist in "The Lotus Eaters" asks, to "a steady loss of impact until violence becomes meaningless"? Do gruesome images of war foster revulsion and opposition to violence on the part of the public, or do the images simply translate into war porn?

Soli doesn't offer simple answers to these questions, but leaves her characters in a state of discomfort about their work. After getting an "incredible shot of a dead soldier/woman/child; a real tearjerker," the journalists would turn away from one another with "a kind of postcoital shame." Helen finds that "in the face of real tragedy, they were unreal, vultures; they were all about getting product. In their worst moments, each of them feared being a kind of macabre Hollywood, and it was only in terms of the future that they regained their dignity, became dubious heroes." Yet Helen believes in the redemptive power of her work. Indeed, she believes that "every good war picture is an antiwar picture." When accused of being a mere tourist of the war, she is chagrined by the realization that her early months in-country were a charade, a time when she had played at war, when "the whole country had merely served as backdrop for her adventure."

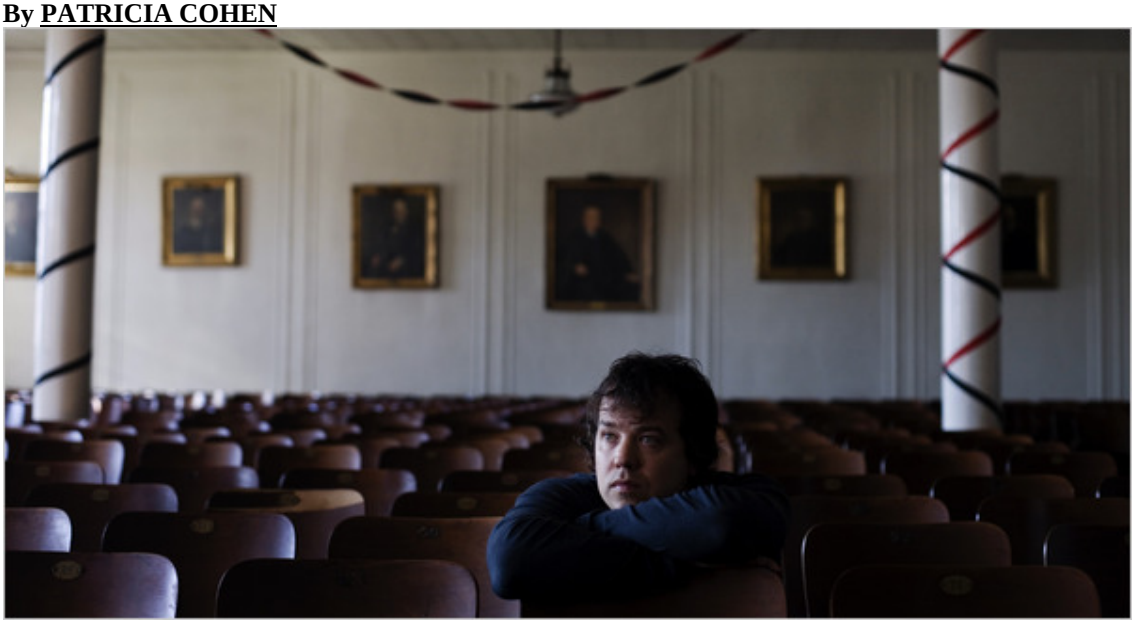
But what, exactly, is the nature of Helen's adventure in Vietnam? The novel's title refers to a passage in Homer's "Odyssey" about a country of lotus eaters, a "race that eat the flowery lotus fruit" and share it — and its opiate comforts — with those who wash ashore, so they won't want to leave. The metaphor is apt. In Soli's novel, there are those who eat the fruit of the lotus and those who do not, journalists who experience the country alongside soldiers and those who choose desk jobs back in Saigon. Soli defines the unquantifiable desire that can seduce a person to danger, even to a kind of suicide wish. "That's one of the keys to life here," says Helen's lover Darrow, a man whose addiction to danger she will come to mimic. "Sudden and sublime. Sudden and awful. Everything distilled to its most intense. That's why we're all hooked."

Helen may try to escape, but in the end she has become one of the lotus eaters herself. "My whole experience was clouded over there," she says in an attempt to make sense of her addiction to Vietnam. "We were in a dream. It was so vivid, I thought it wasn't real. But it was. Truer than anything here."

Danielle Trussoni is the author of "Falling Through the Earth: A Memoir." Her first novel, "Angelology," has just been published.

http://www.nytimes.com/2010/04/04/books/review/Trussoni-t.html?nl=books&emc=booksupdateema1

Next Big Thing in English: Knowing They Know That You Know
By PATRICIA COHEN



To illustrate what a growing number of literary scholars consider the most exciting area of new research, Lisa Zunshine, a professor of English at the University of Kentucky, refers to an episode from the TV series "Friends."

(Follow closely now; this is about the science of English.) Phoebe and Rachel plot to play a joke on Monica and Chandler after they learn the two are secretly dating. The couple discover the prank and try to turn the tables, but Phoebe realizes this turnabout and once again tries to outwit them.
As Phoebe tells Rachel, "They don't know that we know they know we know."
This layered process of figuring out what someone else is thinking — of mind reading — is both a common literary device and an essential survival skill. Why human beings are equipped with this capacity and what particular brain functions enable them to do it are questions that have occupied primarily cognitive psychologists.

Now English professors and graduate students are asking them too. They say they're convinced science not only offers unexpected insights into individual texts, but that it may help to answer fundamental questions about literature's very existence: Why do we read fiction? Why do we care so passionately about nonexistent characters? What underlying mental processes are activated when we read?
Ms. Zunshine, whose specialty is 18th-century British literature, became familiar with the work of evolutionary psychologists while she was a graduate student at the University of California, Santa Barbara in the 1990s. "I thought this could be the most exciting thing I could ever learn," she said.
At a time when university literature departments are confronting painful budget cuts, a moribund job market and pointed scrutiny about the purpose and value of an education in the humanities, the cross-pollination of English and psychology is a providing a revitalizing lift.

Jonathan Gottschall, who has written extensively about using evolutionary theory to explain fiction, said "it's a new moment of hope" in an era when everyone is talking about "the death of the humanities." To Mr. Gottschall a scientific approach can rescue literature departments from the malaise that has embraced them over the last decade and a half. Zealous enthusiasm for the politically charged and frequently arcane theories that energized departments in the 1970s, '80s and early '90s — Marxism, structuralism, psychoanalysis — has faded. Since then a new generation of scholars have been casting about for The Next Big Thing.

The brain may be it. Getting to the root of people's fascination with fiction and fantasy, Mr. Gottschall said, is like "mapping wonderland."

Literature, like other fields including history and political science, has looked to the technology of brain imaging and the principles of evolution to provide empirical evidence for unprovable theories.
Interest has bloomed during the last decade. Elaine Scarry, a professor of English at Harvard, has since 2000 hosted a seminar on cognitive theory and the arts. Over the years participants have explored, for example, how the visual cortex works in order to explain why Impressionist paintings give the appearance of shimmering. In a few weeks Stephen Kosslyn, a psychologist at Harvard, will give a talk about mental imagery and memory, both of which are invoked while reading.

Ms. Zunshine said that in 1999 she and about 10 others won approval from the Modern Language Association to form a discussion group on cognitive approaches to literature. Last year their members numbered more than 1,200. Unlike Mr. Gottschall, however, Ms. Zunshine sees cognitive approaches as building on other literary theories rather than replacing them.
Ms. Zunshine is particularly interested in what cognitive scientists call the theory of mind, which involves one person's ability to interpret another person's mental state and to pinpoint the source of a particular piece of information in order to assess its validity.
Jane Austen's novels are frequently constructed around mistaken interpretations. In "Emma" the eponymous heroine assumes Mr. Elton's attentions signal a romantic interest in her friend Harriet, though he is actually intent on marrying Emma. She similarly misinterprets the behavior of Frank Churchill and Mr. Knightly, and misses the true objects of their affections.

Humans can comfortably keep track of three different mental states at a time, Ms. Zunshine said. For example, the proposition "Peter said that Paul believed that Mary liked chocolate" is not too hard to follow. Add a fourth level, though, and it's suddenly more difficult. And experiments have shown that at the fifth level understanding drops off by 60 percent, Ms. Zunshine said. Modernist authors like Virginia Woolf are especially challenging because she asks readers to keep up with six different mental states, or what the scholars call levels of intentionality.

Perhaps the human facility with three levels is related to the intrigues of sexual mating, Ms. Zunshine suggested. Do I think he is attracted to her or me? Whatever the root cause, Ms. Zunshine argues, people find the interaction of three minds compelling. "If I have some ideological agenda," she said, "I would try to construct a narrative that involved a triangularization of minds, because that is something we find particularly satisfying."

Ms. Zunshine is part of a research team composed of literary scholars and cognitive psychologists who are using snapshots of the brain at work to explore the mechanics of reading. The project, funded by the Teagle Foundation and hosted by the Haskins Laboratory in New Haven, is aimed at improving college-level reading skills.

"We begin by assuming that there is a difference between the kind of reading that people do when they read Marcel Proust or Henry James and a newspaper, that there is a value added cognitively when we read complex literary texts," said Michael Holquist, professor emeritus of comparative literature at Yale, who is leading the project.
The team spent nearly a year figuring how one might test for complexity. What they came up with was mind reading — or how well an individual is able to track multiple sources. The pilot study, which he hopes will start later this spring, will involve 12 subjects. "Each will be put into the magnet" — an M.R.I. machine — "and given a set of texts of graduated complexity depending on the difficulty of source monitoring and we'll watch what happens in the brain," Mr. Holquist explained.

At the other end of the country Blakey Vermeule, an associate professor of English at Stanford, is examining theory of mind from a different perspective. She starts from the assumption that evolution had a hand in our love of fiction, and then goes on to examine the narrative technique known as "free indirect style," which mingles the character's voice with the narrator's. Indirect style enables readers to inhabit two or even three mind-sets at a time.

This style, which became the hallmark of the novel beginning in the 19th century with Jane Austen, evolved because it satisfies our "intense interest in other people's secret thoughts and motivations," Ms. Vermeule said.

The road between the two cultures — science and literature — can go both ways. "Fiction provides a new perspective on what happens in evolution," said William Flesch, a professor of English at Brandeis University.

To Mr. Flesch fictional accounts help explain how altruism evolved despite our selfish genes. Fictional heroes are what he calls "altruistic punishers," people who right wrongs even if they personally have nothing to gain. "To give us an incentive to monitor and ensure cooperation, nature endows us with a pleasing sense of outrage" at cheaters, and delight when they are punished, Mr. Flesch argues. We enjoy fiction because it is teeming with altruistic punishers: Odysseus, Don Quixote, Hamlet, Hercule Poirot. "It's not that evolution gives us insight into fiction," Mr. Flesch said, "but that fiction gives us insight into evolution."

An earlier version of this article misstated the name of the university where Lisa Zunshine is a professor of English and misidentified the university where she was a graduate student.
This article has been revised to reflect the following correction:

Correction: April 2, 2010

An article on Thursday about research into the way the brain processes literature misstated the name of the university where Lisa Zunshine, who is investigating the subject, is a professor of English. It is the University of Kentucky, not Kentucky University. The article also misidentified the school where Ms. Zunshine was a graduate student. It is the University of California, Santa Barbara — not Stanford.

http://www.nytimes.com/2010/04/01/books/01lit.html?ref=books

The Toxic Side of Being, Literally, Green

By ALICE RAWSTHORN

LONDON — As Kermit the Frog sang so wisely, it's not easy being green. Think of Britain's wannabe prime minister, David Cameron, cycling to Parliament followed by a limo carrying his papers. The "organic" products that are smothered by superfluous biodegradable packaging. And "caring" celebrities who blow their eco-cool by flying into environmental protests on private jets.

Even those deluded celebs don't seem as daft as the 265 ton "iceberg" built by Chanel as the set for a recent fashion show in Paris. Made from ice and snow imported from Sweden, it was "recycled" afterward by being returned there in yet another gas-guzzling journey. Presumably it was meant to make me crave a new Chanel bag, but all I could think of were those heartbreaking photographs of polar bears marooned on melting ice caps.

Kermit was correct, being green really is tough, so tough that the color itself fails dismally. The cruel truth is that most forms of the color green, the most powerful symbol of sustainable design, aren't ecologically responsible, and can be damaging to the environment.

"Ironic, isn't it?" said Michael Braungart, the German chemist who co-wrote "Cradle to Cradle," the best-selling sustainable design book, and co-founded the U.S. design consultancy McDonough Braungart Design Chemistry. "The color green can never be green, because of the way it is made. It's impossible to dye plastic green or to print green ink on paper without contaminating them."

This means that green-colored plastic and paper cannot be recycled or composted safely, because they could contaminate everything else. The crux of the problem is that green is such a difficult color to manufacture that toxic substances are often used to stabilize it.

Take Pigment Green 7, the commonest shade of green used in plastics and paper. It is an organic pigment but contains chlorine, some forms of which can cause cancer and birth defects. Another popular shade, Pigment Green 36, includes potentially hazardous bromide atoms as well as chlorine; while inorganic Pigment Green 50 is a noxious cocktail of cobalt, titanium, nickel and zinc oxide.

If you look at the history of green, it has always been troublesome. Revered in Islamic culture for evoking the greenery of paradise, it has played an accident-prone role in Western art history. From the Italian Renaissance to 18th-century Romanticism, artists struggled over the centuries to mix precise shades of green paint, and to reproduce them accurately.

Even if they succeeded, the results often faded or discolored, as did green dyes. When the 19th-century British designer William Morris created wallpapers inspired by medieval tapestries, he copied the blue hues in the originals. But most of those "blues" were really greens, which had changed color over the years.

Green even has a toxic history. Some early green paints were so corrosive that they burnt into canvas, paper and wood. Many popular 18th- and 19th-century green wallpapers and paints were made with arsenic, sometimes with fatal consequences. One of those paints, Scheele's Green, invented in Sweden in the 1770s, is thought by some historians to have killed Napoleon Bonaparte in 1821, when lethal arsenic fumes were released from the rotting green and gold wallpaper in his damp cell on the island of Saint Helena.

This noxious heritage should have been forgotten after green's reinvention as a symbol of ecological purity by environmental protesters in the early 1970s.

It was a perfect choice as their emblem. One reason is, of course, that green is the color of nature. Another is that its natural associations had made it unpopular with the Modern Movement. This enhanced its appeal to early environmentalists, who rejected Modernism as soulless and destructive.

They were also attracted to the maverick qualities that had bedeviled green in the past. Even today, despite all of the advances in color technology, producing green dyes and pigments is still problematic.

"Getting the right tones of artificial green is always difficult, and there's often something disturbing about the result," said the Dutch product designer Hella Jongerius. "Whereas all shades of green look beautiful in nature."

Perhaps because of this, green remains an elusive color. "We can imagine and identify at least as many different shades of green as, say, red or blue, probably more," explained David Batchelor, a British artist and color theorist. "On the other hand it is less easy to imagine a 'pure' green in the way we might think of 'pure' red."

Restless. Anarchic. Technophobic. Nature-loving. Iconoclastic. No wonder the early environmentalists took to green. The love affair began in 1971 when a bunch of Canadian protesters chartered a ship to campaign against nuclear testing in Alaska, and called it "Greenpeace." They then adopted the same name themselves. By the late 1970s, "Green Parties" were emerging all over the world including "Die Grünen" in Germany, "Groen!" in Belgium and "Les Verts" in France.

When environmentalism went mainstream, green was hijacked by businesses as a visual clue to suggest that this, that or the other product was ecologically sound. Look at the organic food section of a supermarket and you'll see a sea of green-colored branding and packaging. The same goes for "eco" cleaning products, "sustainable" clothing, and so on.

Green has had a similar effect on the language of design and marketing. Whether we're talking about "green design," "green energy," "green architecture," "green whatever," the g-word will be interpreted as shorthand for something that is environmentally responsible — or should be.

It has even spawned pejoratives, like "greenwashing," which was coined in 1986 by the American environmentalist Jay Westerveld to describe the hotel signs that suggest guests should use fewer towels to save on laundering, supposedly to help the environment, but mostly to increase the hotel's profits. These days it refers to anyone who makes fake environmental claims.

But greenwashing isn't the only threat. Next time you're tempted to buy something in any shade of green, just remember how poisonous that color was in the past, and can be today.

http://www.nytimes.com/2010/04/05/arts/05iht-design5.html?ref=design

Larger Than Life

By BENJAMIN GENOCCHIO

The Colombian artist Fernando Botero is back at the Nassau County Museum of Art, where more than 70 of his sketches, drawings and paintings were exhibited five years ago. The museum is now showing a small but significant collection of figure paintings, drawings and monumental sculptures; one of the sculptures, a plump female nude, enlivens the plaza fronting the museum.

Mr. Botero, 77, is probably the most famous living Latin American artist, his painting style characterized by rotund, wildly inflated objects and figures. Art is deformation for Mr. Botero, the artist indulging in a frequently comic disregard for natural proportions.

He is essentially a painter, though in the 1970s he turned to sculpture. This was a logical step in Mr. Botero's career, for his figures tend to create the illusion of three-dimensionality on canvas. In general, his sculptures have the same bloated characteristics as his painted figures, but are much bigger in scale, sometimes exceeding 10 feet in height and weighing over a ton.

In painting or sculpture, the artist focuses mainly on everyday life, specifically Colombian society: his preferred subjects include food, music and religion. But he is also deeply interested in art history, frequently appropriating and deforming figures from famous paintings. This has led some critics to compare his inflated forms to caricatures, even satires, which sometimes they are.

The dozen bronze sculptures in the present show are largely based on famous works of art. Edgar Degas obviously provided some inspiration for "Ballerina" (2005) and "Ballerina Vestita" (2006), sculptures of young women dancing, while Pablo Picasso is the source for "Donna in Piedi (Standing Woman)" (2007), a massive work showing a naked woman washing her hair.

Several other sculptures here recall Picasso paintings and sculptures, including "Donna Seduta (Piccola Donna Su Gradino) (2007)," "Reclining Woman" (2000) and "Seated Woman," undated, all of which depict voluptuous nudes. Picasso loved nudes, painting and drawing them throughout his long career. This show suggests that Mr. Botero does, too.

In addition to sculptures of nude women, the show includes a room of paintings and drawings of nudes. Here are acres of voluptuous flesh, the artist depicting women with bulging stomachs, enormous buttocks

and thighs, and, somewhat comically, tiny rounded breasts, small heads, arms and feet. They convey unabashed sensuality, even a hint of sexuality.

Once again art historical imagery comes to mind, for these figures are reminiscent of all those voluptuous female nudes by Botticelli, Rubens, Bonnard, Matisse and other classical European painters, albeit exaggerated and overblown. The main difference is that Mr. Botero's figures fill the canvas, as if they were models on a billboard, looking indifferently out at the viewer.

The artist also likes to incorporate art historical symbols that convey distinct, easily recognizable messages. For example, the ripe apple with a bite out of it lying on a dressing table next to a nude in "Venus" (2005), showing here, symbolizes sin, as the forbidden fruit in the story of Adam and Eve.

The same model in "Venus" seems to reappear in two other paintings here, "Reclining Nude With Book" (1997) and "Odalisca" (1998), both of which also depict single nudes filling the frame. Both works are art historical quotations; the first is taken from a Manet painting, while the second is a copy of a work by Matisse. "Venus" is based on a Bonnard painting.

Apart from the female nudes, the show also includes paintings and sculptures dealing with religion, food, music and other of the artist's interests. "El Cardenal" (1977) shows a portly cleric asleep outdoors in his ecclesiastical attire. It is a simple but lovely image, gently mocking the central, if perhaps slightly antiquated, role of religion in contemporary Colombian life.

The subtle shading of the clothing in "El Cardenal" shows off Botero's tremendous skills as a painter; he has the dexterity of an old master. That is what I admire about him, as well as his ability to bring something fresh and new to old genres such as portraiture. He is a caricaturist, but also a sensualist, creating warm-hearted, eye-catching images through exaggerated form.

"Fernando Botero" is at the Nassau County Museum of Art, 1 Museum Drive, Roslyn Harbor, through May 23. Information: nassaumuseum.org or (516) 484-9337.

http://www.nytimes.com/2010/04/04/nyregion/04artsli.html?ref=design

E.P.A. to Limit Water Pollution From Mining

By TOM ZELLER Jr.
The Environmental Protection Agency issued tough new water quality guidelines on Thursday that could curtail some of the most contentious coal mining techniques used across Appalachia.

In announcing the guidelines, Lisa P. Jackson, the agency's administrator, cited evolving science on the effects of mountaintop removal mining, an aggressive form of coal extraction that uses explosives and vast machinery to tear off hilltops to expose coal seams, dumping the resulting rubble into streams and valleys below. The goal of the new rules, Ms. Jackson said, is to prevent "significant and irreversible damage" to Appalachian watersheds.

"Let me be clear," Ms. Jackson said during a phone call with reporters. "This is not about ending coal mining. This is about ending coal mining pollution."

The most substantial effect of the new guidelines — which the agency will promulgate to regional offices that issue permits — will be to benchmark the permissible levels of mining runoff likely to be introduced into the waterways surrounding a proposed project. Operations that would result in levels roughly five times above normal would be considered too damaging.

Ms. Jackson suggested that one practical result of the guidelines would be to make it far more difficult for so-called valley fill operations, where layers of soil and rock are removed from mountaintops and piled in nearby valleys and streams, to receive permits.

Also on Thursday, the E.P.A. published a pair of scientific reports that supported the new guidelines and announced plans for a new Web-based clearinghouse that will track mining permits under review.

Environmental groups hailed the guidelines as long overdue and an important step in bringing science to bear on environmental policy.

"I think it's a very good day for people in Appalachia," said Jon Devine, a senior attorney with the Natural Resources Defense Council. "E.P.A. is making clear that it is intending to follow the science when it issues permits."

Mining industry representatives, however, said the guidelines threatened jobs in the region.

"America's coal mining communities are deeply concerned by the impact of policy announced today by E.P.A. on coal mining permits, employment and economic activity throughout Appalachia," Bruce Watzman, senior vice president for regulatory affairs at the National Mining Association, said in an e-mailed statement.

"The policy was announced without the required transparency and opportunity for public comment that is afforded to policies of this magnitude," Mr. Watzman added.

http://www.nytimes.com/2010/04/02/science/earth/02coal.html?ref=science

Concern over non-native species

A number of non-native mammal species are damaging the UK countryside by eating crops and threatening wildlife, a conservation charity has warned.

A report by the People's Trust for Endangered Species identified 14 problem species including rats, American mink and muntjac deer.

The trust said some of the creatures have been in the UK for so long, they are thought of as indigenous.

It said it was important to stop the extinction of native species.

Practical action

According to the report, two of the UK's fastest declining native species - the red squirrel and the water vole - which has declined by 90% - are under threat by mammals introduced by humans in the last two centuries.

American minks prey on water voles while grey squirrels, which were introduced to the UK in the 19th century carry the deadly squirrelpox virus and outcompete the native red squirrel when it comes to hunting for food and habitats.

The trust also warned the red-necked wallaby is capable of damaging capercaillie birds on Loch Lomond island, while muntjac deer congregating in high numbers are also accused of being a threat to wildlife.

According to the British Deer Society, muntjac were brought from China to a park in Bedfordshire in the early 20th century.

They spread across the country after they escaped, or were deliberately released, from the park.

Further invasions

People's Trust chief executive Jill Nelson said: "Our campaign to conserve Britain's native mammals is rooted in finding more about each animal's behaviour in response to the various threats they face and translating that knowledge into practical conservation action."

She said the way with how the UK dealt with the problem was a "vital component in preventing their extinction".

The trust said the species can have a negative impact on UK wildlife, landscape and agriculture. This range of problems include carrying disease, breeding with species to produce hybrids and altering the landscape and damaging crops.

The report also warned that global trade and a changing climate could lead to the invasion of more alien species.

Other species to have made the list include house mice and rabbits.

But the report, researched by professor David Macdonald and doctor Dawn Burnham from the University of Oxford Wildlife Conservation Research Unit acknowledged, that while rabbits are mainly seen as a pest, they can also have a positive conservation effect in particular areas where they graze.

Story from BBC NEWS:
http://news.bbc.co.uk/go/pr/fr/-/2/hi/uk_news/8602358.stm

Published: 2010/04/04 01:33:59 GMT

Blocking gene boosts radiotherapy

A gene which hinders the ability of radiotherapy to kill cancer cells has been detected by UK researchers.

The team found that if they blocked the POLQ gene - which has a role in repairing damaged DNA - radiotherapy was more effective.

It is hoped that the discovery, which came about after a trawl through 200 candidate genes, could lead to new drugs to boost radiotherapy.

The findings are published in the journal Cancer Research.

Many thousands of cancer patients will have some form of radiotherapy as part of their treatment, and it is estimated to contribute to 40% of cases where cancer is eliminated.

" **The next stage is to translate this discovery into a treatment that will benefit patients** "
Professor Gillies McKenna

The researchers from the University of Oxford said tumours can differ widely in the way they respond to radiotherapy - but the reasons for these differences are largely unknown.

In order to find a potential target for increasing the chances that radiotherapy would work, they looked specifically at genes involved in repairing DNA damage.

After pinpointing the POLQ gene, they found that blocking it in several different types of cancer cell in the laboratory, including laryngeal and pancreatic tumours, rendered the cells more vulnerable to the effects of radiation.

Selective

Previous research had shown that the POLQ gene is not particularly active in normal healthy tissue.

Doing the same experiment in healthy cells, the team found that blocking the gene did not have any effect on the sensitivity of normal tissue to radiation.

The researchers said the fact that the POLQ seemed to more abundant in cancer cells than normal cells made it a good target for boosting the effects of radiotherapy.

Study leader Dr Geoff Higgins, a Cancer Research UK scientist at the Gray Institute for Radiation Oncology and Biology, said: "We've sieved through a vast pool of promising genetic information and identified a gene that could potentially be targeted by drugs to improve the effectiveness of radiotherapy.

"Blocking the activity of this gene resulted in a greater number of tumour cells dying after radiotherapy and provides new avenues for research."

Professor Gillies McKenna, director of the institute, added: "The next stage is to translate this discovery into a treatment that will benefit patients."

Story from BBC NEWS:
http://news.bbc.co.uk/go/pr/fr/-/2/hi/health/8596797.stm

Published: 2010/04/02 23:00:34 GMT

For a rare few, driving and cell phones go well together

A small portion of the population excels at doing two or more things at once
By Bruce Bower
Web edition : Wednesday, March 31st, 2010

Cell phone users frequently drive themselves to distraction while operating cars, and all too often end up in traffic accidents. But a select few multitask behind the wheel with extraordinary skill, a new study finds.About one in 40 drivers qualifies as a "supertasker," able to combine driving and cell phone use without impairing performance of either activity, say psychologists Jason Watson and David Strayer, both of the University of Utah in Salt Lake City. These unusual exceptions to the general rule that performance declines when a person does two things at once (*SN: 3/13/10, p. 16*) may offer insights into the workings of attention and mental control, Watson and Strayer propose in an upcoming *Psychonomic Bulletin & Review*.Laboratory tests of 200 volunteers operating a driving simulator identified five extraordinary individuals. These people were good drivers: They hit the brakes quickly in response to cars that slowed in front of them and maintained a safe distance from other cars. They also excelled at solving simple math problems and remembering words heard over a hands-free cell phone when not driving. Critically, their performance on these tasks stayed just as high while driving and using cell phones at the same time.

"Supertaskers did a phenomenal job of performing several different tasks at once," Watson says. "We'd all like to think we could do the same, but the odds are overwhelmingly against it."Watson and Strayer studied college students, ages 18 to 43. After learning to operate a driving simulator on a virtual highway, participants followed an intermittently braking pace car driving in the right-hand lane. For each volunteer, the researchers measured time needed to depress the brakes when the pace car slowed and distance from the pace car throughout the trip.In a separate trial, participants listened through hands-free cell phones as an experimenter read two to five words interspersed with simple math problems that had to be immediately labeled as true or false. Volunteers then tried to recall words in the order that they were presented.

As expected, overall group performance declined markedly when driving and the cell-phone task were performed at the same time. Volunteers took an average of 20 percent longer to hit the brakes when needed, and increasingly fell behind the pace car. Word recall fell by 11 percent and math accuracy declined 3 percent.But the handful of supertaskers maintained their braking times, following distances and math accuracy while multitasking. Their word recall rose 3 percent.

Stanford University sociologist Clifford Nass wonders whether supertaskers in the new study prefer doing many things at once in their daily lives. He and his colleagues have found that young adults who often multitask — say by regularly sending text messages while navigating websites and watching television — perform worse when switching back and forth between two mental tasks than peers who rarely multitask. Frequent multitaskers have difficulty ignoring information irrelevant to a task at hand, Nass argues.

That leads Nass to the somewhat surprising conclusion that supertaskers tend not to juggle multiple duties and don't need to practice multitasking to be good at it.Researchers need to explore whether supertaskers jointly simply perform well-learned abilities the same way everyone else does but with far more efficiency, or instead deploy mental resources in distinctive ways, says psychologist Randall Engle of Georgia Tech in Atlanta.

Watson and Strayer plan to do that by comparing various measures of brain activity for people who do and don't rank as supertaskers.

http://www.sciencenews.org/view/generic/id/57822/title/For_a_rare_few%2C_driving_and_cell_phones_go_well_together

Warmth in the dark age

Lower reflectivity kept Earth from freezing under a fainter young sun
By Sid Perkins
Web edition : Wednesday, March 31st, 2010

Though the sun was so much dimmer billions of years ago that the young Earth should have been literally freezing, the planet remained largely covered with liquid water. That was thanks to a substantially darker surface and a dearth of light-scattering clouds, a new study suggests."All other things being equal, Earth should have been frozen over for the first half of its existence," says James F. Kasting, a geoscientist at Pennsylvania State University in University Park who was not involved in the research. "But it wasn't."

Previously scientists have explained the presence of liquid water at that low-light time, during the Archean eon of geologic history, by suggesting that Earth's atmosphere held large amounts of planet-warming greenhouse gases such as carbon dioxide and methane. But new analyses show that greenhouse gases weren't dramatically higher then compared with today, a team of earth scientists reports in the April 1 *Nature*. The researchers now propose that early Earth stayed above freezing because the planet was darker then and therefore absorbed more of the sun's energy — the same phenomenon that renders dark vinyl car seats scorching hot while light-colored seats stay relatively cool.Early in the sun's lifetime, the portion of solar core where the light- and heat-generating fusion reactions take place was much smaller than it is today. So, for an extended period, the sun could have been up to 30 percent dimmer than it is now, says Minik Rosing, a geologist at the University of Copenhagen's Nordic Center for Earth Evolution. Although Earth's surface temperature should have been well below freezing, geological signs of liquid water in that era abound — a puzzler that scientists have dubbed the "faint young sun paradox."

Some studies have suggested that carbon dioxide concentrations in Earth's early atmosphere were more than 100 times current levels. But the new analyses of ancient rocks known as banded iron formations reveal proportions of iron-bearing minerals that could appear only if carbon dioxide levels were no more than three times modern values — a concentration too low to keep the planet from freezing beneath a faint young sun. Methane probably didn't help make up the difference, Rosing adds, because at high concentrations methane reacts chemically to form a light-scattering haze that would have cooled Earth's surface rather than warming it.What probably kept Earth above freezing during the dim-sun era was its darker surface, Rosing and his colleagues contend. The continents were much smaller then, so the planet's oceans — which are typically much darker than landmasses — could absorb more heat. About 3.8 billion years ago, continents covered less than 5 percent of Earth's surface, a proportion that gradually rose to reach today's value of 30 percent around 1.5 billion years ago.

Second, the researchers suggest, light-scattering clouds covered much less of Earth's surface long ago — another net gain for surface warmth. Because early Earth lacked plants and other complex life, the biologically produced particles and chemicals that water droplets coalesce around weren't available. In the few clouds that did form, droplets were larger and scattered light less efficiently, allowing more warming radiation to reach ground level.In their paper, the researchers present a numerical simulation that shows how these two rather straightforward phenomena could have kept Earth's average temperature above freezing.

"A lot of the reviewers of our paper were kicking themselves and asking, 'Why didn't we think of this first?'" Rosing notes.

Despite the new findings, the faint young sun problem may not be fully solved, Kasting notes. For one thing, the new analyses don't consider the effect of high-latitude ice masses on the planet's albedo. "We clearly need additional constraints to understand why the Archean Earth remained habitable," he comments in *Nature*.

http://www.sciencenews.org/view/generic/id/57810/title/Warmth_in_the_dark_age

Why Earth Wasn't One Big Ball of Ice 4 Billion Years Ago When Sun's Radiation Was Weaker

Scientists have solved one of the great mysteries of our geological past: Why the Earth's surface was not one big lump of ice four billion years ago when sun radiation was much weaker than today. (Credit: iStockphoto)

ScienceDaily (Apr. 1, 2010) — Scientists have solved one of the great mysteries of our geological past: Why Earth's surface was not one big lump of ice four billion years ago when Sun radiation was much weaker than today. Scientists have presumed that Earth's atmosphere back then consisted of 30 percent CO_2 trapping heat like a greenhouse. However, new research shows that the reason for Earth not going into a deep freeze at the time was quite different.

In 1972, the late, world famous astronomer Carl Sagan and his colleague George Mullen formulated "The faint early Sun paradox. " The paradox consisted in that Earth's climate has been fairly constant during almost four of the four and a half billion years that the planet has been in existence, and this despite the fact that radiation from the Sun has increased by 25-30 percent.

The paradoxical question that arose for scientists in this connection was why Earth's surface at its fragile beginning was not covered by ice, seeing that the Sun's rays were much fainter than they are today. Science found one probable answer in 1993, which was proffered by the American atmospheric scientist, Jim Kasting. He performed theoretical calculations that showed that 30% of Earth's atmosphere four billion years ago consisted of CO_2. This in turn entailed that the large amount of greenhouse gases layered themselves as a protective greenhouse around the planet, thereby preventing the oceans from freezing over.

Mystery solved

Now, however, Professor Minik Rosing, from the Natural History Museum of Denmark, and Christian Bjerrum, from the Department of Geography and Geology at University of Copenhagen, together with American colleagues from Stanford University in California have discovered the reason for "the missing ice age" back then, thereby solving the Sun paradox, which has haunted scientific circles for more than 40 years.

Professor Minik Rosing explains: "What prevented an ice age back then was not high CO_2 concentration in the atmosphere, but the fact that the cloud layer was much thinner than it is today. In addition to this,

Earth's surface was covered by water. This meant that the Sun's rays could warm the oceans unobstructed, which in turn could layer the heat, thereby preventing Earth's watery surface from freezing into ice. The reason for the lack of clouds back in Earth's childhood can be explained by the process by which clouds form. This process requires chemical substances that are produced by algae and plants, which did not exist at the time. These chemical processes would have been able to form a dense layer of clouds, which in turn would have reflected the Sun's rays, throwing them back into the cosmos and thereby preventing the warming of Earth's oceans. Scientists have formerly used the relationship between the radiation from the Sun and Earth's surface temperature to calculate that Earth ought to have been in a deep freeze during three billion of its four and a half billion years of existence. Sagan and Mullen brought attention to the paradox between these theoretical calculations and geological reality by the fact that the oceans had not frozen. This paradox of having a faint Sun and ice-free oceans has now been solved."

CO_2 history illluminated

Minik Rosing and his team have by analyzing samples of 3.8-billion-year-old mountain rock from the world's oldest bedrock, Isua, in western Greenland, solved the "paradox."

But more importantly, the analyses also provided a finding for a highly important issue in today's climate research -- and climate debate, not least: whether the atmosphere's CO_2 concentration throughout Earth's history has fluctuated strongly or been fairly stable over the course of billions of years.

"The analyses of the CO_2-content in the atmosphere, which can be deduced from the age-old Isua rock, show that the atmosphere at the time contained a maximum of one part per thousand of this greenhouse gas. This was three to four times more than the atmosphere's CO_2-content today. However, not anywhere in the range of the of the 30 percent share in early Earth history, which has hitherto been the theoretical calculation. Hence we may conclude that the atmosphere's CO_2-content has not changed substantially through the billions of years of Earth's geological history. However, today the graph is turning upward. Not least due to the emissions from fossil fuels used by humans. Therefore it is vital to determine the geological and atmospheric premises for the prehistoric past in order to understand the present, not to mention the future, in what pertains to the design of climate models and calculations," underscores Minik Rosing.

Professor Rosing's scientific research has made its mark internationally on several earlier occasions, including research on the point in time when the first fragile life appeared and the impact of life's presence on the formation of Earth's landmass.

Story Source:

Adapted from materials provided by University of Copenhagen.

Journal Reference:

1. Minik T. Rosing, Dennis K. Bird, Norman H. Sleep, Christian J. Bjerrum. **No climate paradox under the faint early Sun**. *Nature*, 2010; 464 (7289): 744 DOI: 10.1038/nature08955

http://www.sciencedaily.com/releases/2010/03/100331141415.htm

Proteins in Unroasted Coffee Beans May Become Next-Generation Insecticides

Unroasted coffee beans. (Credit: iStockphoto/Stacy Able)

ScienceDaily (Apr. 1, 2010) — Scientists in Brazil are reporting for the first time that coffee beans contain proteins that can kill insects and might be developed into new insecticides for protecting food crops against destructive pests.

Their study, which suggests a new use for one of the most important tropical crops in the world, appears in ACS' *Journal of Agricultural and Food Chemistry*, a bi-weekly publication.

Peas, beans and some other plant seeds contain proteins, called globulins, which ward off insects. Coffee beans contain large amounts of globulins, and Paulo Mazzafera and colleagues wondered whether those coffee proteins might also have an insecticidal effect. The high heat of roasting destroys globulins, so that they do not appear in brewed coffee.

Their tests against cowpea weevil larva, insects used as models for studying the insecticidal activity of proteins, showed that tiny amounts of the coffee proteins quickly killed up to half of the insects. In the future, scientists could insert genes for these insect-killing proteins into important food crops, such as grains, so that plants produce their own insecticides, the researchers suggest. The proteins appear harmless to people.

Story Source:

Adapted from materials provided by American Chemical Society, via EurekAlert!, a service of AAAS.

Journal Reference:

1. Mirela Batista Coelho, Maria Li%u0301gia Rodrigues Macedo, Se%u0301rgio Marangoni, Desiree Soares da Silva, Igor Cesarino, Paulo Mazzafera. **Purification of Legumin-Like Proteins from Coffea arabica and Coffea racemosa Seeds and Their Insecticidal Properties toward Cowpea Weevil (Callosobruchus maculatus) (Coleoptera: Bruchidae)**. *Journal of Agricultural and Food Chemistry*, 2010; 58 (5): 3050 DOI: 10.1021/jf9037216

http://www.sciencedaily.com/releases/2010/03/100331122650.htm

Impaired Brain Connections Traced to Schizophrenia Mutation; Like Patients, Engineered Mice Falter at Working Memory Tasks

To receive a reward, a mouse in the T-maze had to remember whether it had turned left or right on the previous trial, and turn in the opposite direction. Mice genetically engineered to lack a specific segment of genetic material on Chromosome 22, a known cause of schizophrenia -- like patients with the disorder -- faltered at such working memory tasks, because of poor functional connections between the brain's executive and memory hubs. (Credit: Torfi Sigurdsson, PhD, Department of Psychiatry, Columbia University)

ScienceDaily (Apr. 1, 2010) — The strongest known recurrent genetic cause of schizophrenia impairs communications between the brain's decision-making and memory hubs, resulting in working memory deficits, according to a study in mice.

"For the first time, we have a powerful animal model that shows us how genetics affects brain circuitry, at the level of single neurons, to produce a learning and memory deficit linked to schizophrenia," explained Thomas R. Insel, M.D., director of the National Institute of Mental Health (NIMH), part of the National Institutes of Health. "This new research tool holds promise for ultimately unraveling the underlying anatomical connections and specific genes involved."

NIMH grantees Joshua Gordon, M.D., Ph.D., Joseph Gogos, M.D., Ph.D., Maria Karayiorgou, M.D., and Columbia University colleagues, report on their discovery in genetically engineered mice in the April 1, 2010 issue of the journal *Nature*.

"Our findings pinpoint a specific circuit and mechanism by which a mutation produces a core feature of the disorder," said Gordon, who led the research.

Researchers have suspected such a brain connectivity disturbance in schizophrenia for more than a century, and the NIH has launched a new initiative on the brain's functional circuitry, or connectome. Although the disorder is thought to be 70 percent heritable, its genetics are dauntingly complex, except in certain rare cases, such as those traced to the mutation in question.

Prior to this study, neuroimaging studies in schizophrenia patients had found abnormal connections between the brain's prefrontal cortex, the executive hub, and the hippocampus, the memory hub, linked to impaired working memory. It was also known that a mutation in the suspect site on chromosome 22, called 22q11.2, boosts schizophrenia risk 30-fold and also causes other abnormalities). Although accounting for only a small portion of cases, this tiny missing section of genetic material, called a

microdeletion, has repeatedly turned up in genetic studies of schizophrenia and is an indisputable risk factor for the illness.

Still, the mutation's link to the disturbed connectivity and working memory deficit eluded detection until now.

To explore the mutation's effects on brain circuitry, Gogos, Karayiorgou and colleagues engineered a line of mice expressing the same missing segment of genetic material as the patients. Strikingly, like their human counterparts with schizophrenia, these animals turned out to have difficulty with working memory tasks -- holding information in mind from moment to moment.

Successful performance of such tasks depends on good connections in a circuit linking the prefrontal cortex and the hippocampus. To measure such functional connections, Gordon and colleagues monitored signals emitted by single neurons implanted in the two distant brain structures while mice performed a working memory task in a T-maze (see below).

The more in-sync the neurons from the two areas fired, the better the functional connections between the two structures -- and the better the mice performed the task. Moreover, the better the synchrony to start with, the quicker the animals learned the task. The more synchrony improved, the better they performed.

As suspected, the mice with the chromosome 22 mutation faltered on all counts -- showing much worse synchrony, learning and performance levels than control mice.

"Our results extend beyond those in patients by showing how an undeniable genetic risk factor for schizophrenia can disrupt connectivity at the level of single neurons," explained Gordon.

The researchers plan to follow up with studies into how the mutation affects brain anatomical and molecular connections and the workings of affected genes.

The research was also funded by the Simons Foundation.

Story Source:

Adapted from materials provided by NIH/National Institute of Mental Health, via EurekAlert!, a service of AAAS.

Journal Reference:

1. Torfi Sigurdsson, Kimberly L. Stark, Maria Karayiorgou, Joseph A. Gogos, Joshua A. Gordon. **Impaired hippocampal-prefrontal synchrony in a genetic mouse model of schizophrenia**. *Nature*, 2010; 464 (7289): 763 DOI: 10.1038/nature08855

http://www.sciencedaily.com/releases/2010/03/100331161623.htm

Computer Model Predicts Shifts in Carbon Absorption by Forest Canopies

An ARS scientist recently helped refine computer models that can indicate when forest "carbon sinks" become net carbon generators instead, such as when gypsy moths defoliate the canopy. (Credit: Photo courtesy of NRCS)

ScienceDaily (Apr. 1, 2010) — An Agricultural Research Service (ARS) scientist participated in a project to fine-tune computer models that can indicate when forest "carbon sinks" become net carbon generators instead. The results will help pinpoint the effectiveness of trees in offsetting carbon releases that contribute to higher atmospheric temperatures and global climate change.

ARS plant physiologist Erik Hamerlynck teamed up with Rutgers University biologist Karina Schafer and U.S. Forest Service colleagues Kenneth Clark and Nicholas Skowronski to calibrate the Canopy Conductance Constrained Carbon Assimilation (4C-A) model, a computer program that generates carbon balance estimates for tree canopies. Hamerlynck works at the ARS Southwest Watershed Research Center in Tucson, Ariz.

In the summer of 2006, the team measured tree sap flow and leaf-level photosynthetic gas exchange at different canopy levels in a stand of oaks and pines in the New Jersey Pine Barrens. These data were used to calibrate the 4C-A model to simulate the amount of carbon the tree canopy absorbs and releases into the atmosphere via photosynthesis and respiration.

Results from the calibrated model -- which were within 15 percent of estimates from three other techniques -- indicated that the average seasonal carbon absorption of the stand was around 1,240 grams of carbon per square meter of canopy area. The scientists then used the 4C-A model to estimate seasonal carbon exchange rates for 2007, when the same stand of trees was completely defoliated for 2 to 3 weeks during an infestation of gypsy moths. This infestation occurred when the stand was at its seasonal peak for carbon uptake.

The model showed that after the gypsy moths had finished foraging, the average carbon absorption rates for the growing season dropped 25 percent to around 940 grams of carbon per square meter of canopy area. This decline meant that the stand was no longer a net carbon "sink" -- it ended up adding more carbon back to the atmosphere than it had absorbed.

According to the U.S. Forest Service, U.S. forests absorb and store about 750 million metric tons of carbon dioxide each year. Managing forest resources to optimize carbon sequestration is essential in mitigating the effects of climate change.

Results from this work were published in *Global Change Biology*.

Story Source:

Adapted from materials provided by USDA/Agricultural Research Service.

Journal Reference:

1. Karina V. R. Schäfer, Kenneth L. Clark, Nicholas Skowronski, Erik P. Hamerlynck. **Impact of insect defoliation on forest carbon balance as assessed with a canopy assimilation model**. *Global Change Biology*, 2010; 16 (2): 546 DOI: 10.1111/j.1365-2486.2009.02037.x

http://www.sciencedaily.com/releases/2010/03/100331104923.htm

Extracting Information from Starlight

The NIRSpec Engineering Test Unit was provided by the European Space Agency, with EADS-Astrium GmbH as Prime Contractor. NIRSpec will be the principal spectrographic instrument on board the Webb telescope. (Credit: EADS Astrium)

ScienceDaily (Mar. 31, 2010) — The cosmos is filled with stars. However, the closest star beyond the Sun is so far away, that it would take the fastest spacecraft 75,000 years to reach it. Astronomers can't study the cosmos by sending probes to gather information about other stars, as we do with our own Sun and its planets. Fortunately they don't have to. The information comes to us at the speed of light!

The light of stars is produced by atoms and molecules that encode, in the starlight itself, key science information about their chemical composition, temperature, pressure, and velocity. To receive and extract this information, astronomers will use the James Webb Space Telescope and a first-of-its kind science instrument whose prototype has just arrived at NASA's Goddard Space Flight Center, Greenbelt, Md. from its manufacturer in Germany.

The Webb telescope contains a giant 25 square meter (~30 square yard) mirror that will collect the faint light from distant stars and feed it to one of four science instruments that are each designed to extract a specific type of information contained in the light itself. One of the most scientifically powerful instruments is a Near-Infrared multi-object Spectrograph (NIRSpec) that disperses the white star light into a spectrum so that the contribution of individual atoms and molecules in the star can be seen. The atoms and molecules in the star imprint lines on this spectrum that uniquely fingerprint each chemical element and reveal a wealth of information about physical conditions in the star. Spectroscopy (the science of interpreting these lines), is among the sharpest tools in the shed for exploring the cosmos.

Many of the objects that the Webb will study, such as the first galaxies to form after the Big Bang, are so faint, that the Webb's giant mirror must stare at them for hundreds of hours in order to collect enough light to form a spectrum. In order to study thousands of galaxies during its 5 year mission, the NIRSpec is designed to observe 100 objects simultaneously. The NIRSpec will be the first spectrograph in space that has this remarkable multi-object capability. To make it possible, Goddard scientists and engineers had to invent a new technology micro-shutter system to control how light enters the NIRSpec.

Although the night sky appears black, it's not really dark. If your eyes could see in the infrared, the night sky would appear to glow just as the daytime sky glows at visible wavelengths. The infrared glow of the night sky, known as the Zodiacal light, is produced by a cloud of dust that surrounds the Earth and Mars that the Webb must look through. Observing the first galaxies through this Zodiacal light, is analogous to observing stars during the daytime with your eye. To prevent the NIRSpec from being blinded by the Zodiacal light, the Webb telescope forms a magnified image of the sky onto a programmable array of 250,000 shutters that are each the diameter of a human hair. Shutters under objects in this image for

which a spectrum is desired, are commanded open allowing their light to enter the NIRSpec. The remaining shutters are held closed to minimize the Zodiacal light that can enter NIRSpec and reduce its sensitivity.

The NIRSpec micro-shutter system is one of 10 technologies that had to be invented to make the Webb mission possible. During the Webb mission, each shutter must withstand approximately 100,000 open/close cycles while operating at 40 K (-230 oC). In order to make the large NIRSpec instrument light enough to fly on the Webb, its structure and optics are made of an advanced ceramic material called silicon carbide. The NIRSpec is among the most advanced astronomy instruments ever built.

NASA Goddard has a lot invested in the NIRSpec. Goddard built NIRSpec's detector and microshutter systems. EADS/Astrium is the European Space Agency's (ESA) prime contractor for the overall NIRSpec instrument. The prototype instrument was integrated and tested at Astrium's facility in Munich, Germany, before being shipped to Goddard.

Now that it has arrived at Goddard, the NIRSpec prototype will go through pre-integration testing with electronic and mechanical systems of the Webb's Integrated Science Instrument Module (ISIM). Along with the other prototype instruments, the NIRSpec will be fitted into the ISIM flight structure, which is also currently at Goddard. These prototype instrument models are flight-like in form, fit, and function. They enable engineers to develop and practice integration and test procedures before handling the actual flight units.

The James Webb Space Telescope is the next-generation premier space observatory, exploring deep space phenomena from distant galaxies to nearby planets and stars. The Webb Telescope will give scientists clues about the formation of the universe and the evolution of our own solar system, from the first light after the Big Bang to the formation of star systems capable of supporting life on planets like Earth.

The Webb Telescope project is managed at NASA's Goddard Space Flight Center in Greenbelt, Md. The telescope is a joint project of NASA, the European Space Agency and the Canadian Space Agency, and will launch in 2014.

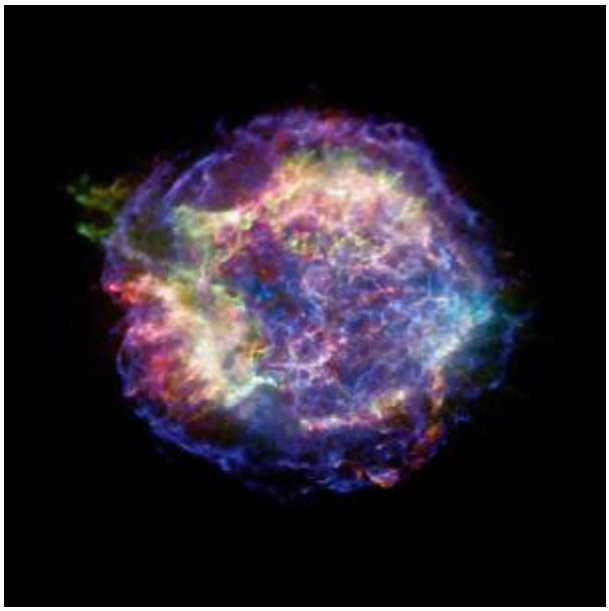
For information about NASA's James Webb Space Telescope, visit: http://www.jwst.nasa.gov/

Story Source:

Adapted from materials provided by NASA/Goddard Space Flight Center.

http://www.sciencedaily.com/releases/2010/03/100330172849.htm

Astronomers See Historical Supernova from a New Angle



Chandra X-ray Observatory image of the supernova remnant Cassiopeia A (Cas A). The red, green, and blue regions in this X-ray image of Cas A show where the intensity of low, medium, and high-energy X-rays, respectively, is greatest. While this photo shows the remains of the exploded star, light echoes show us reflected light from the explosion itself. (Credit: NASA/CXC/MIT/UMass Amherst/M.D.Stage et al.)

ScienceDaily (Mar. 31, 2010) — Since Galileo first pointed a telescope at the sky 400 years ago, a myriad of technological advances have allowed astronomers to look at very faint objects, very distant objects, and even light that's invisible to the human eye. Yet, one aspect usually remains out of reach -- the benefit of a 3-D perspective.

Our telescopes show the Milky Way galaxy only as it appears from one vantage point: our solar system. Now, using a simple but powerful technique, a group of astronomers led by Armin Rest of Harvard University has seen an exploding star or supernova from several angles.

"The same event looks different from different places in the Milky Way," said Rest. "For the first time, we can see a supernova from an alien perspective."

The supernova left behind the gaseous remnant Cassiopeia A. The supernova's light washed over the Earth about 330 years ago. But light that took a longer path, reflecting off clouds of interstellar dust, is just now reaching us. This faint, reflected light is what the astronomers have detected.

The technique is based on the familiar concept of an echo, but applied to light instead of sound. If you yell, "Echo!" in a cave, sound waves bounce off the walls and reflect back to your ears, creating echoes. Similarly, light from the supernova reflects off interstellar dust to the Earth. The dust cloud acts like a mirror, creating light echoes that come from different directions depending on where the clouds are located.

"Just like mirrors in a changing room show you a clothing outfit from all sides, interstellar dust clouds act like mirrors to show us different sides of the supernova," explained Rest.

Moreover, an audible echo is delayed since it takes time for the sound waves to bounce around the cave and back. Light echoes also are delayed by the time it takes for light to travel to the dust and reflect back.

As a result, light echoing from the supernova can reach us hundreds of years after the supernova itself has faded away.

Not only do light echoes give astronomers a chance to directly study historical supernovae, they also provide a 3-D perspective since each echo comes from a spot with a different view of the explosion.

Most people think a supernova is like a powerful fireworks blast, expanding outward in a round shell that looks the same from every angle. But by studying the light echoes, the team discovered that one direction in particular looked significantly different than the others.

They found signs of gas from the stellar explosion streaming toward one point at a speed almost 9 million miles per hour (2,500 miles per second) faster than any other observed direction.

"This supernova was two-faced!" said Smithsonian co-author and Clay Fellow Ryan Foley. "In one direction the exploding star was blasted to a much higher speed."

Previous studies support the team's finding. For example, the neutron star created when the star's core collapsed is zooming through space at nearly 800,000 miles per hour in a direction opposite the unique light echo. The explosion may have kicked gas one way and the neutron star out the other side (a consequence of Newton's third law of motion, which states that every action has an equal and opposite reaction).

By combining the new light-echo measurements and the movement of the neutron star with X-ray data on the supernova remnant, astronomers have assembled a 3-D perspective, giving them new insight into the Cas A supernova.

"Now we can connect the dots from the explosion itself, to the supernova's light, to the supernova remnant," said Foley.

Cassiopeia A is located about 16,000 light-years from Earth and contains matter at temperatures of around 50 million degrees F, causing it to glow in X-rays. A 3-D computer model of the remnant is online.

The Mayall 4-meter telescope at Kitt Peak National Observatory was used to locate the light echoes. Follow-up spectra were obtained with the 10-meter Keck I Telescope.

Story Source:

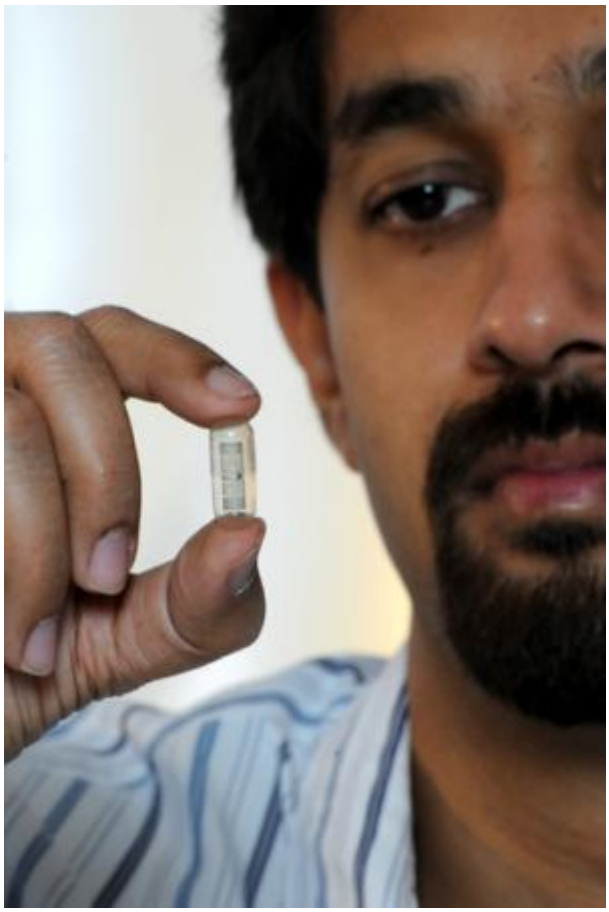
Adapted from materials provided by Harvard-Smithsonian Center for Astrophysics.

Journal Reference:

1. A. Rest, R. J. Foley, B. Sinnott, D. L. Welch, C. Badenes, A. V. Filippenko, M. Bergmann, W. A. Bhatti, S. Blondin, P. Challis, G. Damke, H. Finley, M. E. Huber, D. Kasen, R. P. Kirshner, T. Matheson, P. Mazzali, D. Minniti, R. Nakajima, G. Narayan, K. Olsen, D. Sauer, R. C. Smith, N. B. Suntzeff. **Direct Confirmation of the Asymmetry of the Cas A SN Explosion with Light Echoes**. *Astrophysics*, [link]

http://www.sciencedaily.com/releases/2010/03/100331104925.htm

Tattletale Pills: Engineers Design Pill That Signals It Has Been Swallowed



Rizwan Bashirullah, a University of Florida assistant professor of electrical and computer engineering, holds a pill capsule designed to signal when a patient has swallowed it in this photo taken March 19, 2010. The pill is needed because many patients fail to take their medication, exacerbating medical problems, causing unneeded hospitalizations and leading to an estimated 217,000 deaths annually. Consisting of an antenna made with nontoxic silver nanoparticles and a tiny microchip about the size of a period, the pill works by communicating from inside the body with a stand-alone device worn by the patient. (Credit: Ray Carson, UF News Bureau)

ScienceDaily (Mar. 31, 2010) — Call them tattletale pills. Seeking a way to confirm that patients have taken their medication, University of Florida engineering researchers have added a tiny microchip and digestible antenna to a standard pill capsule. The prototype is intended to pave the way for mass-produced pills that, when ingested, automatically alert doctors, loved ones or scientists working with patients in clinical drug trials.

"It is a way to monitor whether your patient is taking their medication in a timely manner," said Rizwan Bashirullah, UF assistant professor in electrical and computer engineering.

Such a pill is needed because many patients forget, refuse or bungle the job of taking their medication. This causes or exacerbates medical problems, spurs hospitalizations or expensive medical procedures and undercuts clinical trials of new drugs.

The American Heart Association calls patients' failure to follow prescription regimens "the number one problem in treating illness today." Studies have found, for example, that patients with chronic diseases normally take only about half their prescribed medications. According to the American Heart Association,

10 percent of hospital admissions result from patients not following the guidelines on their prescriptions. Other studies have found that not taking medication properly results in 218,000 deaths annually.

So-called "medication compliance" is a big problem for clinical trials, Bashirullah said, because failure to take experiment drugs skews studies' results or renders them meaningless. As a result, researchers often require visual confirmation of participants taking pills, an extremely expensive proposition if hundreds or thousands of people are participating in the trials.

"The idea is to use technology to do this in a more seamless, much less expensive way," Bashirullah said.

Bashirullah, doctoral student Hong Yu, UF materials science and engineering Professor Chris Batich and Neil Euliano of Gainesville-based Convergent Engineering designed and tested a system with two main parts.

One part is the pill, a standard white capsule coated with a label embossed with silvery lines. The lines comprise the antenna, which is printed using ink made of nontoxic, conductive silver nanoparticles. The pill also contains a tiny microchip, one about the size of a period.

When a patient takes the pill, it communicates with the second main element of the system: a small electronic device carried or worn by the patient -- for now, a stand-alone device, but in the future perhaps built into a watch or cell phone. The device then signals a cell phone or laptop that the pill has been ingested, in turn informing doctors or family members.

Bashirullah said the pill needs no battery because the device sends it power via imperceptible bursts of extremely low-voltage electricity. The bursts energize the microchip to send signals relayed via the antenna. Eventually the patient's stomach acid breaks down the antenna -- the microchip is passed through the gastrointestinal tract -- but not before the pill confirms its own ingestion.

"The vision of this project has always been that you have an antenna that is biocompatible, and that essentially dissolves a little while after entering the body," Bashirullah said.

The team has successfully tested the pill system in artificial human models, as well as cadavers. Researchers have also simulated stomach acids to break down the antenna to learn what traces it leaves behind. Bashirullah said those tests had determined the amount of silver retained in the body is tiny, less than what people often receive from common tap water.

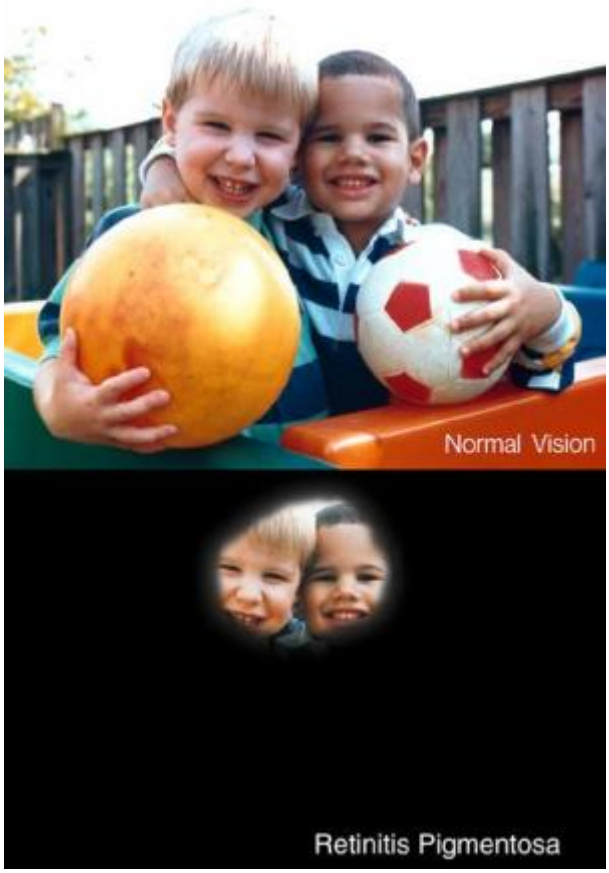
The researchers presented their findings at a conference in Japan last year and are currently at work on a scholarly paper about their research. They have applied for patents, and Bashirullah said a UF spinoff company is seeking to develop the next generation of the pill for FDA testing and commercial development. The research was funded by grants totaling about $700,000 from the National Science Foundation, Convergent Engineering and the Florida High Tech Corridor Council.

Story Source:

Adapted from materials provided by University of Florida.

http://www.sciencedaily.com/releases/2010/03/100331104927.htm

Toward Making the Blind See: Gene Therapy Restores Vision in Mice



Top: Normal vision. Bottom: The same scene as it might be viewed by a person with retinitis pigmentosa. (Credit: National Eye Institute, National Institutes of Health)

ScienceDaily (Mar. 31, 2010) — Scientists from Buffalo, Cleveland, and Oklahoma City made a huge step toward making the blind see, and they did it by using a form of gene therapy that does not involve the use of modified viruses. In a research report published in the April 2010 print issue of *The FASEB Journal*, scientists describe how they used a non-viral, synthetic nanoparticle carrier to improve and save the sight of mice with retinitis pigmentosa, an inherited disease characterized by progressive vision loss and eventual blindness.

"We hope the results of our study will be instrumental in generating a cure for the debilitating blindness associated with retinitis pigmentosa and other inherited and acquired retinal diseases," said Muna I. Naash, Ph.D., a researcher involved in the work from the Department of Cell Biology at the University of Oklahoma Health Sciences Center in Oklahoma City. "Compacted DNA nanoparticles are an exciting treatment strategy for these diseases and we look forward to exciting new developments."

To make this discovery, Naash and colleagues used groups of mice with the retinal degeneration slow (Rds) gene, which causes retinitis pigmentosa. The mice received one of three types of "treatments:" nanoparticles containing the normal copy of the Rds gene, the normal gene alone, or saline solution. After these treatments were delivered to the mice, the structure and function of the retina were analyzed by comparing them to untreated mice with retinitis pigmentosa and healthy mice with the normal Rds gene. Researchers also measured the level and pattern of Rds gene expression, as well as functional, structural and biochemical improvements in disease symptoms. They discovered that mice receiving the nanoparticle gene therapy show significant signs of healing. These mice had structural improvement in their retinas, as well as functional vision improvements, which lasted throughout the duration of the

study. The mice that received the gene alone or saline continued to lose their vision. The nanoparticles were safe and well-tolerated with no adverse effects.

"Making the blind see was once called a miracle," said Gerald Weissmann, M.D., Editor-in-Chief of *The FASEB Journal*. "As we have expanded our understanding of evolution, genetics, and nanotechnology, chances are that "miraculous" cures will become as commonplace as those claimed by faith-healers past and present."

According to the National Institutes of Health Office of Rare Diseases Research, retinitis pigmentosa is a group of inherited eye diseases that affect the retina. Retinitis pigmentosa causes cells in the retina to die prematurely, eventually leading to vision loss. There is no cure.

Story Source:

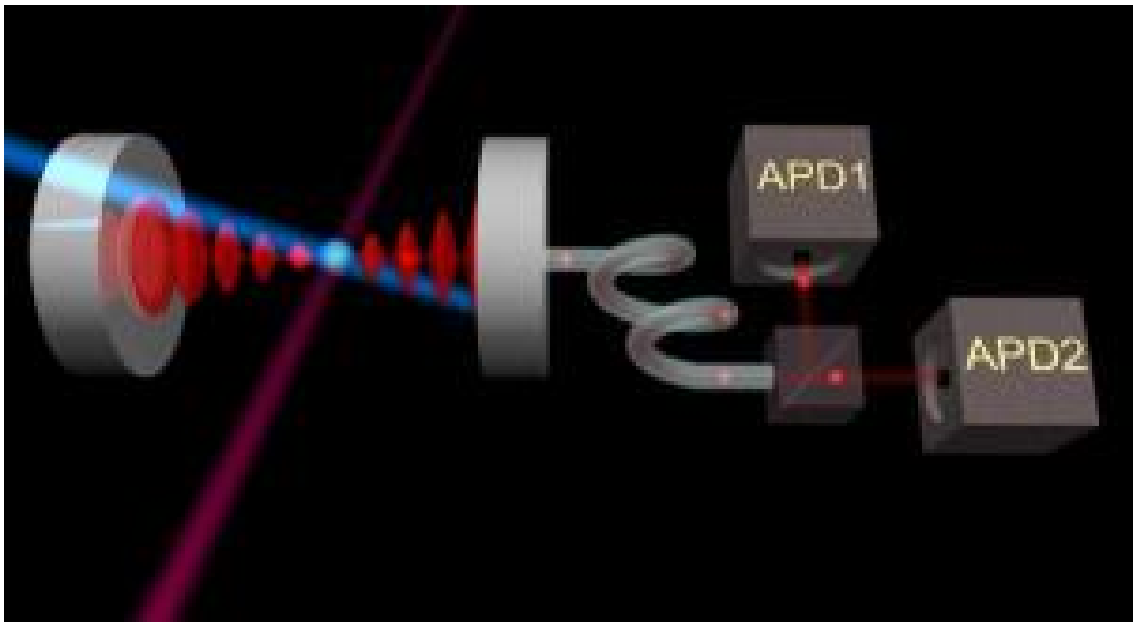
Adapted from materials provided by Federation of American Societies for Experimental Biology, via EurekAlert!, a service of AAAS.

Journal Reference:

1. X. Cai, S. M. Conley, Z. Nash, S. J. Fliesler, M. J. Cooper, M. I. Naash. **Gene delivery to mitotic and postmitotic photoreceptors via compacted DNA nanoparticles results in improved phenotype in a mouse model of retinitis pigmentosa**. *The FASEB Journal*, 2009; DOI: 10.1096/fj.09-139147

http://www.sciencedaily.com/releases/2010/03/100331141623.htm

From a Classical Laser to a 'Quantum Laser'



A high-finesse optical cavity consists of two mirrors, which traps and accumulates the photons emitted by the ion into a mode. The ion is excited cyclically by an external laser and at each cycle a photon is added to the cavity mode, which amplifies the light. (Credit: Piet Schmidt)

ScienceDaily (Mar. 31, 2010) — Rainer Blatt's and Piet Schmidt's research team from the University of Innsbruck has successfully realized a single-atom laser, which shows the properties of a classical laser as well as quantum mechanical properties of the atom-photon interaction.

The scientists have published their findings in the journal *Nature Physics*.

The first laser was developed 50 years ago. Today we cannot imagine life without the artificially produced light waves -- lasers have become an integral part of many appliances used in telecommunication, household, medicine, and research.

A laser normally consists of a gain medium, which is electrically or optically pumped, inside a highly reflective optical cavity (or resonator). The light in the cavity bounces back and forth in the form of modes whereby it is amplified repeatedly. One of the distinctive features of a classical laser is the steep increase of output power when a certain pumping threshold is reached. At this point the gain (amplification by the medium) equals the losses as the light circulates through the cavity. This is caused by the amplification of the interaction between light and atoms: The more photons are present in a mode the stronger the amplification of the light in the mode. This stimulated emission is usually observed in macroscopic lasers comprising of many atoms and photons.

The Innsbruck researchers have demonstrated that a laser threshold can be achieved at the smallest possible building block of a laser: a single atom, which interacts with a single mode in an optical cavity. A single calcium ion is confined in an ion trap and excited by external lasers. A high-finesse optical cavity consists of two mirrors, which traps and accumulates the photons emitted by the ion into a mode. The ion is excited cyclically by an external laser and at each cycle a photon is added to the cavity mode, which amplifies the light.

For strong atom-cavity coupling the regime of atom and cavity shows quantum mechanical behavior: Only single photons can be introduced into the cavity. "As a consequence, stimulated emission and threshold are absent," explains François Dubin, a French postdoc and first author of the publication. A

'quantum laser' was demonstrated in a similar regime some years ago. What is new in the experiment of the Innsbruck researchers is the ability to tune the coupling of the atom to the cavity mode. By choosing the right parameter of the drive laser, the physicists were able to achieve stronger excitation and, consequently, add more photons to the cavity. Although there was still less than one photon in the cavity, the researchers observed stimulated emission in the form of a threshold.

"A single atom is a very weak amplifier. As a consequence, the threshold is much less pronounced than in classical lasers," explains Piet Schmidt.

An even stronger excitation does not result in a higher output, which is the case in a conventional laser, but in the quenching of the output due to quantum mechanical interference. This constitutes an intrinsic limitation of miniature single-atom lasers. Therefore, researchers from the University of Innsbruck want to further investigate the transition between quantum and classical lasers through the controlled addition of more and more ions interacting with the light field.

This research work is supported by the Austrian Science Fund, the European Commission and the Federation of Austrian Industry Tirol.

Story Source:

Adapted from materials provided by University of Innsbruck.

Journal Reference:

1. François Dubin, Carlos Russo, Helena G. Barros, Andreas Stute, Christoph Becher, Piet O. Schmidt, Rainer Blatt. **Quantum to classical transition in a single-ion laser**. *Nature Physics*, 2010; DOI: 10.1038/nphys1627

http://www.sciencedaily.com/releases/2010/03/100331081129.htm

Ice Sheet Melt Identified as Trigger of 'Big Freeze'

Modern-day Hubbard Glacier in Seward, Alaska. New research has identified a mega-flood path across North America which channeled melt-water from a giant ice sheet into the oceans and triggering the Younger Dryas cold snap. (Credit: iStockphoto)

ScienceDaily (Mar. 31, 2010) — The main cause of a rapid global cooling period, known as the Big Freeze or Younger Dryas -- which occurred nearly 13,000 years ago -- has been identified thanks to the help of an academic at the University of Sheffield.

A new paper, which is published in *Nature* on April 1, 2010, has identified a mega-flood path across North America which channelled melt-water from a giant ice sheet into the oceans and triggering the Younger Dryas cold snap.

The research team, which included Dr Mark Bateman from the University of Sheffield's Department of Geography, discovered that a mega-flood, caused by the melting of the Laurentide ice sheet, which covered much of North America, was routed up into Canada and into the Arctic Ocean.

This resulted in huge amounts of fresh water mixing with the salt water of the Arctic Ocean. As a result, more sea-ice was created which flowed into the North Atlantic, causing the northward continuation of the Gulf Stream to shut down.

Without the heat being brought across the Atlantic by the Gulf Stream, temperatures in Europe plunged from similar to what they are today, back to glacial temperatures with average winter temperatures of -25oC. This cooling event has become known as the Younger Dryas period with cold conditions lasting about 1400 years. The cold of the Younger Dryas affected many places across the continent, including Yorkshire in the Vale of York and North Lincolnshire which became arctic deserts with sand dunes and no vegetation.

Before now, scientists have speculated that the mega-flood was the main cause of the abrupt cooling period, but the path of the flood waters has long been debated and no convincing evidence had been found establishing a route from the ice-sheet to the North Atlantic.

The research team studied a large number of cliff sections along the Mackenzie Delta and examined the sediments within them. They found that many of the cliff sections showed evidence of sediment erosion. This evidence spanned over a large region at many altitudes, which could only be explained by a mega-flood from the over-spilling of Lake Agassiz, which was at times bigger than the UK, at the front of the Laurentide Ice-sheet rather than a normal flood of the river.

Dr Bateman, who has been researching past environmental changes both in the UK and elsewhere in the world for almost 20 years, runs the luminescence dating lab at Sheffield. The lab was able to take the MacKenzie Delta sediment samples from above and below the mega-flood deposits, and find out when the mega-flood occurred, enabling its occurrence to be attributed to the start of the Younger Dryas.

The study will help shed light on the implications of fresh water input into the North Atlantic today. There are current concerns that changes in the salinity of the ocean today, could cause another shut down of the Gulf Stream. Current climate changes, including global warming, may be altering the planetary system which regulates evaporation and precipitation, and moves fresh water around the globe.

The findings, which show the cause, location, timing and magnitude of the mega-flood, will enable scientists to better understand how sensitive both oceans and climates are to fresh-water inputs and the potential climate changes which may ensue if the North Atlantic continues to alter.

Dr Mark Bateman, from the University of Sheffield's Centre for International Drylands Research at the Department of Geography, said: "The findings of this paper through the combination of luminescence dating, landscape elevation models and sedimentary evidence allows an insight into what must have been one of the most catastrophic geological events in recent earth's history. They also show how events within the Earth-climate system in North America had huge impacts in Europe."

Story Source:

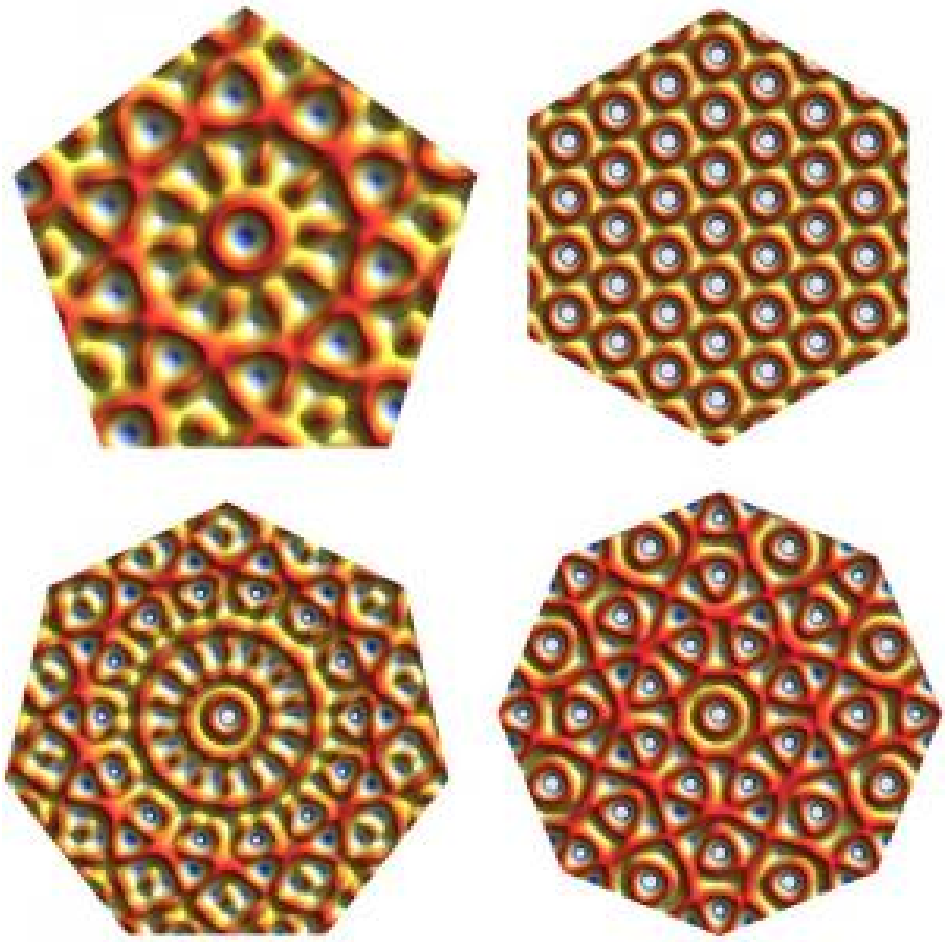
Adapted from materials provided by University of Sheffield, via EurekAlert!, a service of AAAS.

Journal Reference:

1. Julian B. Murton, Mark D. Bateman, Scott R. Dallimore, James T. Teller, Zhirong Yang. **Identification of Younger Dryas outburst flood path from Lake Agassiz to the Arctic Ocean**. *Nature*, 2010; 464 (7289): 740 DOI: 10.1038/nature08954

http://www.sciencedaily.com/releases/2010/03/100331141413.htm

Why Certain Symmetries Are Never Observed in Nature



Symmetry bears flowers: The Stuttgart-based researchers generate light patterns by superimposing several laser beams. Flower-shaped structures form in the laser patterns which act as a nucleus for order. They arise very rarely in the 7-fold pattern (bottom left) - therefore no materials with a 7-fold symmetry are found in nature. (Credit: Jules Mikhael, University of Stuttgart)

ScienceDaily (Mar. 31, 2010) — Nature likes some symmetries, but dislikes others. Ordered solids often display a so-called 6-fold rotation symmetry. To achieve this kind of symmetry, the atoms in a plane surround themselves with six neighbours in an arrangement similar to that found in honeycombs. As opposed to this, ordered materials with 7-fold, 9-fold or 11-fold symmetries are never observed in nature.

Researchers from the Max Planck Institute for Metals Research, the University of Stuttgart and the TU Berlin discovered the reason for this when they tried to impose a 7-fold symmetry on a layer of charged colloidal particles using strong laser fields: the emergence of ordered structures requires the presence of specific sites where the corresponding order nucleates. Indeed, such nuclei are present in large numbers in exactly those structures for which nature shows a preference. In contrast, they only arise sporadically in patterns with 7-fold symmetry.

The process involved here sounds unwieldy, but is, in fact, quite simple: a material has a 6-fold rotation symmetry if the arrangement of its atoms remains unchanged when it is rotated by 60 degrees -- one sixth of a circle. The atoms in metals often order themselves in this way. However, more complicated structures with 5-fold, 8-fold or 10-fold rotation symmetry also exist. "It is surprising that materials with 7-fold, 9-fold or 11-fold symmetry have not yet been observed in nature," says Clemens Bechinger,

fellow at the Max Planck Institute for Metals Research and Professor at the University of Stuttgart: "This is all the more astonishing in view of the fact that patterns with any rotation symmetry can be drawn without difficulty on paper." The question is, therefore, whether such materials have simply been overlooked up to now or whether nature has an aversion to certain symmetries.

This is the question that Clemens Bechinger has been investigating with his colleagues. "The answer is of interest to us both from a fundamental point of view but also because it could be helpful for tailoring materials with novel properties for technical applications," explains the physicist. The characteristics of a material are generally very dependent on its rotation symmetry. Graphite and diamond, for example, both consist of carbon atoms and differ solely in their crystal symmetry.

To produce materials with 7-fold symmetry, which do not actually exist in nature, the researchers resorted to a special trick: they superimposed seven laser beams and thereby generated a light pattern with 7-fold symmetry. They then introduced a layer of colloidal particles approximately three micrometers in diameter into the laser field. The effect of the electromagnetic field of the light pattern on the particles is akin to the formation of a mountain landscape, in which they tend to gravitate to the valleys. The colloidal particles, which repel each other because of their electric charges, attempt, in turn, to form a 6-fold symmetrical structure.

The researchers raise the profile of the light landscape by gradually increasing the intensity of the lasers. In this way, they exert increasing pressure on the colloidal particles to form a 7-fold symmetry instead of a 6-fold one. "This enables us to ascertain the laser intensity up to which the particles do not adept the 7-fold order and retain their 6-fold symmetry," says Jules Mikhael, the doctoral student working on the project.

In the same way, the physicists subjected the particles to a 5-fold light lattice and observed a clear difference: the particles clearly avoid a 7-fold symmetry and assume the 5-fold symmetry at relatively low laser intensities. Therefore, nature's rejection of 7-fold symmetries is also demonstrated in the model system created by the researchers in Stuttgart.

"What is crucial, however, is that our experiment also uncovers the reason why the particles stubbornly refuse to form a 7-fold structure," notes Clemens Bechinger. When the physicists increase the laser intensity, the particles initially only assume a 7-fold symmetry in very isolated places. Only when the intensity is further increased does the order spread to the entire sample. The researchers identified certain structures in the light pattern as the starting point for the 7-fold symmetry. These consist of a central point of light, which is surrounded by a ring of other light points and is, therefore, strongly reminiscent of a flower blossom.

"In the light pattern with 5-fold symmetry we find around 100 times more of these flower-shaped centres than in that with the 7-fold pattern," explains Michael Schmiedeberg. The density of these nuclei clearly plays the crucial role. The higher the density, the less force the researchers must exert to generate structures of the corresponding rotation symmetry. In this case, low light intensity is sufficient for the relevant order to spread from the centre.

The differences in the densities of the flower-shaped nuclei alone also explains why 8-fold and 10-fold symmetries arise in nature but 9-fold and 11-fold ones do not. "The result is astonishing because it involves a simple geometric argument," says Bechinger: "It is completely independent on the special nature of the interaction between the particles, and applies, therefore, both to our colloidal systems and to atomic systems."

The experiments explain, first, why it is no coincidence that materials with certain symmetries are not found in nature. Second, they demonstrate a concrete way, in which such structures can be made artificially in colloidal systems -- that is with the help of external fields. This could be useful for the production of photonic crystals with unusual symmetries in which, for example, individual layers of

colloids with 7-fold rotation symmetry are stacked on top of each other. Photonic crystals consist of microstructures, which affect light waves in a similar way to that in which crystal lattices affect electrons. Due to the higher rotation symmetry, the optical characteristics of 7-fold photonic crystals would be less dependent on the angle of incidence of a beam of light than the existing photonic crystals with 6-fold symmetry.

In addition to this, materials with unconventional symmetries have other interesting characteristics, for example very low frictional resistance. As a result they can reduce the friction between sliding parts e.g. in engines when applied as thin surface coatings. "Overall the search for materials with unusual rotation symmetries is of considerable interest," says Clemens Bechinger: "Our results can help to identify the particular symmetries that are worth looking for."

Story Source:

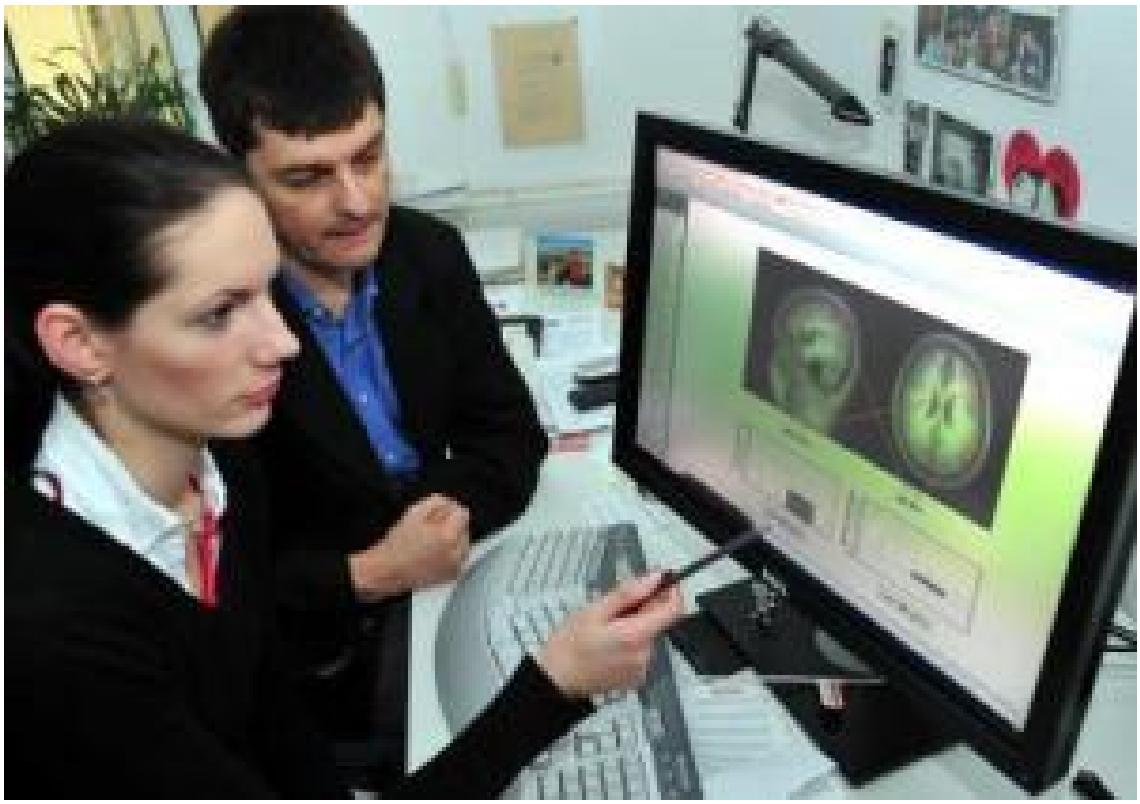
Adapted from materials provided by Max-Planck-Gesellschaft.

Journal Reference:

1. Jules Mikhael, Michael Schmiedeberg, Sebastian Rausch, Johannes Roth, Holger Stark, and Clemens Bechinger. **Proliferation of anomalous symmetries in colloidal monolayers subjected to quasiperiodic light fields**. *Proceedings of the National Academy of Sciences*, March 29, 2010

http://www.sciencedaily.com/releases/2010/03/100330102747.htm

Words Easily Trigger Painful Memories



Professor Dr. Thomas Weiss and his doctoral candidate Maria Richter from Jena University examine how pain-associated words are processed in the brain. (Credit: Photo: Peter Scheere/FSU Jena)

ScienceDaily (Mar. 31, 2010) — "Watch out, it'll hurt for a second." Not only children but also many adults get uneasy when they hear those words from their doctor. And, as soon as the needle touches their skin the piercing pain can be felt very clearly. "After such an experience it is enough to simply imagine a needle at the next vaccination appointment to activate our pain memory," knows Prof. Dr. Thomas Weiss from the Friedrich-Schiller-University Jena.

As the scientist and his team from the Dept. of Biological and Clinical Psychology could show in a study for the first time it is not only the painful memories and associations that set our pain memory on the alert. "Even verbal stimuli lead to reactions in certain areas of the brain," claims Prof. Weiss. As soon as we hear words like "tormenting," "gruelling" or "plaguing," exactly those areas in the brain are being activated which process the corresponding pain. The psychologists from Jena University were able to examine this phenomenon using functional magnetic resonance tomography (fMRT). In their study they investigated how healthy subjects process words associated with experiencing pain. In order to prevent reactions based on a plain negative affect the subjects were also confronted with negatively connotated words like "terrifying," "horrible" or "disgusting" besides the proper pain words.

"Subject performed two tasks," explains Maria Richter, doctoral candidate in Weiss's team. "In a first task, subjects were supposed to imagine situations which correspond to the words," the Jena psychologist says. In a second task, subjects were also reading the words but they were distracted by a brain-teaser. "In both cases we could observe a clear activation of the pain matrix in the brain by pain-associated words," Maria Richter states. Other negatively connotated words, however, do not activate those regions. Neither for neutrally nor for positively connotated words comparable activity patterns could be examined.

Can words intensify chronic pain?

"These findings show that words alone are capable of activating our pain matrix," underlines Prof. Weiss. To save painful experiences is of biological advantage since it allows us to avoid painful situations in the future which might be dangerous for our lives. "However, our results suggest as well that verbal stimuli have a more important meaning than we have thought so far." For the Jena psychologist the question remains open which role the verbal confrontation with pain plays for chronic pain patients. "They tend to speak a lot about their experiencing of pain to their physician or physiotherapist," Maria Richter says. It is possible that those conversations intensify the activity of the pain matrix in the brain and therefore intensify the pain experience. This is what the Jena psychologists want to clarify in another study.

And so far it won't do any harm not to talk too much about pain. Maybe then the next injection will be only half as painful.

Story Source:

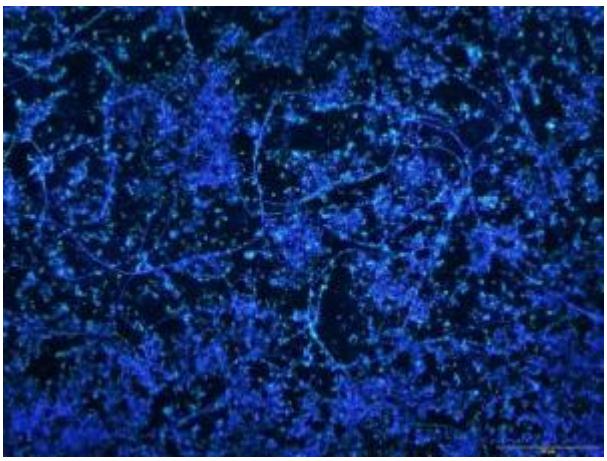
Adapted from materials provided by Friedrich-Schiller-Universität Jena.

Journal Reference:

1. Richter M, Eck J, Straube T, Miltner WHR, Weiss T. **Do words hurt? Brain activation during explicit and implicit processing of pain words**. *Pain*, 2010;148(2):198-205

http://www.sciencedaily.com/releases/2010/03/100330122706.htm

Microbial Answer to Plastic Pollution?



These are microbes from the coastal seabed attached to plastic, as seen through a microscope. (Credit: Jesse Harrison)

ScienceDaily (Mar. 31, 2010) — Fragments of plastic in the ocean are not just unsightly but potentially lethal to marine life. Coastal microbes may offer a smart solution to clean up plastic contamination, according to Jesse Harrison presenting his research at the Society for General Microbiology's spring meeting in Edinburgh.

The researchers from the University of Sheffield and the Centre for Environment, Fisheries and Aquaculture Science have shown that the combination of marine microbes that can grow on plastic waste varies significantly from microbial groups that colonise surfaces in the wider environment. This raises the possibility that the plastic-associated marine microbes have different activities that could contribute to the breakdown of these plastics or the toxic chemicals associated with them.

Plastic waste is a long-term problem as its breakdown in the environment may require thousands of years. "Plastics form a daily part of our lives and are treated as disposable by consumers. As such plastics comprise the most abundant and rapidly growing component of man-made litter entering the oceans," explained Jesse Harrison.

Over time the size of plastic fragments in the oceans decreases as a result of exposure to natural forces. Tiny fragments of 5 mm or less are called "microplastics" and are particularly dangerous as they can absorb toxic chemicals which are transported to marine animals when ingested.

While microbes are the most numerous organisms in the marine environment, this is the first DNA-based study to investigate how they interact with plastic fragments. The new study investigated the attachment of microbes to fragments of polyethylene -- a plastic commonly used for shopping bags. The scientists found that the plastic was rapidly colonised by multiple species of bacteria that congregated together to form a 'biofilm' on its surface. Interestingly, the biofilm was only formed by certain types of marine bacteria.

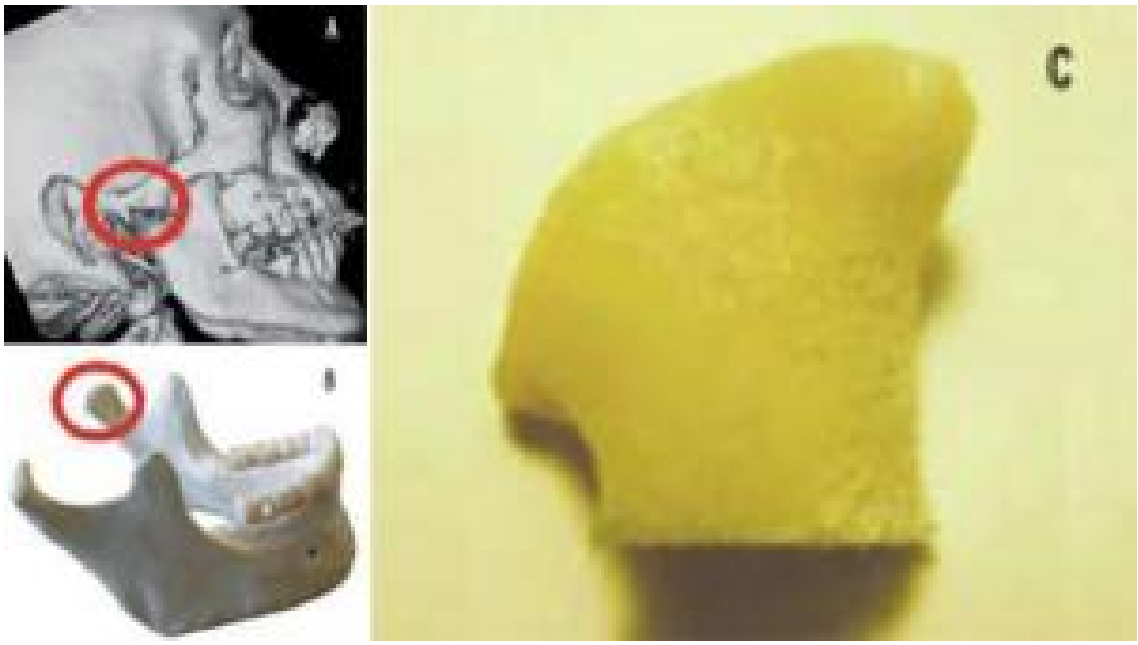
The group, led by Dr. Mark Osborn at Sheffield, plans to investigate how the microbial interaction with microplastics varies across different habitats within the coastal seabed -- research which they believe could have huge environmental benefits. "Microbes play a key role in the sustaining of all marine life and are the most likely of all organisms to break down toxic chemicals, or even the plastics themselves," suggested Mr Harrison. "This kind of research is also helping us unravel the global environmental impacts of plastic pollution," he said.

Story Source:

Adapted from materials provided by Society for General Microbiology, via EurekAlert!, a service of AAAS.

http://www.sciencedaily.com/releases/2010/03/100329075919.htm

Jaw Bone Grown from Adult Stem Cells



Vunjak-Novakovic used CT images (A and B) to build a TMJ-shaped scaffold (C). (Credit: Image courtesy of The Record, Columbia University)

ScienceDaily (Mar. 31, 2010) — A Columbia scientist has become the first to grow a complex, full-size bone from human adult stem cells.

Gordana Vunjak-Novakovic, a professor of biomedical engineering at the Fu Foundation School of Engineering and Applied Science, reports that her team grew a temporomandibular joint (TMJ) from stem cells derived from bone marrow. Her work is reported in the online *Early Edition* of the journal *Proceedings of the National Academy of Sciences* this month.

"The TMJ has been widely studied as a tissue-engineering model because it cannot be generated easily, if at all, by current methods," says Vunjak-Novakovic, whose co-authors include Warren L. Grayson, then a post-doctoral student in her lab and now an assistant professor at Johns Hopkins University. Around 25 percent of the population suffers from TMJ disorders -- including those who suffer from cancer, birth defects, trauma and arthritis -- which can cause joint deterioration. Because the TMJ is such a complex structure, it is not easily grafted from other bones in a patient's body. "The availability of personalized bone grafts engineered from the patient's own stem cells would revolutionize the way we currently treat these defects," she says.

Current methods of treating traumatic injury to the jaw include taking a bone from the patient's leg or hip to replace the missing bone. "Wouldn't it be wonderful if we could get the patient's own stem cells and grow a new jaw?" says Dr. June Wu, a craniofacial surgeon at Columbia University Medical Center who advised Vunjak-Novakovic on her research.

Vunjak-Novakovic's technique for turning stem cells into bone was inspired by the body's natural bone-building process. Her team started by analyzing digital images of a patient's jawbone in order to build a scaffold into the precise shape of a TMJ joint. The scaffold itself was made from human bone stripped of living cells. The team then seeded the scaffold with bone marrow stem cells and placed it into a custom-designed bioreactor. The reactor, filled with culture medium, nourished and physically stimulated the cells to form bone. "Bone tissue is metabolically very active," she says. Bone tissue develops best when it is bathed in fluid flowing around it. Vunjak-Novakovic and the team looked into the exact flow rates one

needs for optimal effects. After five weeks, they had a four-centimeter-high jawbone that was the precise size and shape of a human TMJ.

The technique can be applied to other bones in the head and neck, including skull bones and cheek bones, which are similarly difficult to reconstruct, but Vunjak-Novakovic started with the TMJ because, "We thought this would be the most rigorous test of our technique," she said. "If you can make this, you can make any shape."

Her team's next step is to develop a way to connect the bone graft to a patient's blood supply to ensure that the graft grows with the person's body. "Our bones change, and these biological grafts would change with us," says Vunjak-Novakovic.

Story Source:

Adapted from materials provided by The Record, Columbia University. Original article written by Anna Kuchment.

Journal Reference:

1. W. L. Grayson, M. Frohlich, K. Yeager, S. Bhumiratana, M. E. Chan, C. Cannizzaro, L. Q. Wan, X. S. Liu, X. E. Guo, G. Vunjak-Novakovic. **Regenerative Medicine Special Feature: Engineering anatomically shaped human bone grafts**. *Proceedings of the National Academy of Sciences*, 2010; 107 (8): 3299-3304 DOI: 10.1073/pnas.0905439106

http://www.sciencedaily.com/releases/2010/03/100330152437.htm

Secret to Healing Chronic Wounds Might Lie in Tiny Pieces of Silent RNA

Chandan Sen. (Credit: Image courtesy of Ohio State University)

ScienceDaily (Mar. 31, 2010) — Scientists have determined that chronic wounds might have trouble healing because of the actions of a tiny piece of a molecular structure in cells known as RNA.

The Ohio State University researchers discovered in a new animal study that this RNA segment in wounds with limited blood flow lowers the production of a protein that is needed to encourage skin cells to grow and close over the sore.

In a parallel experiment using human skin cells, the researchers silenced the RNA segment with an experimental drug and saw those protein levels rise. The skin cells multiplied as a result.

The combination of findings suggests that targeting this RNA segment with a drug that could be used topically on skin might offer new strategies for treating chronic wounds, which are sometimes fatal and cost the U.S. health-care system an estimated $25 billion annually.

The research appears this week in the online early edition of the *Proceedings of the National Academy of Sciences*.

RNA in cells is responsible for using instructions from DNA to make proteins, but the piece of RNA identified in this study has a completely different role. It is a microRNA, a small segment of RNA that blocks an important protein-building process. The RNA segment in question is known as miR-210.

The research involves wounds that are ischemic, that is, they heal very slowly or are in danger of never healing because they lack blood flow and oxygen at the wound site. These types of wounds affect about

6.5 million patients each year, and are common complications of diabetes, high blood pressure, obesity and other conditions characterized by poor vascular health.

"When blood supply is inadequate, many things are deficient at the wound site, including oxygen. That leads to a condition called hypoxia," said Chandan Sen, professor and vice chair for research in Ohio State's Department of Surgery and senior author of the study. "We have shown that hypoxia induces miR-210, which actually blocks the ability of the cells to proliferate, a step necessary for the wound-closure process."

Sen's lab has studied the effects of low oxygen on wound healing for years, but just now has been able to identify the sequence of events connecting low oxygen and the inability of skin cells to grow. Sen, who is also executive director of the Comprehensive Wound Center at Ohio State, said this is the first publication to suggest microRNAs regulate the healing process in chronic wounds.

Sen and colleagues created ischemic and non-ischemic wounds on mouse skin for comparison. To create the ischemic wounds, they established a flap of skin with limited blood flow and placed the wound in the middle of the flap.

The scientists used a number of technologies -- including laser Doppler imaging and hyperspectral scanning -- to demonstrate that the wounds received differing levels of blood flow. Additionally, they used a specialized probe to measure actual oxygen levels in the wounds and showed that oxygen in the ischemic wounds on the mice closely matched oxygen levels measured in chronic human wounds in clinical settings.

In these ischemic mouse wounds, the researchers observed that the hypoxic, or low-oxygen, conditions led to the presence of a specific type of protein called hypoxia inducible factor-1a, or HIF-1a. This protein can turn genes on and off and, in this case, appears to influence the behavior of at least one microRNA as well.

By placing markers in the wounds for these substances, the scientists could observe their relationships in the wound. The presence of HIF-1a in low-oxygen conditions led to the activation of the miR-210, and that microRNA in turn lowered levels of the protein needed to kick skin cells into action. This protein is called E2F3.

In contrast, the non-ischemic wounds on the mice showed abundant levels of the E2F3 protein and healed normally within about seven days.

To test these relationships further, the researchers set up experiments using a line of human skin cells most responsible for closing over a wound.

Under normal oxygen levels, the scientists manipulated the cells to activate the HIF-1a protein that normally is induced by hypoxia. When the HIF-1a was present, the cells contained high levels of the miR-210, which in turn lowered levels of the E2F3 protein.

The researchers further manipulated these conditions by inserting an experimental drug into the cells called an antagomir, a synthetic molecule that renders microRNAs inactive and which was designed to act specifically on miR-210. When the miR-210 levels were lowered with the antagomir, the E2F3 protein levels rose and the skin-cell growth increased significantly. When the miR-210 levels were artificially raised using a molecule that mimics its behavior, the skin cells' growth was compromised.

"MicroRNAs are induced only by certain conditions. They have specific profiles in the daily biology of a given organ, but under conditions of an injury, certain microRNAs wake up," Sen said. "Once it sees hypoxia, miR-210 wakes up, and then it governs what happens with the E2F3 protein after that."

Antagomirs are a burgeoning area of drug development research. They are considered potent agents that can interfere with microRNA behavior throughout the body. Their use in wound healing, on the other hand, might benefit from the need to use them only topically on the skin, Sen said. He plans to investigate their effects on wounds in further animal studies.

The National Institutes of Health supported this research.

Co-authors on the paper are Sabyasachi Biswas, Sashwati Roy, Jaideep Banerjee, Syed-Rehan Hussain and Savita Khanna of the Department of Surgery; Gurugahan Meenakshisundaram and Periannan Kuppusamy of the Department of Internal Medicine; and Avner Friedman of the Mathematical Biosciences Institute, all at Ohio State.

Story Source:

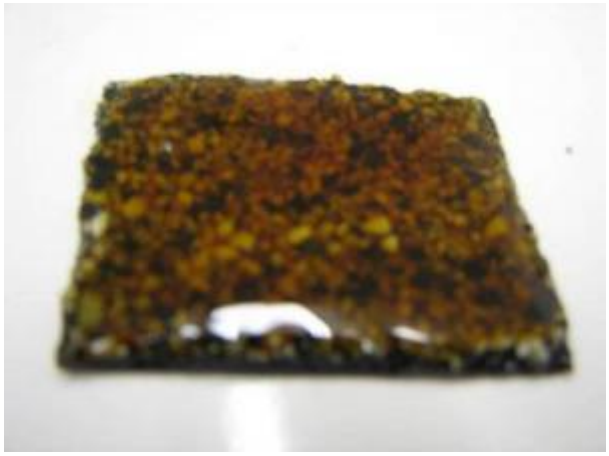
Adapted from materials provided by Ohio State University.

Journal Reference:

1. Sabyasachi Biswas, Sashwati Roy, Jaideep Banerjee, Syed-Rehan A. Hussain, Savita Khanna, Guruguhan Meenakshisundaram, Periannan Kuppusamy, Avner Friedman, and Chandan K. Sen. **Hypoxia inducible microRNA 210 attenuates keratinocyte proliferation and impairs closure in a murine model of ischemic wounds**. *Proceedings of the National Academy of Sciences*, 2010; DOI: 10.1073/pnas.1001653107

http://www.sciencedaily.com/releases/2010/03/100322171056.htm

New 'Smart' Roof Reads the Thermometer, Saves Energy in Hot and Cold Climates



Shingles with a "smart" coating could save energy and lower bills by adjusting to temperature changes. (Credit: Ben Wen, Ph.D.)

ScienceDaily (Mar. 31, 2010) — Top a building with a light-colored "cool roof," and it reflects sunlight, cutting air conditioning bills in summer, but increasing winter heating costs. Choose black shingles, and the roof soaks up sunlight to cut winter heating costs but makes the roof bake in the summer sun. One or the other. You can't have it both ways.

Until now.

Scientists reported the development of a "smart" roof coating, made from waste cooking oil from fast food restaurants, that can "read" a thermometer. The coating automatically switches roles, reflecting or transmitting solar heat, when the outdoor temperature crosses a preset point that can be tuned to the local climate.

They described the coating at the 239th National Meeting of the American Chemical Society (ACS) in San Francisco.

Roofs coated with the material would reflect scorching summer sunlight and reduce sticker-shock air-conditioning bills. When chilly weather sets in, the coating would change roles and transmit heat to help warm the interior.

"This is one of the most innovative and practical roofing coating materials developed to date," said Ben Wen, Ph.D., leader of the research project. He is the vice-president of United Environment & Energy LLC in Horseheads, N.Y. "This bio-based intelligent roof coating, compared with a traditional cool roof, could reduce both heating and cooling costs as it responds to the external environment. It will help save fuel and electricity and reduce emissions of volatile organic compounds from petroleum-based roofing products. In addition, it will provide a new use for millions of gallons of waste oil after it is used to cook french fries and chicken nuggets."

Scientists already have evidence that "white roofs" -- roofs that are painted white to reflect solar heat and help cool buildings during peak summer weather -- could significantly reduce global warming by lowering fuel consumption. However, white roofs can have a wintertime heating penalty because they reflect solar heat that would help warm the building. So white roofs are a benefit in summer but a detriment in winter.

The new "intelligent" coating may sidestep this quandry. Tests on coated asphalt shingles showed that it could reduce roof temperatures by about 50 -- 80 percent in warm weather. In cooler weather, the coating

could increase roof temperatures up to 80 percent compared with the traditional cool roof. By changing the coating's composition, Wen and colleagues can tune the substance, so that it changes from reflective to transmitive at a specific environmental temperature.

"Even though the roof temperature is reduced or increased by a few degrees, depending on the outside temperature, this change could make a big difference in your energy bill," Wen noted.

In producing the coating, waste cooking oil is processed into a liquid polymer that hardens into a plastic after application. Unlike raw waste oil, which can smell like French fries or fish, the resulting polymer is virtually odorless. Manufacturers could potentially produce it in any shade, ranging from clear to black, depending on what additives are used, he said. The material is also non-flammable and nontoxic.

Wen cautions against pouring ordinary cooking oil on a roof in an attempt to achieve a similar energy-saving effect. That's because ordinary cooking oil won't turn into a polymer, doesn't contain the key ingredient for controlling infrared light levels, and could well pose a fire hazard for the building.

The coating can be applied to virtually any type of roof. Wen expects that the coating can last many years and can be reapplied when it wears off. If further testing continues to go well, he estimates that the coating could be ready for commercial use in about three years.

Wen's research is funded by the Department of Energy. His collaborators in this study include Peng Zhang and Marianne Meyers, also of United Environment & Energy LLC.

Story Source:

Adapted from materials provided by American Chemical Society, via EurekAlert!, a service of AAAS.

http://www.sciencedaily.com/releases/2010/03/100321203506.htm

Existing antibiotic might help keep wraps on AIDS virus

Acne drug minocycline inhibits HIV activation in infected immune cells
By Nathan Seppa
Web edition : Thursday, March 25th, 2010

An inexpensive antibiotic might complement standard drugs in fighting the AIDS virus, a new study shows. The drug, called minocycline, has been used for decades to control acne, but the new findings suggest it inhibits HIV that has infected cells from reactivating and replicating itself. The report will appear in the April 15 *Journal of Infectious Disease.*In most people, HIV can be controlled with a drug combination called HAART, short for highly active antiretroviral therapy. But HAART doesn't wipe out the virus, and stresses on the immune system such as an infection can reactivate the latent virus and trigger its spread.

In the new study, molecular biologist Janice Clements of Johns Hopkins University in Baltimore and her colleagues infected human CD4 T cells with HIV in lab dishes, then added minocycline to some of these batches. After 24 hours, the minocycline-treated cells contained half as much HIV RNA as the other cells, suggesting the drug had inhibited the ability of the virus to replicate. The scientists also tested minocycline on CD4 T cells obtained from HIV patients who had been treated with HAART. Minocycline again stalled HIV replication, as demonstrated by a 60 percent decline in activity of a key gene that HIV needs to awaken and replicate.These properties of minocycline add to the drug's growing résumé. In addition to its role as an acne-fighting antibacterial, minocycline slows inflammation and can limit brain damage. In earlier work, Clements and her colleagues found that minocycline reduced brain inflammation and limited the amount of virus in the brains of monkeys with SIV, the simian version of the AIDS virus. And in the mid-1990s, Dutch scientists found that minocycline, a derivative of tetracycline, knocked down inflammation in rheumatoid arthritis patients.

Although inflammation is a normal immune response, too much causes damage. Minocycline seems to reduce hyperactivation of T cells, key players in inflammation, says immunologist Gregory Szeto of Johns Hopkins, who coauthored the new study.In a third experiment using healthy CD4 T cells that were activated by the presence of an antibody, Clements, Szeto and their colleagues showed that cells exposed to minocycline made reduced amounts of three inflammatory proteins.

In HIV patients, inflammation can exhaust the immune response and contribute to AIDS progression. But Szeto cautions that inflammation can be accurately evaluated only in the context of a person's body and not in a cell study such as this. Meanwhile, minocycline's brain-protecting attributes have attracted interest (*SN 10/13/07, p. 238*). HIV can enter the central nervous system and remain dormant there for long stretches. Even as HAART has extended survival in AIDS patients, many now develop cognitive impairments, several studies have shown. Clements estimates that roughly half of HIV patients receiving HAART for more than 10 years have some cognitive damage from the virus. Because minocycline can enter the brain, it may provide protection to these patients, Clements says. "Certainly, this could have very positive effects, because HAART drugs have differing abilities to cross the blood-brain barrier," says virologist Celsa Spina of the Veterans Affairs San Diego Healthcare System and the University of California, San Diego. "That would be a benefit — to reduce HIV activation within the central nervous system."

At Johns Hopkins and elsewhere, scientists are now testing whether giving HIV patients minocycline benefits them.Spina cautions that although minocycline has a long track record in acne patients, HIV patients are a very different group. "I would be worried about using something that appears to be a broad-spectrum suppressor of T cell activation," she says. "If you have patients who are immune-suppressed but otherwise healthy, you don't want to subject them to something that's going to hurt them." She says patients will require close monitoring in these trials.

http://www.sciencenews.org/view/generic/id/57626/title/Existing_antibiotic_might_help_keep_wraps_on_AIDS_virus

The skinny on indoor ozone
Oils break it down, but the resulting byproducts may be worse than the starting lung irritant
By Janet Raloff
Web edition : Thursday, March 25th, 2010

People 'pollution' knocks out ozoneOur bodies continuously shed flakes of skin hosting ozone-busting oils that accumulate in house dust and on surfaces from tables to carpeting. Kudumomo/Flickr

SAN FRANCISCO — Smog's ozone isn't just a problem outdoors. This respiratory irritant seeps into homes and other buildings. Indoor concentrations tend to be far lower than those outside, largely because much gets destroyed as the gas molecules collide with surfaces and undergo transformative chemical reactions. New research identifies a hitherto ignored surface that apparently plays a major role in quashing indoor ozone: It's human skin — or, more precisely, the oils in it.

While the removal of ozone from the air in homes and offices is good, what takes its place may not be. Indeed, some byproducts created when ozone hits skin oils are probably more toxic than the starting ozone, according to scientists here at the American Chemical Society spring national meeting.

Charles Weschler of the University of Medicine and Dentistry, New Jersey, in Piscataway, described stumbling onto skin's newfound role in driving the chemistry of indoor air while working on the Indoor Environment and Children's Health Study in Denmark.

Part of the program required analyzing pollutants in dust from the bedrooms of 500 children living on the island of Fyn. The highest volume constituent was diethylhexyl phthalate, better known as DEHP, a hormone-mimicking chemical found in plastics (including those used by hospitals to dispense blood and blood products), fragrances and many other items. Its quantities came as little surprise; phthalates are, after all, everywhere.

But cholesterol, the second most prominent chemical — accounting for around 300 micrograms of every gram of dust — was initially a bit of a head-scratcher. Until, that is, the aerosol chemists realized what the third most common chemical pollutant in the dust was: squalene, a fatty substance that accounts for 10 to 12 percent of the oil found in human skin — but few other places within a home.

As cholesterol also occurs in skin (accounting for about four percent of the oils there), the human body suddenly began to look like a likely source of both.

The body sloughs off its entire outer surface, in bits and pieces, once every two to four weeks, Weschler notes. Each corn-flake-shaped piece of skin weighs perhaps 2 billionths of a gram. Which doesn't sound like much until you consider that the average person sheds 30 to 90 milligrams of oil-bearing skin flakes per hour. Over time, these skin shards end up coating surfaces throughout a room — every room that people enter.

Crowding out ozoneRegions that host crowds stand to accumulate the most squalene, and any toxic pollutants that form during its reactions with ozone.Kuchingboy/Flickr

In Denmark, squalene accounted for, on average, around 30 micrograms per gram of house dust collected from preschoolers' bedrooms and 10 µg/g in daycare centers' dust. And that piqued Weschler's curiosity, because squalene suddenly started to suggest an explanation for a long-standing conundrum.

"We've known that the ozone indoors is being gobbled up," Weschler says. "But we really didn't know what's doing the gobbling." It's now clear, he told me after his talk, "This squalene is just great at chewing up ozone."

Cholesterol isn't as good an ozone gobbler as squalene is or nearly as prevalent in skin oil, but Weschler and his colleagues found scads of it in house dust. In kids' bedrooms, for instance, the dust contained about 300 µg/g. Even daycare dust hosted some 100 µg/g. Clearly, this didn't correlate with the human occupancy of the rooms, Weschler noted; it was way too high. So there must be other sources, such as foods perhaps.

In any case, he says it now appears our skin oils might be largely determining indoor ozone concentrations.

And that's because shed skin's adherence to other surfaces tends to make the reactivity to ozone of those underlying surfaces more like squalene's. The skin essentially homogenizes what had been vastly different ozone reactivity potentials of paint, glass, furniture, wood, metal and carpeting.

For instance, Weschler pointed to a window and noted that "when this glass started out clean, ozone would just look at it — nothing would happen. But once I put my fingerprints on it [as he pressed his hand onto the window], the ozone [that strikes it] will now be gobbled up by all of the skin oils I've just left behind."

And it's possible, Weschler notes, that the relatively high volatility of squalene means some of the oil may just enter the air from intact skin and then plate out over time onto walls and other surfaces.

The big issue, of course, is what the ozone-breakdown products mean for human health. And no one knows for sure yet because the families that form were just described at the meeting — and will be published soon by Weschler and Armin Wisthaler of Leopold-Franzens University in Innsbruck, Austria, in the *Proceedings of the National Academy of Sciences*. That paper is available online, ahead of print.

In it, the pair describe the chemicals spawned during small scale chemical-mixing experiments using skin oils and ozone in addition to a study where people were exposed to ozone concentrations typical of air. A host of novel pollutants emerged, including some carbonyls — at least one of which is a chemical cousin to diacetyl, the carbonyl responsible for popcorn-worker's lung disease.

That ozone-bred carbonyl in indoor air is 4-oxopentanal, or 4-OPA. Not only was it not recognized as an indoor air pollutant, Weschler says, but until now, "there were absolutely no tox[icology] studies on 4-OPA." Such studies are getting under way at the National Institute of Occupational Safety and Health.

Ray Wells noted that preliminary data by his team at this federal research center in Morgantown, W. Va., suggest 4-OPA might indeed be nasty.

They used something called a "local lymph node assay" to evaluate the chemical's irritancy. And "what the local lymph node work that we did showed is that 4-OPA is a very high sensitizer to irritation and inflammation," Wells says.

What's really new in the work Weschler just presented "is showing how important human occupants are in reacting with ozone," says William Nazaroff, an indoor-air quality expert at the University of California, Berkeley.

"Ozone's harmful, so reducing its level is good," he says. But it appears that when squalene and other skin oils interact with ozone, "the tradeoff is a losing proposition. For every molecule of ozone that you get rid of — and get some health benefits from — you are producing byproducts. And these byproducts, molecule for molecule, are more harmful than the ozone was." Or at least at first blush, they appear to be. He too expressed special concern about the newly identified formation of carbonyls like 4-OPA.

But if these are short-lived pollutants, the byproducts might not be so bad? "They are short-lived," Nazaroff says. "But they're not short-lived enough. So you're going to be breathing them."

In homes with a few occupants, concentrations of these compounds may not be too bad. But their production, he says, might pose problems, at least for sensitive segments of the population, while they're in densely packed spaces — schools, perhaps, or planes and crowded subway cars.

http://www.sciencenews.org/view/generic/id/57596/title/The_skinny_on_indoor_ozone

Unequal Leg Length Tied to Osteoarthritis, Study Finds

Queen's University adjunct professor Derek Cooke studies misalignment and leg length differential. (Credit: Photo by Kristyn Wallace)

ScienceDaily (Apr. 4, 2010) — A new study shows that arthritis in the knee is linked to the common trait of having one leg that is longer than the other. Whether or not leg length differential is a direct cause of osteoarthritis is not clear, but the findings may allow people to take preventive measures before the onset of the chronic and painful condition.

Developing early strategies for treatment may be possible, says Derek Cooke, Queen's University adjunct professor and a co-author of the study.

"Most pediatricians adopt a 'wait and see' attitude for children with limb misalignment when they're growing," says Dr. Cooke. "If we can spot factors creating changes in alignment early in bone development, theoretically we could stop or slow down the progression of osteoarthritis."

The data was collected using x-ray images from more than 3,000 adults aged 50 to 79 who either had knee pain or risk factors for knee osteoarthritis as a part of the Multi Centre Osteoarthritis Study (MOST). Subjects were reassessed after a 30-month period and the researchers found that osteoarthritic changes in the knee were most significant in individuals with pronounced (more than 1 cm) leg length inequality, the shorter leg being most affected.

Leg length inequality is difficult to detect. A small leg length differential -- 1 cm or less -- can be corrected with a shoe insert, while a bigger one can be corrected with surgery. But because the condition often goes undiagnosed, many people don't realize they have a leg length differential until they're diagnosed with osteoarthritis.

Arthritis in the knees can cause pain, swelling and stiffness, and limit mobility. Osteoarthritis is very common, affecting 1 in 10 Canadians. The older a person gets, the greater the chance he or she has of developing the disease.

OAISYS Inc. undertook the image analysis work, collecting the limb length and angles measurements for the MOST project.

William F Harvey from Boston University, currently at Tufts Medical Center, was the lead author on the paper, which was recently published in the journal *Annals of Internal Medicine*. Queen's University was the only Canadian university involved in this international study.

Story Source:

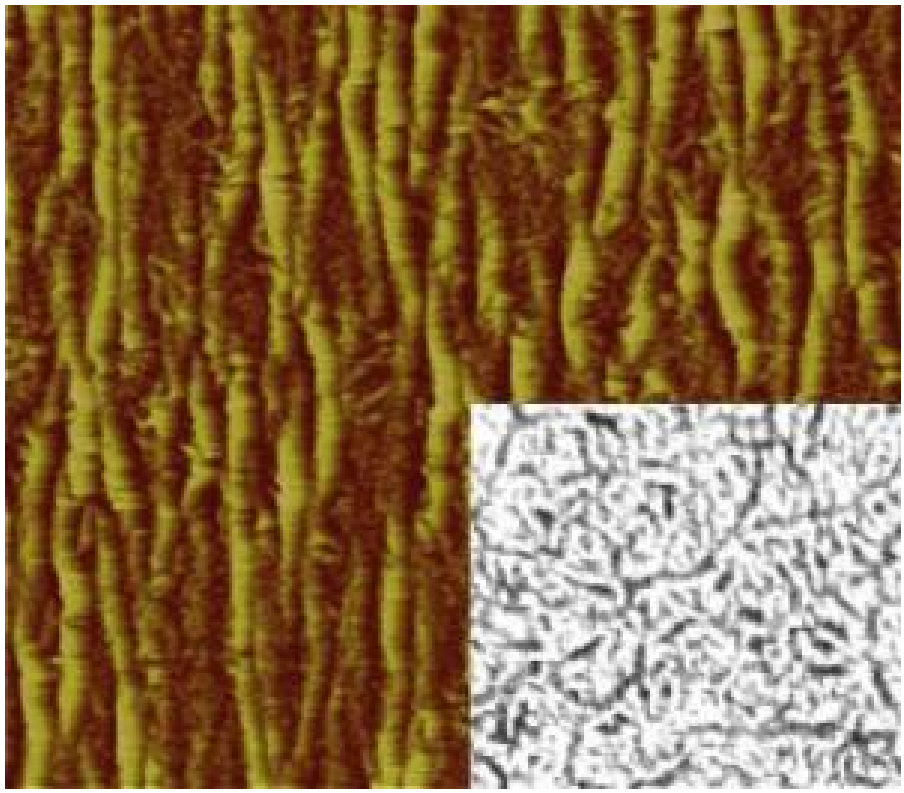
Adapted from materials provided by Queen's University.

Journal Reference:

1. William F. Harvey, Mei Yang, Theodore D.v. Cooke, Neil A. Segal, Nancy Lane, Cora E. Lewis, and David T. Felson. **Association of Leg-Length Inequality With Knee Osteoarthritis: A Cohort Study**. *Annals of Internal Medicine*, 2010; 152: 287-295 [link]

http://www.sciencedaily.com/releases/2010/03/100331161625.htm

Scientists Address 'Wrinkles' in Transparent Film Development



This atomic-force microscopy image shows wrinkling in a single-wall carbon nanotube membrane; the inset shows an optical reflection micrograph of the membrane without any strain. The random arrangement of the nanotubes shown in the inset creates conductivity, but wrinkling can disrupt that. Each image is 40 micrometers in width. (Credit: NIST)

ScienceDaily (Apr. 4, 2010) — A closer look at a promising nanotube coating that might one day improve solar cells has turned up a few unexpected wrinkles, according to new research conducted at the National Institute of Standards and Technology (NIST) and North Dakota State University (NDSU) -- research that also may help scientists iron out a solution.

The scientists have found that coatings made of single-walled carbon nanotubes (SWCNTs) are not quite as deformable as hoped, implying that they are not an easy answer to problems that other materials present. Though films made of nanotubes possess many desirable properties, the team's findings reveal some issues that might need to be addressed before the full potential of these coatings is realized.

"The irony of these nanotube coatings is that they can change when they bend," says Erik Hobbie, now the director of the Materials and Nanotechnology program at NDSU. "Under modest strains, these films can develop irreversible changes in nanotube arrangement that reduce their conductivity. Our work is the first to suggest this, and it opens up new approaches to engineering the films in ways that minimize these effects."

High on the wish list of the solar power industry is a cheap, flexible, transparent coating that can conduct electricity. If this combination of properties can somehow be realized in a single material, solar cells might become far less expensive, and manufacturers might be able to put them in unexpected places -- such as articles of clothing. Transparent conductive coatings can be made of indium-tin oxide, but their rigidity and high cost make them less practical for widespread use.

Carbon nanotubes are one possible solution. Nanotubes, which resemble microscopic rolls of chicken wire, are inexpensive, easy to produce, and can be formed en masse into transparent conductive coatings whose weblike inner structure makes them not only strong but deformable, like paper or fabric. However, the team's research found that some kinds of stretching cause microscopic 'wrinkles' in the coating that disrupt the random arrangement of the nanotubes, which is what makes the coating conduct electricity.

"You want the nanotubes to stay randomly arranged," Hobbie says. "But when a nanotube coating wrinkles, it can lose the connected network that gives it conductivity. Instead, the nanotubes bundle irreversibly into ropelike formations."

Hobbie says the study suggests a few ways to address the problem, however. The films might be kept thin enough so the wrinkling might be avoided in the first place, or designers could engineer a second interpenetrating polymer network that would support the nanotube network, to keep it from changing too much in response to stress. "These approaches might allow us to make coatings of nanotubes that could withstand large strains while retaining the traits we want," Hobbie says.

Story Source:

Adapted from materials provided by National Institute of Standards and Technology (NIST).

Journal Reference:

1. E. K. Hobbie, D. O. Simien, J. A. Fagan, J. Y. Huh, J. Y. Chung, S. D. Hudson, J. Obrzut, J. F. Douglas, C. M. Stafford. **Wrinkling and Strain Softening in Single-Wall Carbon Nanotube Membranes**. *Physical Review Letters*, 2010; 104 (12): 125505 DOI: 10.1103/PhysRevLett.104.125505

http://www.sciencedaily.com/releases/2010/04/100401130340.htm

Traces of Early Native Americans -- In Sunflower Genes

Sunflower (Helianthus annuus) is among the first wild plants cultivated by Native Americans. (Credit: Nolan Kane)

ScienceDaily (Apr. 3, 2010) — New information about early Native Americans' horticultural practices comes not from hieroglyphs or other artifacts, but from a suite of four gene duplicates found in wild and domesticated sunflowers.

In an upcoming issue of *Current Biology*, Indiana University Bloomington biologists present the first concrete evidence for how gene duplications can lead to functional diversity in organisms. In this case, the scientists learned how duplications of a gene called FLOWERING LOCUS T, or FT, could have evolved and interacted to prolong a flower's time to grow. A longer flower growth period means a bigger sunflower -- presumably an attribute of great value to the plant's first breeders.

"Our paper shows how gene duplication creates potential for evolutionary innovation not just through creating new gene content but also through new interactions among duplicates," said Ben Blackman, the report's lead author.

Blackman conducted the research as an IU Bloomington Ph.D. student. He is now a postdoctoral fellow at Duke University.

Biologists have long thought the accidental duplication of genetic material provides important fodder for evolution. Less risky than modifying an existing, possibly important gene, duplicates offer an out -- one copy can continue its normal activities while the other copy acquires new functions. That's a hypothesis, anyway. The *Current Biology* paper suggests reality may be a little more complex.

FT genes play a role in sensitizing flowering plants to seasons, and their expression is usually triggered by changes in day length. Some flowering plants express FT genes early in the growing season as days get longer. Sunflower FT genes are expressed toward the end of the growing season when days are getting shorter. As far as biologists know, all flowering plants have at least one FT gene.

Blackman and his colleagues identified four FT genes in sunflower, *Helianthus annuus*, which are known as HaFT paralogs. Each of the paralogs, HaFT1 through HaFT4, has a unique genetic sequence, but is

similar enough to the others to conclude three of them were the result of DNA duplication events in sunflower's distant past.

"Based on the level of divergence between the various HaFTs and the presence of a single FT copy in lettuce, we inferred that one copy became two during a whole genome doubling event that occurred roughly 30 million years ago," Blackman said. "One of those copies proliferated further through two small-scale duplications that we infer occurred much more recently."

The scientists examined each paralog's expression patterns within sunflower, and by strategically cloning variants of the HaFT genes into the model plant Arabidopsis thaliana, discerned the paralogs' physiological properties in one another's presence.

One of the paralogs, HaFT3, has lost function and is no longer expressed. Countless genome surveys show "non-functionalization" is a common fate for gene duplicates in plants and other eukaryotes, possibly because the extra dose of genetic expression can be wasteful or overtly harmful to the organism.

Two of the paralogs, HaFT2 and HaFT4, are structurally similar to each other and have retained normal function. The proteins they encode are produced in leaves in response to day length. It is believed the HaFT2 and HaFT4 proteins travel down to the stem and up to the shoot tip, where they compel meristem cells to develop into flower buds, but this has yet to be shown conclusively for *Helianthus annuus*.

HaFT1 isn't produced in the leaves but at the site of HaFT2 and HaFT4's target -- the shoot tip and the green bracts that will radiate out from the flower itself. There are two basic versions of the HaFT1 called alleles. The domesticated HaFT1 allele is distinguished from the wild allele by the omission of a single nucleotide. But what a difference that nucleotide makes. The protein produced from the domesticated HaFT1 is larger than its wild cousin and has a novel domain.

Only two of the 23 wild populations surveyed possess both types of the HaFT1 allele.

That is not the case for domesticated sunflower populations, for which the domestic version of HaFT1 completely (or almost completely) dominates. Modern domesticated sunflowers used in farming are homogeneous for domesticated HaFT1. The scientists also examined "landraces," Native Americans' own domesticated cultivars, some of which are quite old. These too are dominated by domesticated HaFT1.

By comparing the activity of domesticated and wild HaFT1, the scientists learned it is the domesticated version of HaFT1 that lengthens the time period during which flowers grow and mature. This can have a wide variety of effects, from increasing the size of the sunflowers' seed disk to increasing the flowers' total seed mass.

Despite its name, domestic HaFT1 isn't the result of domestication -- its origin likely precedes human cultivation. It is called domestic, because it is the version of HaFT1 that caused traits early Native Americans seem to have preferred as they bred the plants for horticulture. Genetic evidence the scientists collected from a broad survey of domesticated and wild HaFT1 genes suggests domesticated HaFT1 experienced a "selective sweep" around the time early Native Americans would have begun cultivating sunflower.

"Our study is the first to provide both strong functional evidence and strong evolutionary evidence that a particular nucleotide variant in this one gene -- HaFT1 -- was critical for early sunflower domestication," Blackman said.

How HaFT1 was exerting its flower-delaying effects was not clear until the scientists cloned HaFT1, HaFT2 and HaFT4 into Arabidopsis thaliana in different combinations. A. thaliana's own FT gene had been removed. Cloning genes in this way can eliminate complicating factors when scientists are interested in knowing how a few genes (and the proteins they encode) interact.

Domesticated HaFT1 had no impact on flowering in the presence of HaFT2. But HaFT1 did delay A. thaliana flowering in the presence of HaFT4. The scientists concluded the newer HaFT1 and older HaFT4 are interacting, possibly directly, in such a way to interfere with HaFT4's function, thereby delaying flowering.

"In the sunflower story, what is most interesting in my view is how evolution has exploited both recent and ancient gene duplicates in the same gene family to achieve shifts in flowering time and photoperiod sensitivity," said IU Bloomington plant evolutionary biologist Loren Rieseberg, the study's principal investigator.

Rieseberg has dual appointments at IU Bloomington and the University of British Columbia.

Jared Strasburg, Andrew Raduski and Scott Michaels also contributed to the research. It was supported with grants from the National Institutes of Health and the National Science Foundation.

Story Source:

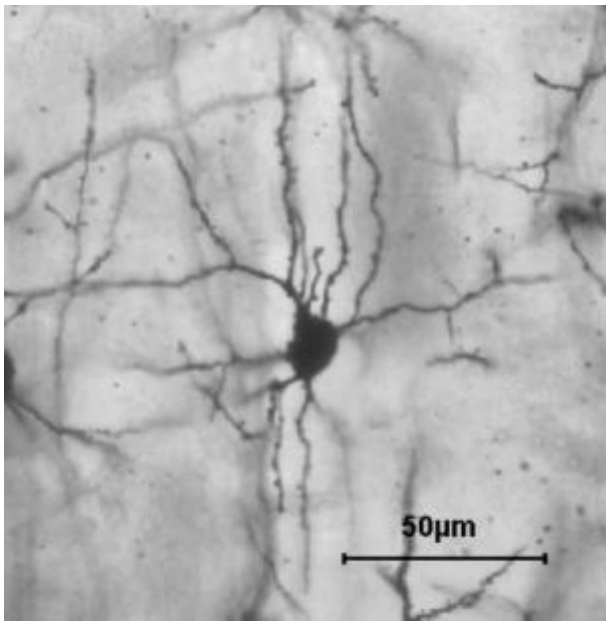
Adapted from materials provided by Indiana University.

Journal Reference:

1. Blackman et al. **The Role of Recently Derived FT Paralogs in Sunflower Domestication**. *Current Biology*, 2010; DOI: 10.1016/j.cub.2010.01.059

http://www.sciencedaily.com/releases/2010/04/100402110131.htm

All for One and One for All: Computer Model Reveals Neurons Coordinating Their Messaging, Yielding Clues to How the Brain Works



This is an image of a spiny stellate cell. (Credit: This image originally appeared in Churchill et al. BMC Neuroscience 2004 5:43.)

ScienceDaily (Apr. 5, 2010) — There is strength in numbers if you want to get your voice heard. But how to do you get your say if you are in the minority? That's a dilemma faced not only by the citizens of a democracy but also by some neurons in the brain.

Although they only account for a fraction of the synapses in the visual cortex, neurons in the thalamus get their message across loud and clear by coordination -- simultaneously hitting the "send" button -- according to a computer simulation developed by researchers at the Salk Institute for Biological Studies.

Their findings, published in the April 2, 2010 issue of the journal *Science*, hold important clues to how the brain encodes and processes information, which can be applied to a wide variety of applications, from understanding psychiatric disorders to the development of novel pharmaceuticals and new ways of handling information by computers or communication networks.

Historically, neuroscientists have been limited to recording the activity of single brain cells, which led to the widely accepted view that neurons communicate with each other through volleys of electrical spikes and that they increase the average rate of spiking to "speak up."

But communication between neurons is not limited to one-on-one interactions. Instead, any given cell receives signals from hundreds of cells, which send their messages through thousands of synapses, specialized junctions that allow signals to pass from one neuron to the next.

"Unfortunately, we don't have the technology yet to actually measure what all these neurons are saying to the recipient cell, which would require recording simultaneously from hundreds of cells, " says graduate student and first author Hsi-Ping Wang. "For this reason, nobody could answer a very basic question that's been puzzling neuroscientist for decades, which is: 'How many neurons or synapses does it take to reliably send a signal from point A to point B?'"

This question is particularly pressing for the thalamus, the central switchboard that processes and distributes incoming sensory information to all parts of the cortex. Thalamic input only accounts for five percent of the signals that so-called spiny stellate cells in the cortex receive, even though they drive a good portion of activity throughout the cerebral cortex.

"That is a paradox," says Howard Hughes Medical Institute investigator Terrence J. Sejnowski, Ph.D., professor and head of the Computational Neurobiology Laboratory. "How can so few synapses have such a big impact? If the average spiking rate were the determining factor, thalamic input would be drowned out by the other 95 percent of the inputs from other cortical cells."

Based on the assumption that the brain cares about the reliability and precision of spikes, Sejnowki's team developed a realistic computer model of a spiny stellate cell and the signals it receives through its roughly 6,000 synapses. "We found that it is not the number of spikes that's relevant but rather how many spikes arrive at the same time," says Sejnowski.

"Surprisingly, our model predicts that it only takes about 30 synapses out of 6,000 firing simultaneously to create extremely reliable signaling," explains Wang, "and our prediction lines up with currently available in vivo measurements and understanding. You could have all 6,000 synapses firing at the same time, but it would be a waste of resources."

The researchers hope that their findings will give them new insight into the holy grail of neurobiology: decoding the neural code or language of the brain. If the eye receives the same visual information under identical conditions over and over again, one would expect that the signal, the series of generated spikes or bits, is essentially the same.

"But it's not known whether that happens under natural conditions, and it's technically very difficult to measure, " says senior researcher and co-author Donald Spencer, Ph.D. "That's where the power of computational neurobiology really comes to bear on otherwise intractable questions."

"Applying theories of engineering to the study of the brain has helped us gain new insight into how neurons communicate with each other," says Wang. "On the other hand, there are certain things that the brain does in unique ways that are completely different from how computers work. A better understanding of the brain allows us the capture these algorithms and could very well affect the things engineers do in everyday life."

Jean-Marc Fellous, an associate professor in the Department of Psychology and Applied Mathematics at the University of Arizona, also contributed to the work.

The work was supported by the Howard Hughes Medical Institute.

Story Source:

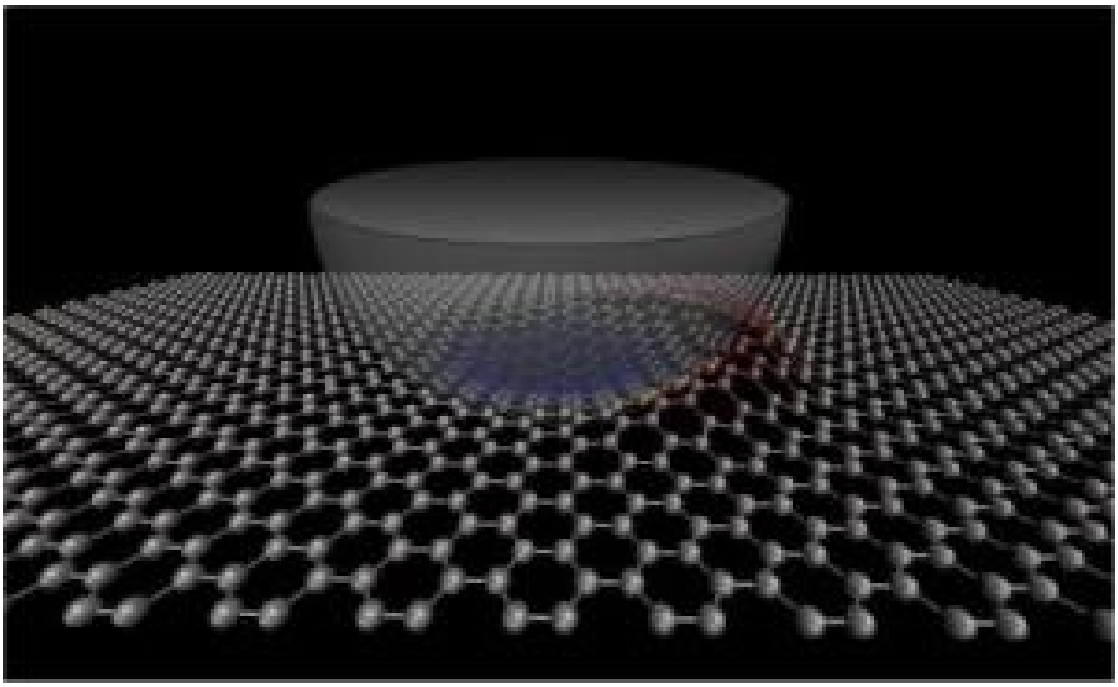
Adapted from materials provided by Salk Institute, via EurekAlert!, a service of AAAS.

Journal Reference:

1. H. P. Wang, D. Spencer, J. M. Fellous, T. J. Sejnowski. **Synchrony of Thalamocortical Inputs Maximizes Cortical Reliability**. *Science*, 2010; 328 (5974): 106 DOI: 10.1126/science.1183108

http://www.sciencedaily.com/releases/2010/04/100401143121.htm

Nanotechnologists Reveal the Frictional Characteristics of Atomically Thin Sheets



Interatomic forces cause attraction between the atomic sheet and the nano-scale tip of the atomic force microscope. Thin sheets deflect toward the tip, therefore increasing friction. When the tip starts to slide, the sheet deforms further as the deformed area is partially pulled along with the tip. The color scale of the atoms indicates how far the atoms have moved upward (red) or downward (blue) from their original positions. Thicker sheets cannot deflect as easily because they are much stiffer, so the increase in friction is less pronounced, consistent with study measurements. (Credit: University of Pennsylvania and Science)

ScienceDaily (Apr. 5, 2010) — A team of nanotechnology researchers from the University of Pennsylvania and Columbia University has used friction force microscopy to determine the nanoscale frictional characteristics of four atomically-thin materials, discovering a universal characteristic for these very different materials. Friction across these thin sheets increases as the number of atomic layers decreases, all the way down to one layer of atoms. This friction increase was surprising as there previously was no theory to predict this behavior.

The finding reveals a significant principle for these materials, which are widely used as solid lubricant films in critical engineering applications and are leading contenders for future nanoscale electronics.

Researchers found that friction progressively increased as the number of layers is reduced on all four materials, regardless of how different the materials may behave chemically, electronically or in bulk quantities. These measurements, supported by computer modeling, suggest that the trend arises from the fact that the thinner a material the more flexible it is, just as a single sheet of paper is much easier to bend than a thick piece of cardboard.

Robert Carpick, professor in the Department of Mechanical Engineering and Applied Mechanics at Penn, and James Hone, professor in the Department of Mechanical Engineering at Columbia, led the project collaboratively.

The team tested the nanotribological, or nano-scale frictional properties, of graphene, molybdenum disulfide (MoS2), hexagonal-BN (h-BN) and niobium diselenide (NbSe2) down to single atomic sheets. The team literally shaved off atomic-scale amounts of each material onto a silicon oxide substrate and

compared their findings to the bulk counterparts. Each material exhibited the same basic frictional behavior despite having electronic properties that vary from metallic to semiconducting to insulating.

"We call this mechanism, which leads to higher friction on thinner sheets the 'puckering effect,'" Carpick said. "Interatomic forces, like the van der Waals force, cause attraction between the atomic sheet and the nanoscale tip of the atomic force microscope which measures friction at the nanometer scale."

Because the sheet is so thin -- in some samples only an atom thick -- it deflects toward the tip, making a puckered shape and increasing the area of interaction between the tip and the sheet, which increases friction. When the tip starts to slide, the sheet deforms further as the deformed area is partially pulled along with the tip, rippling the front edge of the contact area. Thicker sheets cannot deflect as easily because they are much stiffer, so the increase in friction is less pronounced.

The researchers found that the increase in friction could be prevented if the atomic sheets were strongly bound to the substrate. If the materials were deposited onto the flat, high-energy surface of mica, a naturally occurring mineral, the effect goes away. Friction remains the same regardless of the number of layers because the sheets are strongly stuck down onto the mica, and no puckering can occur.

"Nanotechnology examines how materials behave differently as they shrink to the nanometer scale," Hone said. "On a fundamental level, it is exciting to find yet another property that fundamentally changes as a material gets smaller."

The results may also have practical implications for the design of nanomechanical devices that use graphene, which is one of the strongest materials known. It may also help researchers understand the macroscopic behavior of graphite, MoS2 and BN, which are used as common lubricants to reduce friction and wear in machines and devices.

The study, published in the current edition of the journal *Science*, was conducted collaboratively by Carpick and Qunyang Li of the Department of Mechanical Engineering in Penn's School of Engineering and Applied Science; Hone, Changgu Lee and William Kalb of the Department of Mechanical Engineering in the Fu Foundation School of Engineering and Applied Science at Columbia; Xin-Zhou Liu of Leiden University in the Netherlands; and Helmuth Berger of Ecole Polytechnique Fédérale de Lausanne in Switzerland.

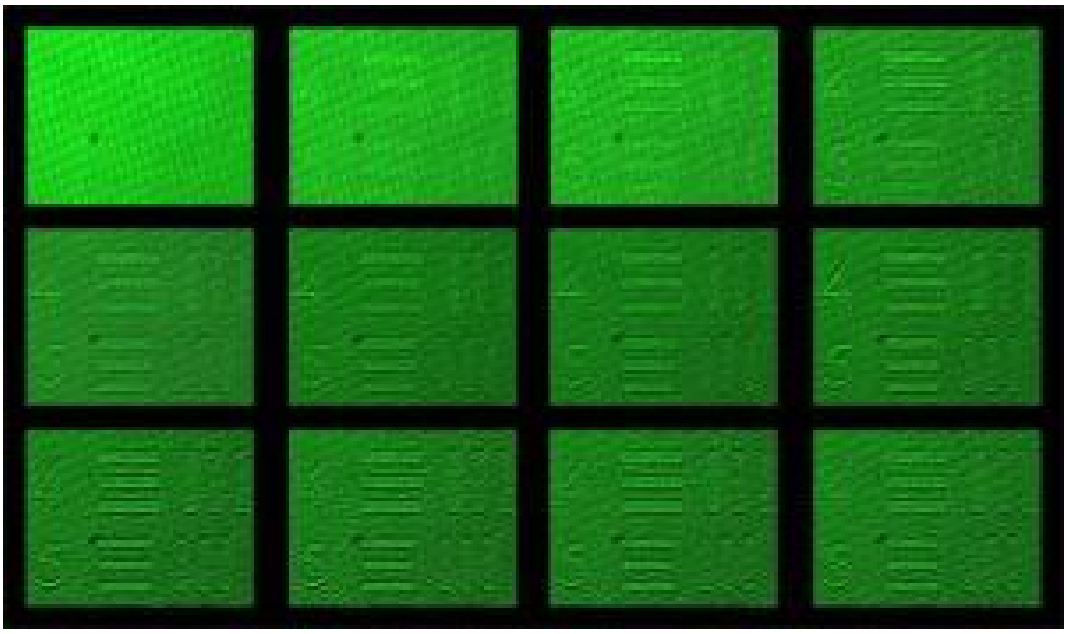
Research was funded by the National Science Foundation through Penn's Laboratory for Research into the Structure of Matter, Columbia's Nanoscale Science and Engineering Center, the NSF's Directorate for Engineering, the Defense Advanced Research Projects Agency, the Air Force Office of Scientific Research and the New York State Office of Science, Technology and Academic Research.

Story Source:

Adapted from materials provided by University of Pennsylvania, via EurekAlert!, a service of AAAS.

http://www.sciencedaily.com/releases/2010/04/100401143117.htm

Turning Noise Into Vision: New Way to Reveal Images of Hidden Objects



By adjusting an electrical voltage across a crystal of nonlinear material, the researchers recovered an image of lines and numbers that originally was hidden in noise (upper left). As they tuned the system (from left to right across each row from top to bottom), the image "stole" energy from the noise, first appearing and then degrading as they adjusted past the optimal voltage. (Credit: Jason Fleischer/Dmitry Dylov)

ScienceDaily (Apr. 5, 2010) — A new technique for revealing images of hidden objects may one day allow pilots to peer through fog and doctors to see more precisely into the human body without surgery.

Developed by Princeton engineers, the method relies on the surprising ability to clarify an image using rays of light that would typically make the image unrecognizable, such as those scattered by clouds, human tissue or murky water.

In their experiments, the researchers restored an obscured image into a clear pattern of numbers and lines. The process was akin to improving poor TV reception using the distorted, or "noisy," part of the broadcast signal.

"Normally, noise is considered a bad thing," said Jason Fleischer, an assistant professor of electrical engineering at Princeton. "But sometimes noise and signal can interact, and the energy from the noise can be used to amplify the signal. For weak signals, such as distant or dark images, actually adding noise can improve their quality."

He said the ability to boost signals this way could potentially improve a broad range of signal technologies, including the sonograms doctors use to visualize fetuses and the radar systems pilots use to navigate through storms and turbulence. The method also potentially could be applied in technologies such as night vision goggles, inspection of underwater structures such as levies and bridge supports, and in steganography, the practice of masking signals for security purposes.

The findings were reported online March 14 in *Nature Photonics.*

In their experiments, Fleischer and co-author Dmitry Dylov, an electrical engineering graduate student, passed a laser beam through a small piece of glass engraved with numbers and lines, similar to the charts

used during eye exams. The beam carried the image of the numbers and lines to a receiver connected to a video monitor, which displayed the pattern.

The researchers then placed a translucent piece of plastic similar to cellophane tape between the glass plate and the receiver. The tape-like material scattered the laser light before it arrived at the receiver, making the visual signal so noisy that the number and line pattern became indecipherable on the monitor, similar to the way smoke or fog might obstruct a person's view.

The crucial portion of the experiment came when Fleischer and Dylov placed another object in the path of the laser beam. Just in front of the receiver, they mounted a crystal of strontium barium niobate (SBN), a material that belongs to a class of substances known as "nonlinear" for their ability to alter the behavior of light in strange ways. In this case, the nonlinear crystal mixed different parts of the picture, allowing signal and noise to interact.

By adjusting an electrical voltage across the piece of SBN, the researchers were able to tune in a clear image on the monitor. The SBN gathered the rays that had been scattered by the translucent plastic and used that energy to clarify the weak image of the lines and numbers.

"We used noise to feed signals," Dylov said. "It's as if you took a picture of a person in the dark, and we made the person brighter and the background darker so you could see them. The contrast makes the person stand out."

The technique, known as "stochastic resonance," only works for the right amount of noise, as too much can overwhelm the signal. It has been observed in a variety of fields, ranging from neuroscience to energy harvesting, but never has been used this way for imaging.

Based on the results of their experiment, Fleischer and Dylov developed a new theory for how noisy signals move through nonlinear materials, which combines ideas from the fields of statistical physics, information theory and optics.

The research was funded by the National Science Foundation, the U.S. Department of Energy and the U.S. Air Force.

Their theory provides a general foundation for nonlinear communication that can be applied to a wide range of technologies. The researchers plan to incorporate other signal processing techniques to further improve the clarity of the images they generate and to apply the concepts they developed to biomedical imaging devices, including those that use sound and ultrasound instead of light.

Story Source:

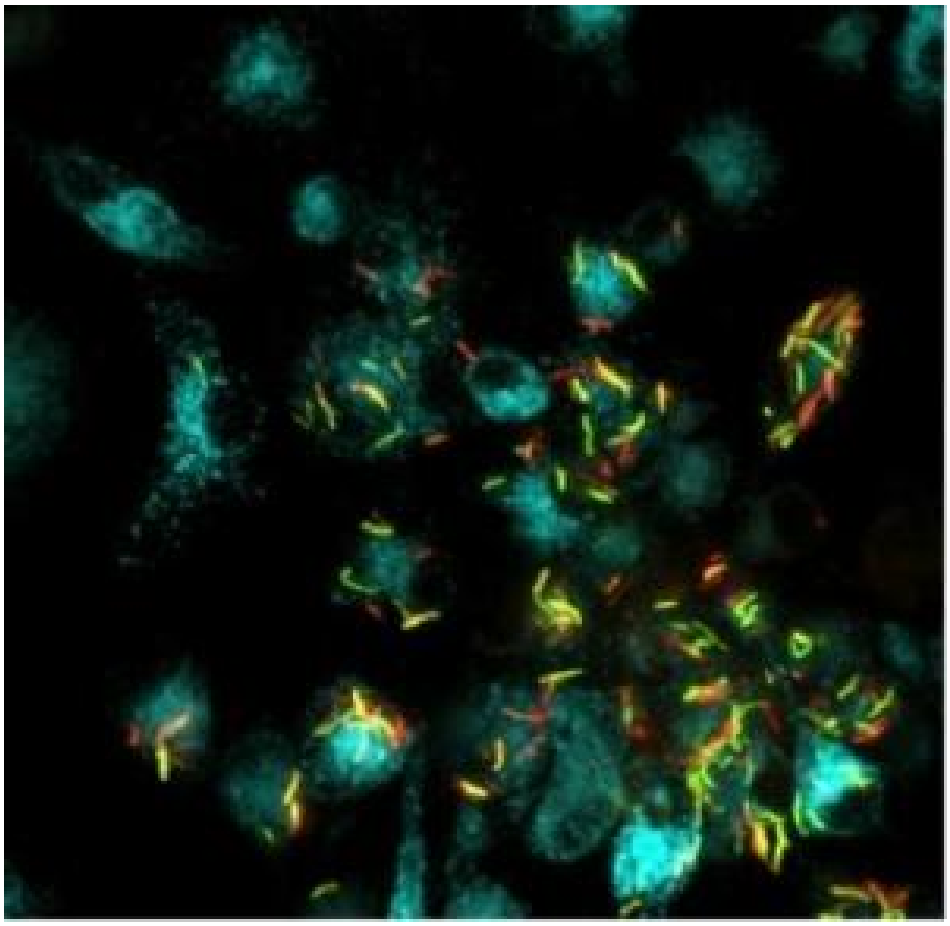
Adapted from materials provided by Princeton University, Engineering School.

Journal Reference:

1. Dylov et al. **Nonlinear self-filtering of noisy images via dynamical stochastic resonance**. *Nature Photonics*, 2010; DOI: 10.1038/nphoton.2010.31

http://www.sciencedaily.com/releases/2010/04/100402110133.htm

Fat Clue to Triggering Latent Tuberculosis



Macrophages infected with Mycobacterium tuberculosis that have been transformed to express the red fluorescent protein (constitutively), and the green fluorescent protein in response to stress from low pH. The macrophages are loaded with a lysosomal tracer (cyan) The picture was taken shortly after infection when the bacteria are stressed and trying to establish the infection. These bacterial strains allow one to probe bacterial fitness during in vivo infections and to evaluate the efficacy of drug treatments and immune therapy. (Credit: Robert Abramovitch and David G. Russell)

ScienceDaily (Apr. 5, 2010) — The factors instrumental in triggering latent tuberculosis (TB) infection to progress into active disease have long remained elusive to researchers. New insight into the mystery is provided by Professor David Russell, speaking at the Society for General Microbiology's spring meeting in Edinburgh. His work could help develop innovative strategies for treating the disease.

Professor Russell and his group at Cornell University in New York, USA, have demonstrated that TB-causing bacteria are able to hijack fat metabolism in the host to drive the progression of the disease. The team's research shows that *Mycobacterium tuberculosis* (Mtb) is able to stimulate macrophages -- the immune cells the bacterium infects -- to accumulate fat droplets, turning them into "foamy" cells. This cellular transformation can trigger a reawakening of the TB infection from its latent state.

Following initial infection by Mtb, the infected immune cells in the body can clump together in the lungs in a cellular mass that is surrounded by a fibrous cuff. This containing structure, called a tubercle, physically protects the bacteria from being destroyed by the immune system. This allows them to persist inside the host for years during a latent period in which the host shows no symptoms. The respiratory infection is reactivated only in a small percentage of individuals (often those who are immunosuppressed)

in whom it progressively destroys lung tissue. Very little is known about the exact causes of reactivation and the relative roles of the host and the pathogen.

Professor Russell's group discovered that inside the tubercle, surface molecules of Mtb prompted host macrophage cells to take up vast quantities of cholesterol-type lipids from the surrounding blood vessels. "We think that the lipids in the newly-formed foamy cell are then expelled into the cellular environment, which contributes to the collapse of the tubercle," he said.

Once freed from their containing structure, the infectious bacteria are able to leak out into the airways where they can progressively destroy lung tissue. "If our model is correct, it has huge implications for vaccines and chemotherapy programmes. A more detailed knowledge of the bacterium's life cycle and its host interactions will allow us to spot new targets for drugs -- opening up new possibilities for treatment," said Professor Russell.

Story Source:

Adapted from materials provided by Society for General Microbiology, via EurekAlert!, a service of AAAS.
http://www.sciencedaily.com/releases/2010/03/100329075917.htm

Chocolate Might Reduce Blood Pressure and Risk of Heart Disease, Research Suggests

Easter eggs and other chocolate may be good for you -- at least in small quantities and preferably if it's dark chocolate -- according to research that shows just one small square of chocolate a day can lower your blood pressure and reduce your risk of heart disease. (Credit: iStockphoto/Luis Carlos Torres)

ScienceDaily (Apr. 4, 2010) — Easter eggs and other chocolate may be good for you -- at least in small quantities and preferably if it's dark chocolate -- according to research that shows just one small square of chocolate a day can lower your blood pressure and reduce your risk of heart disease. The study is published online on March 31 in the *European Heart Journal*.

Researchers in Germany followed 19,357 people, aged between 35 and 65, for at least ten years and found that those who ate the most amount of chocolate -- an average of 7.5 grams a day -- had lower blood pressure and a 39% lower risk of having a heart attack or stroke compared to those who ate the least amount of chocolate -- an average of 1.7 grams a day. The difference between the two groups amounts to six grams of chocolate: the equivalent of less than one small square of a 100g bar.

Dr Brian Buijsse, a nutritional epidemiologist at the German Institute of Human Nutrition, Nuthetal, Germany, who led the research said: "People who ate the most amount of chocolate were at a 39% lower risk than those with the lowest chocolate intakes. To put it in terms of absolute risk, if people in the group eating the least amount of chocolate (of whom 219 per 10,000 had a heart attack or stroke) increased their chocolate intake by six grams a day, 85 fewer heart attacks and strokes per 10,000 people could be expected to occur over a period of about ten years. If the 39% lower risk is generalised to the general population, the number of avoidable heart attacks and strokes could be higher because the absolute risk in the general population is higher."[1]

However, he warned that it was important people ensured that eating chocolate did not increase their overall intake of calories or reduce their consumption of healthy foods. "Small amounts of chocolate may help to prevent heart disease, but only if it replaces other energy-dense food, such as snacks, in order to keep body weight stable," he said.

The people in the study were participants in the Potsdam arm of the European Prospective Investigation into Cancer (EPIC). They received medical checks, including blood pressure, height and weight measurements at the start of the study between 1994-1998, and they also answered questions about their diet, lifestyle and health. They were asked how frequently they ate a 50g bar of chocolate, and they could say whether they ate half a bar, or one, two or three bars. They were not asked about whether the chocolate was white, milk or dark chocolate; however, the researchers asked a sub-set of 1,568 participants to recall their chocolate intake over a 24-hour period and to indicate which type of chocolate they ate. This gave an indication of the proportions that might be expected in the whole study. In this sub-set, 57% ate milk chocolate, 24% dark chocolate and 2% white chocolate.

In follow-up questionnaires, sent out every two or three years until December 2006, the study participants were asked whether they had had a heart attack or stroke, information which was subsequently verified by medical records from general physicians or hospitals. Death certificates from those who had died were also used to identify heart attacks and strokes.

The researchers allocated the participants to four groups (quartiles) according to their level of chocolate consumption. Those in the top quartile, eating around 7.5g of chocolate a day, had blood pressure that was about 1mm Hg (systolic) and 0.9mm Hg (diastolic) lower than those in the bottom quartile. [2]

"Our hypothesis was that because chocolate appears to have a pronounced effect on blood pressure, therefore chocolate consumption would lower the risk of strokes and heart attacks, with a stronger effect being seen for stroke," explained Dr Buijsse.

This is, in fact, what the study found. During the eight years there were 166 heart attacks (24 fatal) and 136 strokes (12 fatal); people in the top quartile had a 27% reduced risk of heart attacks and nearly half the risk (48%) of strokes, compared with those in the lowest quartile.

The researchers found lower blood pressure due to chocolate consumption at the start of the study explained 12% of the reduced risk of heart attacks and strokes, but even after taking this into account, those in the top quartile still had their risk reduced by a third (32%) compared to those in the bottom quartile over the duration of the study.

Although more research needs to be carried out, the researchers believe that flavanols in cocoa may be the reason why chocolate seems to be good for people's blood pressure and heart health; and since there is more cocoa in dark chocolate, dark chocolate may have a greater effect.

"Flavanols appear to be the substances in cocoa that are responsible for improving the bioavailability of nitric oxide from the cells that line the inner wall of blood vessels -- vascular endothelial cells," said Dr Buijsse. "Nitric oxide is a gas that, once released, causes the smooth muscle cells of the blood vessels to relax and widen; this may contribute to lower blood pressure. Nitric oxide also improves platelet function, making the blood less sticky, and makes the vascular endothelium less attractive for white blood cells to attach and stick around."

The authors of the study conclude: "Given these and other promising health effects of cocoa, it is tempting to indulge more in chocolate. Small amounts of chocolate, however, may become part of a diet aimed to prevent CVD [cardiovascular disease] only after confirmation by other observational studies and particularly by randomized trials."

Commenting on the research on behalf of the European Society of Cardiology (ESC), Frank Ruschitzka, Professor of Cardiology, Director of Heart Failure/Transplantation at the University Hospital Zurich, Switzerland, and a Fellow of the ESC, said: "Basic science has demonstrated quite convincingly that dark chocolate particularly, with a cocoa content of at least 70%, reduces oxidative stress and improves vascular and platelet function. However, before you rush to add dark chocolate to your diet, be aware that

100g of dark chocolate contains roughly 500 calories. As such, you may want to subtract an equivalent amount of calories, by cutting back on other foods, to avoid weight gain."

Notes

[1] Examples of absolute risk are given here to help with understanding the findings; however, the study itself only reports relative risk.

[2] mm Hg = millimetres of mercury (the measure for blood pressure).

Systolic = when the heart's ventricles contract.

Diastolic = when the ventricles relax.

The normal blood pressure for a healthy adult is around 120/80.

Story Source:

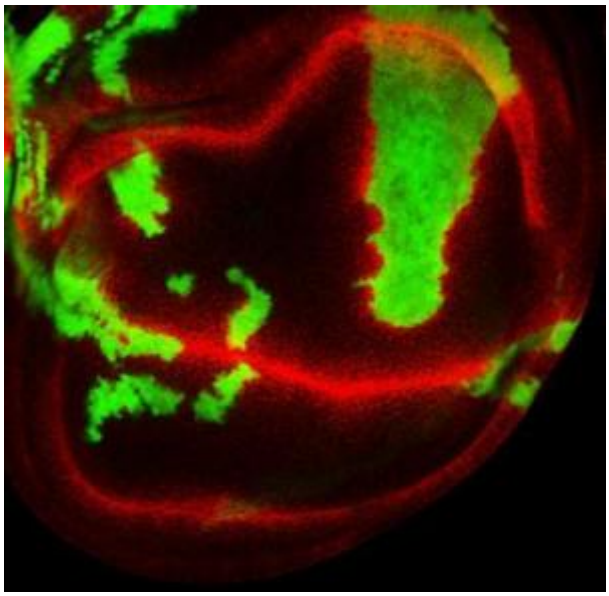
Adapted from materials provided by European Society of Cardiology, via EurekAlert!, a service of AAAS.

Journal Reference:

1. Brian Buijsse, Cornelia Weikert, Dagmar Drogan, Manuela Bergmann, and Heiner Boeing. **Chocolate consumption in relation to blood pressure and risk of cardiovascular disease in German adults**. *European Heart Journal*, DOI: 10.1093/eurheartj/ehq068

http://www.sciencedaily.com/releases/2010/03/100330092809.htm

Opposing Functions of Key Molecule in Development of Organisms



This is a Drosophila wing disc containing a group of cells (in green) where the receptor Notch has been removed. The absence of Notch leads to the activation of the pathway in the neighboring normal cells as you can see by the expression of a target gene of the Notch pathway (in red). (Credit: Copyright MMilan Lab. IRB Barcelona)

ScienceDaily (Apr. 4, 2010) — Scientists headed by ICREA researcher Marco Milán, at the Institute for Research in Biomedicine (IRB Barcelona), reveal a surprising new function of Notch protein that contrasts with the one known to date. Found in the cell membrane, this protein activates a signalling pathway that regulates the expression of genes that make the cell divide, grow, migrate, specialise or die. Notch activity is required for the correct development of organisms and for the maintenance of tissues in adults.

When Notch acts at an incorrect time or in an incorrect context, it can give rise to the generation of tumours, among these leukaemia, breast cancer, colon cancer, skin cancer, lung cancer and renal carcinomas.

"The same pathways responsible for the development and growth of organisms are involved in the transformation of healthy cells into cancerous ones," says Marco Milán, so "all new data on the modulation of Notch activity, the first step in the chain, may be relevant for the design of effective therapies." Marco Milán's group has now discovered that the presence of Notch proteins in the cell membrane is also required to inactivate the pathway. The description of the new role of Notch, found in the fly *Drosophila melanogaster*, and the mechanism that regulates this function have been published in the journal *Current Biology*, which belongs to the Cell group.

Stop! Notch is a double agent

In order for the Notch pathway to be activated, ligand-type proteins from neighbouring cells bind to the Notch receptor. When the ligand and receptor come into contact, the Notch receptor is processed and the intracellular part moves to the nucleus to activate gene expression. This is the basic and "extremely simple activation system" of the Notch signalling pathway, which is based on short distance contact between cells through a ligand and a receptor.

In a developing wing and through a technique called Clonal Analysis, the researchers manipulated groups of cells, among groups of normal cells, to remove Notch receptor expression. The scientists used the

Drosophila wing because it is an excellent model to describe how cells behave when a certain gene is mutated and to determine and test how this mutation affects adjacent cells. This was the objective of the study designed by Isabelle Becam, post-doctoral researcher in Milán's Group and first author of the article. "As expected, the cells lacking Notch did not activate the pathway, but what was surprising was the observation that neighbouring cells did." Becam then questioned whether the absence of Notch in a group of mutated cells could cause activation.

Indeed, the analyses demonstrated that the Notch receptor sequesters the ligands and prevents these from connecting to the Notch receptors of adjoining cells. The experiments showed that the absence of the receptor in the mutated cells leaves many ligands free, ready to enter into contact with Notch receptors of the non-manipulated cells. "It is strange, but in the cell emitting the signal, Notch receptor captures the ligands by acting as a silencer while in the cell receiving the signal the binding of ligands with Notch allows activation of the pathway." "In fact," says Milán, "it is all to do with a fine balance between ligands and receptors of the emitting and receiving cell." In other words, Notch is a kind of double agent and exerts opposing functions: repressing or activating the pathway depending on whether it is located in cells emitting or receiving the signal. It must be noted that such a simple activation system involves multiple repression mechanisms, "because this is a crucial but also dangerous signalling pathway," explains Milán.

The researchers have discovered the self-repression mechanism of Notch in *Drosophila* and it should be checked now whether this also operates in mice and humans. They speculate that it does because the ligand-receptor system of Notch activation has been conserved in all organisms. "If this new mechanism is also present in vertebrates, it should be taken into consideration when designing effective therapies against certain kinds of cancer, such as T-cell acute lymphoblastic leukaemia (T-ALL)," concludes Milán.

It is well established that the Notch pathway controls the development of T lymphocytes, cells of the immune response system found in blood. The cells destined to become lymphocytes receive the appropriate signalling through Notch receptors. In more than half T-ALL patients the Notch receptor is permanently activated in the T-cell precursors. Thus the continuous proliferation of cells is stimulated until tumours form. "A priori, blocking the Notch receptor could appear to be a good strategy to combat this kind of leukaemia. However, the results of our work suggest that blocking the receptor only in some cells would cause undesirable effects in adjacent cells," warns Milán.

Story Source:

Adapted from materials provided by Institute for Research in Biomedicine (IRB Barcelona).

Journal Reference:

1. Isabelle Becam, Ulla-Maj Fiuzza, Alfonso Martínez-Arias and Marco Milán. **A role of Notch in ligand cis-inhibition in Drosophila**. *Current Biology*, DOI: 10.1016/j.cub.2010.01.058

http://www.sciencedaily.com/releases/2010/03/100312091405.htm

New Procedure Could Speed Cell Phone Testing

NIST engineer Kate Remley (center) was part of a team that conducted wireless communications tests using several different technologies in downtown Denver in 2009. At left is Jeremy May, a participant in NIST's Summer Undergraduate Research Fellowship program, and David Matolak, a professor at Ohio University in Athens, Ohio. (Credit: NIST)

ScienceDaily (Apr. 4, 2010) — By accurately re-creating the jumbled wireless signal environment of a city business district in a special indoor test facility, researchers at the National Institute of Standards and Technology (NIST) have shown how the wireless industry could lop hours off the process of testing the capabilities of new cellular phones. The NIST techniques also could simulate complex real-world environments for design and test of other wireless equipment.

As described in a forthcoming paper,* NIST researchers conducted tests in downtown Denver, Colo., to measure precisely the clustering of signal reflections from radio waves bouncing off one or more multi-story buildings multiple times before reaching a distant receiver. The researchers replicated this environment indoors using a "reverberation chamber," a room with highly reflective surfaces and a big, slowly rotating paddle that automatically alters signal paths. First, researchers feed a wireless transmitter's signal into a device called a fading simulator, which is adjusted to re-create the timing and strength of the reflections of an outdoor urban area. The output then is fed into the reverberation chamber, where signal reflections decay exponentially over time, creating a cluster of signals similar to that observed in the field tests.

Industry certification of cell phones currently requires tests of parameters such as total radiated power using the opposite of a reverberation chamber, a room called an anechoic chamber that is lined with materials that absorb radio waves and reflect as little as possible. This testing takes about a day, requiring dozens of measurements of cell phone directional power from multiple angles. By contrast, an equivalent set of tests could be performed in about an hour in a reverberation chamber, according to NIST engineer Kate Remley, a senior author of the new paper. Reverberation chambers also could be used to measure cell phone receiver sensitivity, although currently there would be no time savings for this test, Remley says. Many industry testing practices are established by CTIA-The Wireless Association, the trade group representing the wireless industry.

NIST is studying new applications for reverberation chambers, which have typically been used to measure electronic equipment's immunity to radio-frequency interference. By adjusting the reflectivity of the chamber through selective use of signal-absorbing material, researchers have found they can "tune" the signal decay time to simulate the conditions found in real-world environments. NIST researchers expect the new method will be useful for test and design of wireless devices such as cell phones, notebook computers equipped with wireless links, as well as new technology such as wireless beacons being developed for the emergency responder community.

The Denver tests were conducted in 2009. NIST researchers measured the power delays between a transmitter and a distant receiver positioned on streets lined with buildings three floors high or taller and a flat, single-layer parking lot. Most buildings were constructed of glass, steel, and concrete.

Story Source:

Adapted from materials provided by National Institute of Standards and Technology (NIST).

Journal Reference:

1. H. Fielitz, K.A. Remley, C.L. Holloway, Q. Zhang, Q. Wu and D.W. Matolak. **Reverberation-chamber test environment for outdoor urban wireless propagation studies**. *IEEE Antennas and Wireless Propagation Letters*, 2010; (Forthcoming)

http://www.sciencedaily.com/releases/2010/03/100304165852.htm

New Study Investigates Infection of Human Cells in Space

At 3:21 a.m. PDT on April 5, Biodesign's Cheryl Nickerson (center) and her team, including post-doctoral researchers Jennifer Barrila (right) and Shameema Sarker (left) will see their latest experiment launched into low earth orbit aboard the space shuttle Discovery on mission STS-131. (Credit: Image courtesy of Arizona State University)

ScienceDaily (Apr. 4, 2010) — In a first-of-its-kind experiment, the unique conditions of spaceflight will be used to examine how cells remain healthy or succumb to disease, particularly in the face of stress or damage.

At 3:21 a.m. PDT on April 5, ASU Biodesign Institute researchers Cheryl Nickerson and her team, including Jennifer Barrila and Shameema Sarker, will see their latest experiment launched into low earth orbit aboard the space shuttle Discovery on mission STS-131.The goals of the team's research are to provide fundamental new insight into the infectious disease process, and further undestanding of other progressive diseases, including immune disorders and cancer.

The knowledge gained from this work may eventually aid in the development of new treatments for infectious diseases, which remain a leading cause of human morbidity and mortality worldwide. Results of the current study will also be used to help mitigate infectious disease risks to the crew, who are particularly vulnerable to infection, due to reduced immune function during spaceflight missions.

"The key to this research" said Nickerson, a School of Life Sciences associate professor and researcher at Biodesign's Center for Infectious Diseases and Vaccinology, "is the novel way that cells adapt and respond to the unique microgravity environment of spaceflight. In response to microgravity, cells exhibit important biological characteristics that are directly relevant to human health and disease, including changes in immune function, stress responses, and virulence (infectious disease potential) that are not observed using traditional experimental approaches."

This is the third time that Nickerson and her ASU team have flown their NASA-funded experiments aboard a space shuttle. Their previous research on board Shuttles Atlantis and Endeavour were the first to show that spaceflight induces major changes in the gene expression and virulence of the food-born pathogen, Salmonella. These changes were due, at least in part, to the unique way extracellular fluid flows around the surface of cells -- like water flowing over and around a pebble in a streambed. This physical perturbation of the cell surface caused by the surrounding fluid flow over it results in a low fluid shear force that induces unique cellular responses in both bacteria (like Salmonella) and human cells.

The current mission will be the first time that human cells will undergo infection by a pathogen in spaceflight. Specifically, this thirteen day experiment, called STL-Immune, will characterize the effect of microgravity on intestinal cellular responses before and after infection with the food-borne pathogen, *Salmonella typhimurium*. Results of this study will be analyzed in a collaborative effort between Nickerson's lab and that of her co-investigator Mark Ott, a researcher at NASA's Johnson Space Center, and his graduate student, Sarah Castro.

The goals of these experiments are twofold: a) to better understand the effect of spaceflight on human cells before and after infection with an invasive bacterial pathogen -- information of vital importance for ensuring the safety of astronauts, and b) to gain insight into responses of human and pathogenic cells in their customary environment within the human body on Earth. These conditions, Nickerson explains, can sometimes bear intriguing similarities to those observed during spaceflight, though this effect is often masked by gravity in conventional, Earth-based experiments.

Disease-causing bacteria like Salmonella are capable of keenly sensing the environmental conditions they encounter during infection in their human or animal hosts, adjusting their virulence as conditions dictate. As they infect their hosts, bacteria use a battery of options to dodge attempts to destroy them. Nickerson's previous work showed that bacteria can use the Hfq protein to regulate their pathogenic responses to fluid shear. The Hfq protein is highly conserved in bacteria, meaning it is found among a wide array of species, and plays an essential role in the infection process.

Interestingly, human cells have their own version of the bacterial Hfq protein, call Sm proteins, which are involved in cellular differentiation and responses to stress, immune system function, and the production of tumors. The group hopes to determine if the Sm proteins also act as response regulators during spaceflight, like the Hfq protein does in bacteria.

The excitement of Nickerson and her team is palpable as the launch day approaches. "To actually look at the host-pathogen interaction in flight," she said, "is really taking the findings from our previous spaceflight research to a whole new level." This research holds important benefits and applications for mitigating infectious disease risks to the crew during spaceflight, and for the development of new strategies to combat disease for the general public on Earth.

Dr. Duane Pierson, Chief Microbiologist for the NASA Life Sciences Directorate, stresses the importance of Nickerson's foundational studies into host-pathogen behavior: "Dr. Nickerson's earlier studies produced landmark discoveries of increased virulence in bacteria during spaceflight. Her current investigation may yield even more discoveries of the fundamental processes of microbial infection of human cells in the space environment."

A more thorough understanding of the way pathogens and human cells interact in space may pave the way to new vaccines and therapeutics for a broad range of infectious diseases, as well as other afflictions affecting human populations. Additionally, the results will be used to fine-tune protocols affecting astronauts, helping to ensure they don't fall victim to heightened microbial virulence.

"While studying cells using traditional experimental conditions in the laboratory has taught us an enormous amount about how cells behave normally or develop disease," Nickerson said, "we are starting to realize just how much we've missed using these conventional approaches. Our work using the spaceflight platform for such studies has and will continue to advance our fundamental understanding of the disease process in cells and could lead to major advancements in human health."

Story Source:

Adapted from materials provided by Arizona State University.

http://www.sciencedaily.com/releases/2010/04/100402154914.htm

Early Detection of Age-Related Memory Deficits in Mice

Experimental maze through which the mice must travel. To find their way, they need to memorize where and when to turn corners, a task that calls upon their episodic memory. (Credit: Copyright CNRS- Equipe ENMVI(Navigation, mémoire et vieillissement))

ScienceDaily (Apr. 4, 2010) — By studying the aging of memory in the mouse, researchers in the Laboratoire Neurobiologie des Processus Adaptatifs (CNRS/Université Pierre et Marie Curie) have developed an experimental protocol that can detect age-related memory deficits at an early stage. They have shown that even at 10 months, which corresponds to a third of their life expectancy, some mice present with age-related memory disorders.

Published in *Neurobiology of Aging*, this work opens new perspectives for an understanding of the cellular and molecular mechanisms underlying the aging of memory and for the diagnosis of Alzheimer's disease.

Events of our everyday life, or our recollections, are all constituents of our episodic memory. This is one of the first types of memory to be impaired during aging and at the onset of Alzheimer's disease, following modifications to hippocampal function. Testing this memory remains a challenge for modern neurology. Indeed, how is it possible to verify the authenticity of someone else's recollections? The only solution is to create a new one experimentally.

Mice do not spontaneously develop either amyloid plaques or neurofibrillary degeneration, the characteristic signs of Alzheimer's disease. However, they constitute a model of choice to study age-related memory loss not linked to any loss of neurons.

Researchers in the Navigation Mémoire et Vieillissement team in the Laboratoire Neurobiologie des Processus Adaptatifs (CNRS/Université Pierre et Marie Curie) have developed a behavioral mouse model based on remembering a pathway supplemented with considerable spatial and temporal information, which calls upon use of their episodic memory. The mice are placed in an aquatic maze full of visual images (pyramids, balls, cards, circles, etc.) that constitute clues that the rodents need to memorize in order to orient themselves and then reach a platform. The researchers assessed the navigation strategies developed by mice aged 3 months, 10 months and 17 months. The results showed that approximately 20% of the individuals tested at 10 months, and 50% of those tested at 17 months, were unable to solve the problem. This protocol thus enables the specific testing of episodic memory and can differentiate at an early stage those individuals who are displaying the memory deficits that appear with age. This is the first study to have achieved such results in an animal model.

The isolation of mice presenting with specific, age-related spatial and temporal memory deficits will then enable scientists to detect in them the cellular and molecular causes of memory loss.

Use of this non-verbal task also enables the same protocol to be applied in both animal models and human subjects, providing researchers with reliable results that are devoid of any misleading language effects. This behavioral model has been adapted to humans, using virtual reality, by the same research team. It may help to distinguish patients with Alzheimer's disease from those suffering from disorders linked to normal aging or other neurodegenerative diseases. Further studies are currently under way.

Story Source:

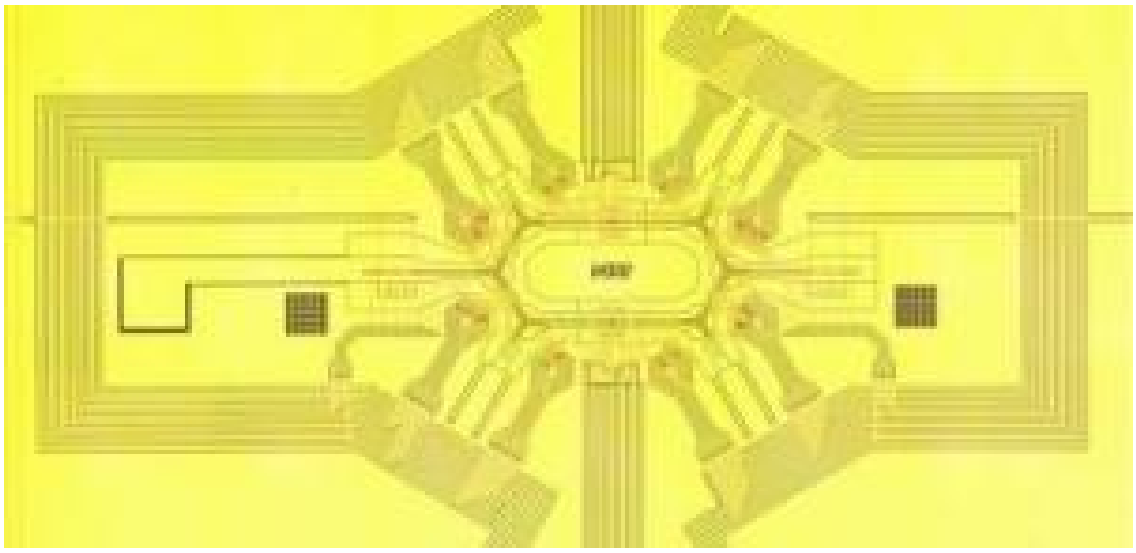
Adapted from materials provided by CNRS (Délégation Paris Michel-Ange).

Journal Reference:

1. Fouquet et al. **Early detection of age-related memory deficits in individual mice**. *Neurobiology of Aging*, 2009; DOI: 10.1016/j.neurobiolaging.2009.11.001

http://www.sciencedaily.com/releases/2010/03/100331152652.htm

Racetrack Ion Trap Is a Contender in Quantum Computing Quest



This is a photograph of NIST racetrack ion trap under development as possible hardware for a future quantum computer. The 150 zones for storing, transporting and probing ions (electrically charged atoms) are located in the center ring structure and the six channels radiating out from its edges. (Credit: Credit: J. Amini/NIST)

ScienceDaily (Apr. 4, 2010) — Physicists at the National Institute of Standards and Technology (NIST) have built and tested a device for trapping electrically charged atoms (ions) that potentially could process dozens of ions at once with the most versatile control of any trap demonstrated to date. The novel design is a first attempt to systematically scale up from traps that hold a few ions in a few locations to large trap arrays that can process many ions simultaneously, with the ultimate goal of building a practical quantum computer.

If they can be built, quantum computers would rely on the curious rules of quantum mechanics to solve certain currently intractable problems, such as breaking today's most widely used data encryption codes. The same NIST research group has previously demonstrated various components and operations of a potential quantum computer using ions as quantum bits (qubits). The trap structure is only one component, analogous to the wiring in today's computers. Lasers are also needed to control and use the quantum data, as transistors do for classical bits today.

Made of a quartz wafer coated with gold in an oval shape roughly 2 by 4 millimeters, NIST's "racetrack" ion trap features 150 work zones where qubits -- ions encoding 1s and 0s in their "spins" -- could be stored and transported using electric fields and manipulated with laser beams for information processing. The trap theoretically could be scaled up to a much larger number of zones and mass fabricated in a variety of materials. Preliminary testing of the trap, including loading of 10 magnesium ions at once and transport of an ion through a junction between channels, is described in a new paper.

Geometry is a key feature of the new trap design. This is the first demonstration of ion transport through a junction in a trap where all electrodes are located on one flat surface, a more scalable design than the multilayer ion traps originally developed. The various electrodes are used to position and move the ions. At least three adjacent electrodes are needed to hold an ion in a dedicated energy "well." This well and the ion can then be moved around to different locations by applying voltages to several other electrodes. The modular design would allow the addition of extra rings, which could significantly increase capabilities, according to Jason Amini, who designed the trap while a NIST postdoctoral researcher and is now at the Georgia Tech Quantum Institute in Atlanta.

"The trap design demonstrates the use of a basic component library that can be quickly assembled to form structures optimized for a particular experiment," Amini says. "We can imagine rapid development of traps tailored to individual experiments."

NIST scientists are continuing development of the racetrack ion trap as well as other designs. The new work was funded in part by the Intelligence Advanced Research Projects Activity and the Office of Naval Research. Four of the 10 authors of the new paper were postdoctoral or guest researchers at NIST at the time of the research and are currently affiliated with the Georgia Tech Quantum Institute, Atlanta, Ga.; Council for Scientific and Industrial Research, Pretoria, South Africa; Centre for Quantum Technologies, National University of Singapore; and Institut Neel-CNRS, Grenoble, France.

Story Source:

Adapted from materials provided by National Institute of Standards and Technology (NIST).

Journal Reference:

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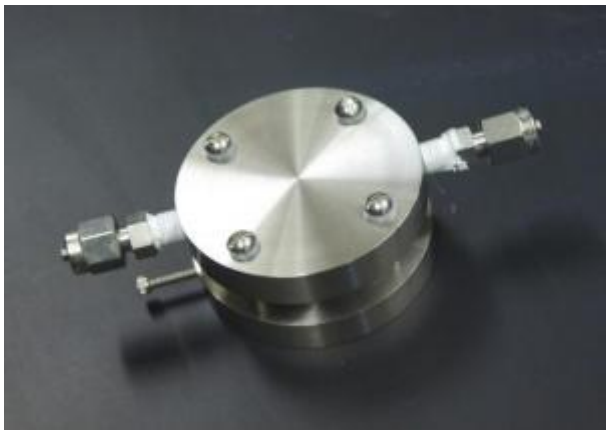
http://www.sciencedaily.com/releases/2010/04/100401130336.htm

Significant Step Toward Lightweight Batteries



Test battery has inlet and outlet on the sides to provide a flow of air, providing oxygen for the battery's operation. Photo: (Credit: Patrick Gillooly/MIT)

ScienceDaily (Apr. 4, 2010) — A team of researchers at MIT has made significant progress on a technology that could lead to batteries with up to three times the energy density of any battery that currently exists.

Yang Shao-Horn, an MIT associate professor of mechanical engineering and materials science and engineering, says that many groups have been pursuing work on lithium-air batteries, a technology that has great potential for achieving great gains in energy density. But there has been a lack of understanding of what kinds of electrode materials could promote the electrochemical reactions that take place in these batteries.

Lithium-oxygen (also known as lithium-air) batteries are similar in principle to the lithium-ion batteries that now dominate the field of portable electronics and are a leading contender for electric vehicles. But because lithium-air batteries replace the heavy conventional compounds in such batteries with a carbon-based air electrode and flow of air, the batteries themselves can be much lighter. That's why leading companies, including IBM and General Motors, have committed to major research initiatives on lithium-air technology.

In a paper published this week in the journal *Electrochemical and Solid-State Letters*, Shao-Horn, along with some of her students and visiting professor Hubert Gasteiger, reported on a study showing that electrodes with gold or platinum as a catalyst show a much higher level of activity and thus a higher efficiency than simple carbon electrodes in these batteries. In addition, this new work sets the stage for further research that could lead to even better electrode materials, perhaps alloys of gold and platinum or other metals, or metallic oxides, and to less expensive alternatives.

Doctoral student Yi-Chun Lu, lead author of the paper, explains that this team has developed a method for analyzing the activity of different catalysts in the batteries, and now they can build on this research to study a variety of possible materials. "We'll look at different materials, and look at the trends," she says. "Such research could allow us to identify the physical parameters that govern the catalyst activity. Ultimately, we will be able to predict the catalyst behaviors. "

Lightweight batteries that can deliver lots of energy are crucial for a variety of applications -- for example, improving the range of electric cars. For that reason, even modest increases in a battery's energy-density rating -- a measure of the amount of energy that can be delivered for a given weight -- are important advances.

One issue to be dealt with in developing a battery system that could be widely commercialized is safety. Lithium in metallic form, which is used in lithium-air batteries, is highly reactive in the presence of even minuscule amounts of water. This is not an issue in current lithium-ion batteries because carbon-based materials are used for the negative electrode. Shao-Horn says the same battery principle can be applied without the need to use metallic lithium; graphite or some other more stable negative electrode materials could be used instead, she says, leading to a safer system.

A number of issues must be addressed before lithium-air batteries can become a practical commercial product, she says. The biggest issue is developing a system that keeps its power through a sufficient number of charging and discharging cycles for it to be useful in vehicles or electronic devices.

Researchers also need to look into details of the chemistry of the charging and discharging processes, to see what compounds are produced and where, and how they react with other compounds in the system. "We're at the very beginning" of understanding exactly how these reactions occur, Shao-Horn says.

Gholam-Abbas Nazri, a researcher at the GM Research & Development Center in Michigan, calls this research "interesting and important," and says this addresses a significant bottleneck in the development of this technology: the need find an efficient catalyst. This work is "in the right direction for further understanding of the role of catalysts," and it "may significantly contribute to the further understanding and future development of lithium-air systems," he says.

While some companies working on lithium-air batteries have said they see it as a 10-year development program, Shao-Horn says it is too early to predict how long it may take to reach commercialization. "It's a very promising area, but there are many science and engineering challenges to be overcome," she says. "If it truly demonstrates two to three times the energy density" of today's lithium-ion batteries, she says, the likely first applications will be in portable electronics such as computers and cell phones, which are high-value items, and only later would be applied to vehicles once the costs are reduced.

Funding was provided by the Department of Energy, with additional support from the Martin Family Society of Fellows for Sustainability and the National Science Foundation.

Story Source:

Adapted from materials provided by Massachusetts Institute of Technology. Original article written by David L. Chandler, MIT News Office.

Journal Reference:

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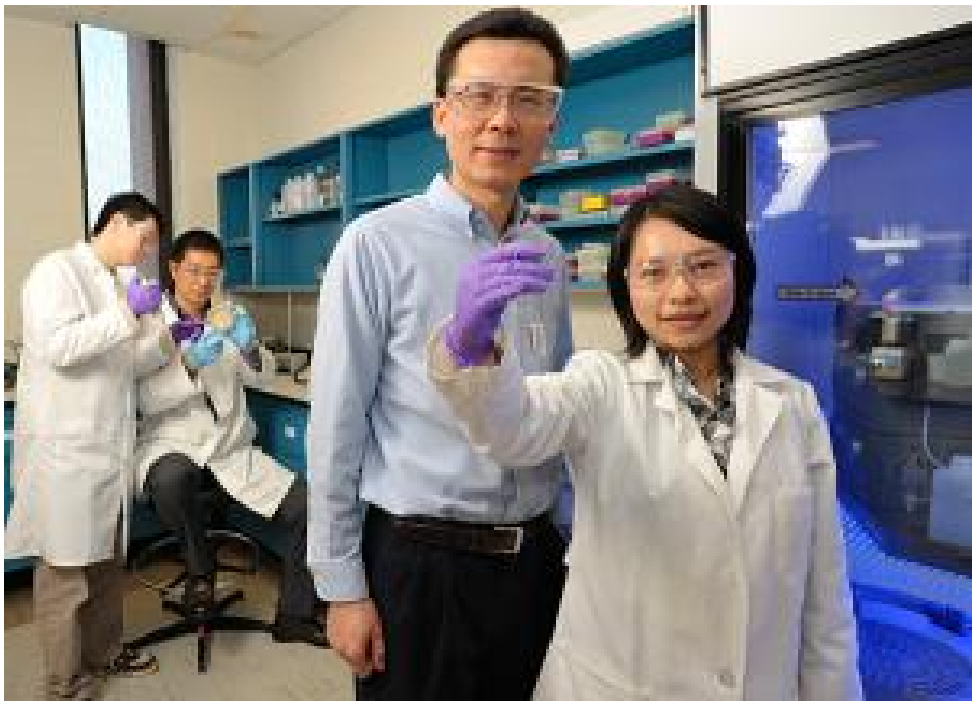
http://www.sciencedaily.com/releases/2010/04/100402110128.htm

New Method for Producing Proteins Critical to Medical Research



Zhihao Zhuang, UD assistant professor of chemistry and biochemistry (second from right), and his team have developed a new method for producing proteins critical to research on cancer, Alzheimer's, and other major diseases. Next to Zhuang is graduate student Junjun Chen; in the background, from left, are graduate student Jialiang Wang and postdoctoral fellow Yongxing Ai. (Credit: Photo by Kathy F. Atkinson)

ScienceDaily (Apr. 4, 2010) — Scientists at the University of Delaware have developed a new method for producing proteins critical to research on cancer, Alzheimer's, and other diseases.

Developed by Zhihao Zhuang, UD assistant professor of chemistry and biochemistry, and his research group, the chemical method yields hundredsfold more ubiquitylated proteins than current approaches. Such proteins may hold the key to revealing such mysteries as how cancer cells gain resistance to cancer drugs.

The advance is reported in the April issue of *Nature Chemical Biology*, the leading journal in the field of chemical biology. Zhuang's co-authors include graduate students Junjun Chen and Jialiang Wang and postdoctoral fellow Yongxing Ai, all from UD, and Lajos Haracska, a researcher in the Institute of Genetics at the Hungarian Academy of Sciences.

Ubiquitin is a small protein, the basis of Nobel Prize-winning research in 2004, which deemed the molecule the "kiss of death" for its role in tagging damaged or unneeded proteins for the cell's waste disposal in the constant process of protein generation and degradation. In recent years, the non-proteolytic functions of ubiquitin in diverse cellular processes, including protein trafficking, immune response, and DNA damage tolerance, have been discovered at a rapid pace, and it has become clear that ubiquitin plays far-broader roles in cell biology.

However, preparing sufficient samples of ubiquitylated proteins for study has been a major challenge facing scientists.

The availability of these proteins is critical for Zhuang and members of his research team, who are working at the interface of chemistry and biology trying to understand the molecular basis of human cancer development and prevention.

The new method for developing ubiquitylated proteins, which Zhuang and his team developed, combines the power of intein chemistry and disulfide crosslinking to bond ubiquitin to another essential protein called proliferating cell nuclear antigen.

"Our yield is hundredsfold higher compared to the commonly used enzymatic approach," Zhuang says. "We also have the flexibility of modifying the selected residues, which has not been possible with the previous approach."

In investigating the effect of the differently modified proteins, Zhuang and his group also revealed a surprising phenomenon regarding ubiquitylation.

"We found that ubiquitin as a protein modifier is far more flexible than we have thought. This property distinguishes ubiquitylation from other better studied protein post-translational modifications, such as phosphorylation and acetylation," Zhuang says.

The new UD approach will help researchers studying ubiquitin biology by providing the means to prepare milligrams of protein samples for in-depth structural and functional characterization.

SInce the publication of the work online in *Nature Chemical Biology*, Zhuang has received requests for samples from research groups across the United States.

Additionally, the new approach has already opened up doors to new research in Zhuang's own laboratory, where he and his team are investigating new anti-cancer therapies.

The research on the new method was supported by Zhuang's laboratory start-up funding from UD, as well as a recent grant from the University of Delaware Research Foundation (UDRF).

Story Source:

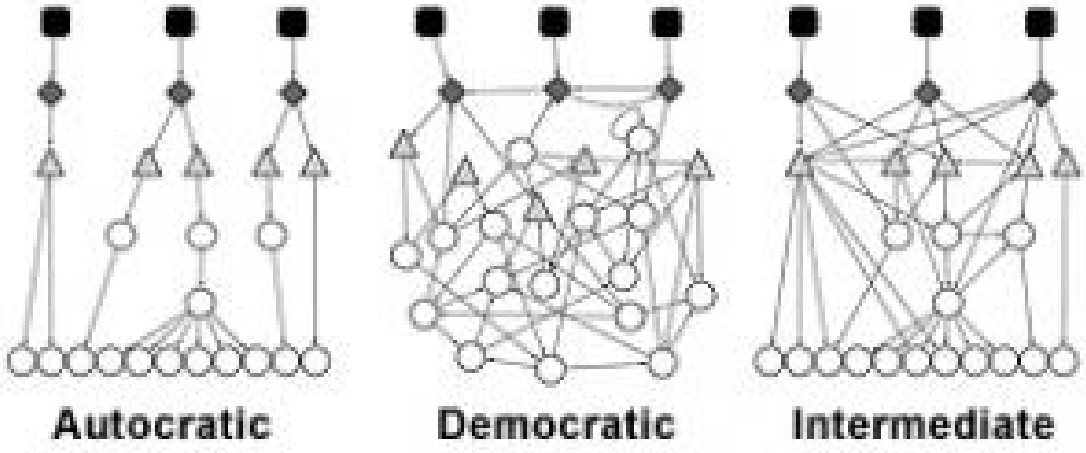
Adapted from materials provided by University of Delaware. Original article written by Tracey Bryant.

Journal Reference:

1. Junjun Chen, Yongxing Ai, Jialiang Wang, Lajos Haracska, Zhihao Zhuang. **Chemically ubiquitylated PCNA as a probe for eukaryotic translesion DNA synthesis**. *Nature Chemical Biology*, 2010; 6 (4): 270 DOI: 10.1038/nchembio.316

http://www.sciencedaily.com/releases/2010/04/100401101051.htm

Molecular Middle Managers Make More Decisions Than Bosses



Scientists are finding that on a molecular level organisms often function like social institutions. Some employ a military-like chain of command while in others important decisions are made by genetic middle managers.

ScienceDaily (Apr. 4, 2010) — Organisms are structured at the molecular level in ways similar to social hierarchies. In some, master genetic regulators call most of the shots, and in others most of life's activities are carried out by more egalitarian collaborations.

Knowing these organizational rules will help us understand biological systems and our social interactions, argues Mark Gerstein, A L Williams professor of biomedical informatics, molecular biophysics and biochemistry, and computer science. He is the senior author of a paper on the subject published online in the *Proceedings of the National Academy of Sciences*.

Gerstein and postdoctoral associate Nitin Bhardwaj analyzed regulatory networks of five diverse species, from *E. coli* to human, and rearranged those systems into hierarchies with a number of broad levels, including "master regulators," "middle managers" and "workhorses." In most organisms, master regulators control the activity of middle managers, which in turn govern suites of workhorse genes that carry out instructions for making proteins.

As a general rule, the more complex the organism, the less autocratic and more democratic the biological networks appear to be, researchers report. In both biological systems and corporate structures, interactions between middle managers are often more critical to functioning than actions by bosses. "If my department chair takes another job, the emphasis of my lab might change, but it will survive," Gerstein said. "But if my systems administrator leaves, my lab dies."

In simpler organisms such as *E. coli*, there tends to be a simple chain of command in which regulatory genes act like generals, and subordinate molecules "downstream" follow a single superior's instructions. Gerstein calls these systems "autocratic." But in more complex organisms, most of these subordinate genes co-regulate biological activity, in a sense sharing information and collaborating in governance. Gerstein labels these systems "democratic." If they share some qualities of both they are deemed "intermediate."

The interactions in more democratic hierarchies lead to mutually supporting partnerships between regulators than in autocratic systems, where if one gene is inactivated, the system tends to collapse. This is why Gerstein and colleagues in earlier work found that when they knocked out a master regulating gene in a complex organism, the "effects were more global, but softer" than when a key middle manager gene in a simpler life form was inactivated, which led to the death of the organism.

"Regulators in more complex species demonstrate a highly collaborative nature. We believe that these are due to the size and complexity of these genomes," Gerstein said. For example, about 250 master regulators in yeast have 6000 potential targets, a ratio of about one to 25. In humans, 20,000 targets are regulated by about 2,000 genes, a ratio of one to 10.

The work was funded by the National Institutes of Health.

Story Source:

Adapted from materials provided by Yale University.

Journal Reference:

1. Nitin Bhardwaj, Koon-Kiu Yan, and Mark B. Gerstein. **Analysis of diverse regulatory networks in a hierarchical context shows consistent tendencies for collaboration in the middle levels**. *Proceedings of the National Academy of Sciences*, 2010; DOI: 10.1073/pnas.0910867107

http://www.sciencedaily.com/releases/2010/03/100329152527.htm

Insulin-producing cells can renegerate in diabetic mice

Discovery suggests potential treatment strategy for type 1 diabetes
By Tina Hesman Saey
Web edition : Sunday, April 4th, 2010

Replacements for some diabetics' missing insulin-producing cells might be found in the patients' own pancreases, a new study in mice suggests.Alpha cells in the pancreas can spontaneously transform into insulin-producing beta cells, researchers from the University of Geneva in Switzerland report online in *Nature* April 4. The study, done in mice, is the first to reveal the pancreas's ability to regenerate missing cells. Scientists were surprised to find that new beta cells arose from alpha cells in the pancreas, rather than stem cells.If the discovery translates to people, scientists may one day be able to coax type 1 diabetics' own alpha cells into replacing insulin-producing cells. Type 1 diabetes, also known as juvenile diabetes, results when the immune system destroys beta cells in the pancreas. People with the disease must take lifelong injections of insulin in order to keep blood sugar levels from rising too high.
"The exciting discovery from this study is that alpha cells can spontaneously convert to beta cells without any interference from the researchers," says Andrew Rakeman, the scientific program manager for the Juvenile Diabetes Research Foundation's beta cell therapies program. "It's very early and very basic research right now, but it opens up the idea that reprogramming is not just something we have to force cells to do, that it's an intrinsic property of the cells."

Although the immune system continually wipes out beta cells in people with type 1 diabetes, some studies have found a small number of beta cells in the pancreases of people who have had the disease for years. Some researchers thought the cells could be ones that had somehow survived the immune system's ongoing assault, but that "is very unlikely, because the immune system is very, very efficient," says Pedro Herrera, a developmental biologist at the University of Geneva Medical School and a leader of the new study. So that suggested to Herrera and his colleagues that the pancreas was making new beta cells.

Researchers treated mice to destroy beta cells in the pancreas, and kept the mice alive by giving them insulin. After six months, the mice no longer needed the extra insulin because their pancreases had regenerated between 4 percent and 17 percent of the beta cells that had been present before the treatment. Although only a fraction of beta cells regenerated, it was enough to provide the insulin the mice needed to maintain nearly normal blood sugar levels. When the researchers examined the mice they found that some of the insulin-producing cells also made glucagon, which is normally made by alpha cells. The finding suggested that the beta cells in the mice had once been alpha cells.

The researchers confirmed that hypothesis by genetically tagging alpha cells in other mice, then killing their beta cells. Newly generated beta cells carried the tags, indicating that a switch had indeed occurred.About 5 percent of alpha cells converted to beta cells, says Fabrizio Thorel, a developmental biologist in Herrera's group and a coauthor of the new study. "What we don't know at the moment is whether all alpha cells have the ability to be converted to beta cells," he says. The researchers also don't know what signals prompt alpha cells to begin their conversion, Thorel says, but it is clear that the transformation happens only after nearly all beta cells have been wiped out.Even if human pancreases can perform the alpha to beta conversion — and Herrera says he believes it is possible — the immune system in type 1 diabetics would kill the newly transformed cells unless researchers could figure out how to stop the immune system attack and reduce inflammation in the pancreas that accompanies diabetes. Herrera says that efforts to control the immune system could give the pancreases of type 1 diabetic patients a chance to recover at least some function. "The life of diabetics would change even if the pancreas is only able to produce 1 or 2 percent of normal insulin levels," he says.The team is now trying to determine if older mice retain the regenerative capacity seen in the young mice used in the study and which signal tells alpha cells to begin transforming into beta cells.

http://www.sciencenews.org/view/generic/id/57902/title/Insulin-producing_cells_can_renegerate_in_diabetic_mice

Picking our brains: How many ways can we be conscious?

- 01 April 2010 by **Linda Geddes**

Magazine issue 2754.

Conscious or not? (Image: Howard Kingsnorth/Taxi/Getty)

YOU might think consciousness is like a light switch, either on or off. But the true picture now seems rather murkier, challenging our notions of awareness and free will, as well as raising issues of consent in coma patients.

People used to think just three states of consciousness existed, says Adam Zeman of the Peninsular Medical School in Exeter, UK. "You're either awake or asleep - and if you're asleep you're either in dream or non-dream sleep."But brain imaging suggests there are more. Take sleepwalking, which affects as many as 1 in 20 adults. "The sleepwalking brain is literally in a half-awake, half-asleep state," says Zeman. Researchers once manoeuvred a sleepwalker into a brain scanner, and while they saw that much of the cortex - involved in awareness and consciousness - was offline, other brain areas were active, including those linked with emotion.

Similar overlaps might explain other weird states of consciousness. In dreaming sleep - also known as REM sleep - we lie still because an area of the brainstem called the pons blocks signals to the muscles. People with REM behaviour disorder lose this inhibition and physically act out their dreams. The opposite condition, known as sleep paralysis, occurs if people wake up while still unable to move.There may also be some hitherto unnoticed stopping-off points in the twilight between consciousness and coma. In February, a team led by Adrian Owen at the University of Cambridge discovered that it was possible to communicate with a man in a vegetative state - in which someone has intact reflexes and can breathe unaided, but seems completely unaware of their surroundings. By asking him to visualise playing tennis or moving around his house as he lay in a brain scanner, they were able to elicit yes or no answers from him. Such patients are currently treated as unconscious, but if they can understand questions and communicate, they might be able to express opinions about their treatment - and whether or not it should be withdrawn.

We may not yet know how many states of consciousness there are, but the nature of consciousness is looking increasingly like a ladder rather than a light switch.

http://www.newscientist.com/article/mg20627541.500-picking-our-brains-how-many-ways-can-we-be-conscious.html?DCMP=OTC-rss&nsref=online-news

Only mind games will make us save power

- 15:38 01 April 2010 by **Colin Barras**

Taking action to cut consumption (Image: Jeffrey Hamilton/Getty)

Innovation *is our regular column that highlights emerging technological ideas and where they may lead*

Energy meters are coming out of the closet and being upgraded to "smart meters" as governments press us to think about how much power we're using. The hope is this will provide easy carbon cuts by provoking us into cutting energy use. But a number of studies suggest it's not going to be that simple.

By the end of the year a million smart meters will have been installed in UK homes, and hundreds of thousands of US homes already have them. It's too early to draw many conclusions about their effect on power use, but a number of small studies suggest that the new infrastructure won't have the desired effect unless it's supported with the right psychological approach.

Not only are few people motivated to change their energy use, but using an energy meter can reveal just how small the payback for changing your behaviour can be.

Device indifference

Eric Paulos at Carnegie Mellon University in Pittsburgh, Pennsylvania, and colleagues report in a new paper how, as part of a study of domestic energy consumption, they gave 12 US households gadgets called Kill A Watts that reveal the energy use of devices.

Not one participant used the Kill A Watt and few showed interest in energy saving that would force a change in their behaviour. When they were told of the comparatively meagre potential savings the Kill A Watt might reveal – for example, that a computer consumes 25¢-worth of electricity per day – they became even less interested in turning off appliances.

Push the button

Despite such indifference and the tiny savings, however, many participants said they regularly switched off lights to save energy. But psychological experiments suggest that imagined peer pressure is the real reason for this behaviour: we turn out lights because we think everyone else does.

When a whole neighbourhood has smart meters, they can be used to apply such peer pressure. In 2007, P. Wesley Schultz at California State University in San Marcos and Robert Cialdini at Arizona State University in Tempe studied the influence on 290 households of what the neighbours think.

They monitored the power used by each household and then wrote each homeowner a note comparing their consumption with the neighbourhood average. A week later households with above-average power usage had reduced it significantly – but those with below-average usage had increased theirs, perhaps from fear of appearing too miserly. The researchers found that the low-energy users could be prevented from using more power simply by drawing a smiley face on the notes to indicate that conserving energy carries approval.

Schultz told *New Scientist* that such psychological tactics will be needed to make smart metering effective.

Call to action

Cialdini, a psychologist, is now chief scientist with Opower, a US firm making a business out of power consumption psychology. Working for utility firms, Opower sends reports to people detailing how their usage compares with similar homes in their area. It says 80 per cent of people receiving those reports take action to cut their consumption, compared with just 5 per cent if less personalised advice is given.

However, Opower reports that people cut their energy use by just 2 to 3 per cent on average, yielding annual savings of just tens of dollars. Participants in the Carnegie Mellon study said it would take savings 10 times greater to change their behaviour.

One alternative to the psychological approach is to design smart meters that take action for you. A device sold by UK firm Passivsystems can automatically make small changes to save power, for example adjusting a central heating thermostat in response to the temperature outdoors.

There's a limit to how far that can go, though, before people feel out of control of their own home. Perhaps smart-meter pedlars will have to sharpen up their powers of persuasion for now, hoping that people will eventually get more excited about making small savings on power.

References: Paulos and colleagues will present their work at the Association for Computing Machinery 2010 Conference on Human Factors in Computing Systems in Atlanta, Georgia, this month; Schultz and Cialdini published their study in *Psychological Science*, vol 18, p 429

http://www.newscientist.com/article/dn18727-innovation-only-mind-games-will-make-us-save-power.html

Ice plumbing is protecting Greenland from warm summers

- 01 April 2010 by **Anil Ananthaswamy**

Magazine issue 2754.

Greenland's plumbing helps prevent the glacier from splitting (Image: Ashley Cooper/SpecialistStock/SplashdownDirect/Rex Features)

IF SOME of the spectacular calving of ice shelves in Antarctica is down to global warming, then why did we not see break-ups on the same scale in Greenland, which is much warmer? It turns out that, counter-intuitively, it's because Greenland is warmer.

When the ice sheets that blanket Antarctica and Greenland eventually meet the sea, they don't immediately calve off and create icebergs. Instead, they extend out to sea as floating ice shelves while remaining joined to the ice sheets on land.

In 2002, a gigantic section of the Larsen B ice shelf in the Antarctic Peninsula suddenly broke off. It had been an unusually warm summer, with temperatures rising to a balmy 4 °C. As the ice melted, huge pools of meltwater formed on the surface of the ice, and as this water poured down crevasses it forced apart sections of the shelf. "It fell apart in a whole lot of little slivers," says Richard Alley, a glaciologist at Pennsylvania State University in University Park.

In contrast, while Greenland has experienced summer temperatures of up to 11 °C over the past half century, many of the ice shelves had held firm, despite some surface melting. "Greenland ice shelves are surviving," says Alley.

Now Alley, along with Byron Parizek, also of Penn State, and colleagues have worked out how the warmer temperatures themselves could explain why. Mathematical models suggest the higher temperatures in Greenland cause lakes of meltwater to form on the ice sheet, rather than on the ice shelf as happens in Antarctica. This meltwater then pours down the glacier's "plumbing" - its crevasses and moulins - to the ice sheet's base, where it flows out to sea. Had the meltwater pooled on an ice shelf, the water flowing into the cracks would have split the floating ice.

Warmer temperatures allow meltwater to pool on the ice sheet, where it can flow down the plumbing

The models suggest that something similar could happen in Antarctica as it warms. Over time, as "plumbed" ice forms on land and flows down to the sea, the ice shelf could regrow. The plumbing would channel the water to the sea without forcing apart cracks in the ice.

However, Alley cautions that the regrowth would be temporary, as witnessed in Greenland, where the ice shelf in front of the Jakobshavn glacier finally fell apart in the mid-1990s, as seawater eroded it from underneath (*Journal of Geophysical Research*, DOI: 10.1029/2009jf001325).

The idea could be put to the test by studying the glaciers behind the now-disintegrated Larsen A and B ice shelves. If these ice sheets develop plumbing and push this ice towards the sea, then we may see the ice shelves regrow. "Whether the regrowth could slow down the ice loss, that's a question we have to go after next," says Alley.

http://www.newscientist.com/article/mg20627544.400-ice-plumbing-is-protecting-greenland-from-warm-summers.html

Which is the greenest US city of all?

- 04 April 2010
- Magazine issue 2754.

Recognise this eco-friendly skyline? (Image: Chad Ehlers/Rex Features)

WHICH US city is the greenest of all, in terms of numbers of energy-efficient commercial buildings? The surprising answer is Los Angeles, with 293, well ahead of Washington DC with 203 and San Francisco with 173, reports the US Environmental Protection Agency this week.

The rankings are part of the agency's annual list of the top 25 US cities earning "energy star" ratings for their commercial and municipal buildings.

At 7 million square metres, LA also had the greatest amount of floor space in energy-starred buildings and the highest energy cost savings, at $94 million. Houston, which came sixth in the list, would be first based on total energy savings, with reductions in consumption equivalent to 53,400 homes.

Overall, 3900 US buildings last year earned an EPA energy star, saving 4.7 million tonnes of carbon dioxide emissions. Stars are awarded to nominees that are among the 25 per cent using energy most efficiently.

http://www.newscientist.com/article/mg20627543.800-which-is-the-greenest-us-city-of-all.html

When will a Mediterranean tsunami hit Italy?

- 13:14 01 April 2010 by **Richard Fisher**

Lurking beneath waves of the Mediterranean, between Sicily and the Italian mainland, lies a submarine volcano, which is showing telltale signs of being unstable. News reports this week declared that its flanks could cave in, triggering a tsunami that would swamp southern Italy.

But geologists caution that while the threat is real, it is impossible to say when the volcano might collapse.

Enzo Boschi of the National Institute for Geophysics and Volcanology in Rome, Italy, and colleagues took a peek at the internal structure of the Marsili seamount using remote sensing methods, which included measuring how the volcano affects Earth's gravitational field.

Marsili has a hidden but active magma chamber and lies beneath the surface of the Tyrrhenian Sea, which is part of the Mediterranean west of Italy.

Weak flanks

The team found that parts of the seamount's steep flanks were made of porous volcanic material, leaving them weak and unstable.

They warn that an earthquake nearby or an eruption within Marsili itself would be enough to cause the seamount's flank to collapse, triggering a tsunami that would strike the coasts of southern Italy, Sicily and Sardinia.

It wouldn't be the first time the seamount has collapsed. The distribution of material around Marsili hints that smaller collapses have occurred there before. In addition, the Vavilov seamount, around 200 kilometres north-west of Marsili, is made of similarly porous material. It seems to have lost an entire 40-kilometre-long flank in one catastrophic event, say the researchers.

Bill McGuire of University College London cautions that it's impossible to say when the volcano might erupt in the future.

However, he adds: "The apparently fragile construction of Marsili suggests that a collapse at some future time would not be a surprise. Depending on the scale, velocity and nature of the collapse, this could generate a significant and potentially damaging tsunami."

Journal reference: *Geophysical Research Letters*, DOI: 10.1029/2009GL041757

http://www.newscientist.com/article/dn18726-when-will-a-mediterranean-tsunami-hit-italy.html

Tidal power? No thanks

- 31 March 2010 by **Hans van Haren**

Magazine issue 2754.

The sea can't provide for all out needs (Image: Andrzej Krauze)

THE vastness of the ocean has always created the illusion of infinite resources, whether for food or waste disposal. Yet despite its huge size, the ocean is vulnerable to exploitation.

The ocean also seems like an attractive source of vast amounts of sustainable energy, including tidal power. Just last month, the UK's Crown Estate announced four tidal energy schemes off the north coast of Scotland with the aim of generating 600 megawatts of electricity. Scotland's first minister, Alex Salmond, described the waters as the "Saudi Arabia of marine power".

Again, this is an illusion. In practice, only relatively small amounts of energy are available from tides, and extracting it will have devastating effects on the ocean ecosystem.

Tides created by the moon and sun generate about 3.5 terawatts of power in total. This may sound like a huge amount, but is in fact only about 20 per cent of global energy demand. The amount of this energy that can be used is necessarily lower: to make tidal power viable, the speed of the current has to be at least 1.2 metres per second. This rules out the vast majority of tidal energy because it is found in the open ocean where tidal currents are too weak to be useful, generally less than 0.1 metres per second.

Viable speeds are only found in the shallow seas around the perimeter of oceans. In fact, there are only about 20 suitable sites in the world, including the north of Scotland and the Severn estuary in the UK. In the Netherlands a test plant is proposed for the Wadden Sea, a UNESCO World Heritage site.

Unfortunately, these sites are all in extraordinarily rich and ecologically fragile straits and estuaries that are critically important spawning grounds for marine life. Strong tides are what make these waters so productive: their turbulence stirs up nutrients vital for life.

In total, less than 100 gigawatts of power could be generated by the suitable sites, and it is debatable whether even this can ever be extracted efficiently. Tidal currents vary greatly over time and maximum power-generating currents are only a minor part of a tidal cycle. Even small decreases in current speed have large impacts on electricity generation.

Recent evidence also questions the efficiency of electricity generation once tidal barrages and turbines are in place (*Renewable Energy*, vol 33, p 2485). Obstructing 25 per cent of the area through which the tide flows alters currents so substantially that the potential power is no longer extracted efficiently. Thus permanently exploitable tidal power is reduced to a few tens of gigawatts.

On top of that, turbines kill up to 80 per cent of fish passing through them, and changes in current affect nutrient supply, thereby altering the ecology of estuarine life.

Tides are indispensable for life in shallow seas. Without them, ocean life would come to a halt. Extraction of their energy may seem attractive, but in reality there is very little tidal energy to be had - and what there is comes at high ecological cost. We should save the tides.

Hans van Haren is an oceanographer at the Royal Netherlands Institute for Sea Research in Den Burg

http://www.newscientist.com/article/mg20627546.600-tidal-power-no-thanks.html

Why space shuttle exhaust races to the poles

- 30 March 2010
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Sky writing by a space shuttle (Image: Justin Dernier/EPA/Corbis)

SPACE shuttle exhaust plumes tend to move and spread faster than they should - seemingly because they are fast-tracked inside a low-density part of the atmosphere.

The shuttle leaves over 300 tonnes of water in the atmosphere and a 1000-kilometre-long exhaust trail. This creates a plume, parts of which travel to the poles far faster than expected.

Now Robert Meier of George Mason University in Fairfax, Virginia, and colleagues have found that simple diffusion can explain the anomaly. Satellite images in a paper to appear in *Geophysical Research Letters* reveal that the exhaust diffuses upwards into less dense regions of the atmosphere, where diffusion rates are naturally faster. "Once you get the gas up into a more rarefied region of the atmosphere it's really easy to spread sideways," says Meier.

He adds that better understanding of such high-altitude processes will help explain why "noctilucent" clouds have become more common in the past 50 years. They have previously been linked both to space traffic and to increased carbon dioxide levels.

http://www.newscientist.com/article/mg20527536.500-why-space-shuttle-exhaust-races-to-the-poles.html

Electric cars jostle for position on the power grid

- 12 March 2010 by **Tom Simonite**
- Magazine issue 2751. **Subscribe** and get 4 free issues.
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Plug-in power (Image: Roger Bentley/Rex Features)

IT MIGHT have hogged the limelight at last week's Geneva Motor Show in Switzerland, but the most arresting detail on Porsche's latest concept car (pictured) was actually somewhat mundane: a wall plug. But over the next 12 months plugs will be increasingly appearing on production models from the world's biggest car makers. And as they do, electricity providers and governments will be scrambling to prepare for the as-yet-unknown effects of shackling our transport power needs to the electricity grid.

Plug-in cars come in two forms: electric vehicles fully reliant on a battery and the electricity grid, and plug-in hybrids that combine a smaller battery with a conventional engine.

When they start to appear in significant numbers, electric cars have the potential to drastically alter the demand patterns that our electricity infrastructure has been built around (see graph). The Nissan Leaf, a fully electric family car, will start to roll off production lines in October with a 24-kilowatt-hour battery pack. That sort of capacity is not far short of the average American household's daily consumption of electricity - 30 kWh, according to 2008 figures from the US Department of Energy.

Plug-in hybrids' batteries have lower capacities: 5 kWh in the case of the Toyota Prius and 16 kWh for the Chevrolet Volt, due out in November. These batteries can also draw charge from their gasoline-driven engines, but they will nevertheless consume additional mains power.

"The concern is that this new demand is potentially invisible to us," says David Densley, head of sustainability at UK energy supplier Scottish & Southern Energy, which is working with car-maker BMW on a trial of about 50 electric versions of its Mini, the Mini E, in southern England. "People could go and buy cars, plug them into their existing socket and the first thing we'll know is that the lights go out on the whole street."

Densley says a clustering effect is expected, where the appearance of one electric vehicle in a neighbourhood leads to a concentration of several on the same section of grid. "That could have a significant impact."

Results from the Mini E trial and others taking place around the world are being used by suppliers to try to predict how many cars can be supported without upgrading local networks.

Given that the specification of vehicles set to ship and the plug-point power are both known, basic forecasting of demand is possible. For example, charging a Nissan Leaf takes 16 hours on a standard US 110-volt supply, or 8 hours using the 230-volt supply which is standard in Europe and also installed in US homes for high-demand appliances like tumble-dryers.Predicting the all-important behaviour of the drivers of these cars is more tricky, however. Extensive user testing has taken place in advance of the Leaf's launch, says Olivier Paturet, head of Nissan's European Zero-Emissions Mobility Program. "But we still don't quite know how they will be used."

A variety of studies, including the Mini E research, has found that "two-centre charging" is popular with drivers, combining an overnight charge at home using cheap power during the low-demand hours with a top-up at work during the day. The public charging networks being rolled out in cities such as London, Amsterdam in the Netherlands and Houston, Texas, will allow more options.

However they choose to charge, drivers will have to become used to power suppliers taking a strong interest in what they do with their vehicles, whether by needing to know when a new vehicle is bought, the pricing of peak power use, or through direct control of their car's connection.

"The electricity industry has to keep the lights on," says Joe DiNucci, a director of Coulomb Technologies in San Jose, California, which makes electric vehicle charging points. "They need to know what charging points are doing, and to have some control."

Electricity companies need to know what car charging-points are doing, and to have some control

Coulomb's charging points are linked to the internet and can be monitored and even remotely controlled by a power utility, allowing them to slow down the rate cars are drawing power at times of high demand, for example. The firm is already operating chargers on the sites of Silicon Valley companies such as Apple, Pixar and Google, and in public for city authorities such as San Francisco and Houston.

The chargers being used in the UK's Mini E trial are less subtle. They deliver power only after 11 pm, when electricity is cheap, unless a "boost" button is pressed to trigger an hour of more costly charge at any given time. In future, the kind of nuanced monitoring offered by networked points like Coulomb's is likely to become standard for home chargers, says Denseley. As these "smart meters" are rolled out by the US, the UK and other western governments and start to appear in homes, electricity grids will become more efficient.

So can a balance be struck between drivers' freedom to head out on the highway and keeping the power grid working efficiently? The flexibility of networked chargers should make that possible, says Denseley. For example, a driver might join a tariff that allows a supplier to determine when a car draws power, but guarantees a minimum charge level so a driver can be sure they won't be stranded.

That technology would also allow electric cars to make the grid more resilient, rather than just more complex. Ireland, Portugal and Denmark are all blessed with reliably strong winds that make wind-power attractive. But a lot of their output comes at night when demand is low. Feeding it to hungry cars will ensure it isn't wasted, says Paturet.

Moving further into the future, it may even be possible to draw power from plugged-in vehicles to smooth out any sudden surges in demand. "It makes the grid smarter and increases its ability to suck up extra capacity," says DiNucci.

http://www.newscientist.com/article/mg20527515.700-electric-cars-jostle-for-position-on-the-power-grid.html

Making the most of a second look

- 05 April 2010
- Magazine issue 2754.

IT SOUNDS straightforward: give staff a second chance to examine images, and you could cut error rates in medical image analysis or improve airport baggage screening. But second viewings don't always work, because people might focus on the same areas they looked at first time around, says Pernilla Qvarfordt of the FX Palo Alto Laboratory in California.

Now Qvarfordt and colleagues think they have found a way to uncover detail that may have been missed. They devised a system that uses eye-tracking technology to identify which areas within an image have been checked by the viewer. On a second viewing, those areas are blacked out.

The system was tested by asking volunteers to identify specific objects in images containing 300 confetti-like shapes. On a second viewing, those presented with the partly blacked-out images found significantly more shapes than people simply shown the original a second time.

"I think the technique has potential for augmenting inspection systems," says Andrew Duchowski at Clemson University in South Carolina. Qvarfordt presented the work at the Eye Tracking Research and Applications conference in Austin, Texas, last week.

http://www.newscientist.com/article/mg20627546.100-making-the-most-of-a-second-look.html

Oceanology: Robot 'gliders' swim the undersea world

- 30 March 2010
- Magazine issue 2753.

Engage the wave drive (Image: Liquid Robotics)

THE way we study oceans could be transformed by a high-tech "surfboard" that generates its own power from sunlight and water waves. The device is capable of navigating at sea for months at a time and recently completed a 4000-kilometre trip from Hawaii to San Diego, California.

Gathering data on the oceans has always been difficult: survey ships are costly to deploy and buoys take data only at single sites. So engineers at Liquid Robotics, a company based in Kamuela, Hawaii, decided to build an autonomous vehicle that would be cheaper and more flexible than either of these options. They knew that winged robot "gliders" had been patrolling the ocean depths for a decade. These craft have a bladder which can be inflated or deflated to make them rise or sink. Tilting their wings appropriately allows this vertical movement to be converted into forward thrust.

But how to create a self-powered surface vehicle? Liquid Robotics's answer is Wave Glider, a surfboard-like float attached by a cable to a set of wings several metres underwater. "The glider is propelled entirely by wave power," says Justin Manley, the company's science director. When a wave lifts the board, it pulls on the wings and tilts them from the horizontal, generating forward thrust. A trough lets the wings tilt the other way, also producing forward thrust (see diagram). The craft's top speed is about 2.25 knots (1.2 metres per second).

The float has solar panels that recharge its onboard batteries and provide up to 10 watts of power for communications, GPS and other sensors. The craft's course, which is independent of the direction of the waves, is set by a radio-controlled rudder. "You simply log in from your laptop and tell it where to go. And since we have the luxury of GPS all the time, navigation can be very accurate," says Manley.

Wave Glider could have several applications beyond simply measuring the state of the ocean along its route. It could act as a communications relay for robotic submarines so they would never need to surface, and it is so quiet that it is ideal for passive sonar systems, which detect underwater sounds. It could also help track marine animals which have been fitted with radio tags.

Another possibility is that the craft could serve as a replacement for monitoring buoys. The US National Oceanic and Atmospheric Administration (NOAA) has a global network of moored buoys that relay data from sensors measuring pressure on the ocean floor, looking for telltale signs of a tsunami.

The trouble is that the buoys often lose their moorings, and must be replaced by ship. "We can put a Wave Glider on an aircraft and deploy it using a locally hired fishing boat almost anywhere in the world in under 48 hours," says Manley. By moving in small circles Wave Glider can stay in one spot, emulating a buoy.

Eddie Bernard, director of the NOAA's Pacific Marine Environmental Laboratory in Seattle, is evaluating the Wave Glider and other robotic vehicles, which he says are revolutionising data collection.

"Chartering an oceanographic vessel costs $20,000 a day," he says. "So we need a way to get more data more cheaply and we need as many options for getting it as possible."

http://www.newscientist.com/article/mg20527533.200-oceanology-robot-gliders-swim-the-undersea-world.html

Electronic car bugs: What drivers need to know

- 29 March 2010 by **Nic Fleming**

Magazine issue 2753.

Real car, virtual control linkages

In today's cars, electronics and computers have replaced many mechanical components, taking over control of crucial systems. Many of these changes are intended to improve safety, but has their complexity introduced new and unnecessary risks? ***New Scientist*** *assesses the electronic systems found in modern cars and the ways in which they can fail*

Cruise control

Cruise control systems use an electronic control module (ECM) to maintain a speed set by the driver. The ECM sends signals to an actuator to open or close the throttle. Several manufacturers have recalled models over cruise control problems, such as drivers being unable to disengage the control. Newer "adaptive" cruise control systems add feedback from in-car radar to stay a safe distance from the car in front.

Manufacturers have recalled several models over problems with cruise control

Anti-lock brakes

The electronic anti-lock braking systems introduced by Chrysler and General Motors in 1971 represented the first technical advance that took direct control from drivers and handed it over to electronics built into the car. By modulating the braking force during an emergency stop, ABS ensures the wheels do not lock, and so prevents the car entering an uncontrollable skid. If one wheel is rotating much more slowly than the others, an electronic control unit activates valves in the hydraulic braking systems to lessen the braking force on that wheel. A study by the US National Highway Traffic Safety Administration of crashes between 1995 and 2007 concluded that ABS reduced the number of non-fatal car crashes by 6 per cent; no change was found in the number of fatal crashes.

Engine control module

Controlling the engine is the most complex job in a modern car, so the engine control module (ECM) is the most powerful computer in a vehicle. It gathers information such as the amount of oxygen in the exhaust gases and the temperature of the engine from dozens of sensors, and uses these measurements to calculate how much fuel should be injected into the engine at each stroke and when, so that it ignites at precisely the right moment. The overall aim is to optimise performance while producing the lowest possible emissions and the best possible fuel economy. Problems with the ECM can result in the engine failing to work at all.

Door locks

The door locks on most new cars can be operated by a remote control that also deactivates the alarm. The radio frequencies these devices operate on are close to those used by communications systems operated by the military, radio amateurs and emergency services, including the Tetra system used by UK police forces. In February this year, hundreds of British motorists in Windermere, Cumbria, reported being unable to lock or unlock their cars. The problem was traced to interference from hand-held wireless devices used at a nearby restaurant to take orders.

Power steering

First introduced by Honda in 1990, electronically controlled power-assisted steering uses sensors in the steering column to send information on the motion of the steering wheel to an electronic control unit. This sends control signals to operate electric motors that reduce the physical effort required from the driver. The amount of assistance provided depends on driving speed and road conditions. This year, General Motors recalled 1.3 million vehicles in North America to fix a power steering problem that caused cars to veer off-course. And in February, Toyota confirmed it had received reports of power steering problems in some of its Corolla cars sold in the US.

Electronic throttle control

Mechanical throttles use a flexible, sheathed cable, known as a Bowden cable, to transmit movement of the accelerator pedal to the engine's throttle valve. Electronic throttles rely on sensors which monitor the position of the pedal. An electronic control unit then takes into account other inputs, such as engine and vehicle speed to set the position of the throttle valve.

There are allegations that systems of this kind have contributed to incidents in which cars from Honda, Ford, Audi and most recently Toyota have accelerated out of control, but no clear link with the electronic throttle has ever been established. Some manufacturers have blamed these incidents on a floor mat jamming the pedal mechanism, or on worn pedal components. Others have blamed driver error.

Vehicle data bus

Electronic control units, sensors and actuators communicate via a digital network called the "vehicle bus". Most modern cars use the CAN-bus standard, which operates at up to 1 megabit per second. The format of the data sent across the network enables different modules to rapidly decide whether the information is relevant to the functions they control. Brian Kirk of software design group Robinson Associates, based near Stroud, Gloucestershire, UK, has demonstrated that CAN-bus messages can be corrupted - possibly as a result of corrosion or electromagnetic interference - and that modules receiving bad data packets may not be able to detect this corruption, potentially leading to malfunctions and accidents. Manufacturers deny these claims.

Consumers will want reassurance that software will not jeopardise safety

Too complicated to understand

During the 1980s, drivers of Mercedes-Benz cars with anti-lock brakes (ABS) reported that their brakes were failing on a section of autobahn in the Saarland region of Germany. The problem, caused by electromagnetic interference (EMI) from a nearby radio transmitter, was solved by putting up a giant wire mesh by the side of the road to shield traffic from its radio transmissions.

Ever since, there has been a plethora of court cases claiming that EMI has caused cars' electronic systems to malfunction - and in some cases that cars have crashed as a result. Cellphones, radar, and military and emergency services' radios - and even the cars' own electronic systems - have all come under suspicion as the source of the EMI.

Manufacturers deny that EMI is a problem, claiming that electronic shielding and duplication of key components keep cars operating properly. Last month Toyota released a report it had commissioned from California engineering consultancy Exponent which concluded that cars were protected from EMI because they incorporated multiple sensors to perform each function.

Another area highlighted as a risk factor is the sheer complexity of the software in modern cars. Ford and Toyota have recently issued updates to fix glitches in the software used to control the braking systems in some of their hybrid models. Other manufacturers have at various times reported problems with automatic transmission systems, engine control modules and the software that controls the deployment of airbags.

While computer users accept software updates as routine, the prospect may be more disconcerting for car owners, says Krishnasami Rajagopalan, an analyst at international business consultancy Frost & Sullivan. He predicts that consumers will in future want reassurance that the increased use of electronics does not jeopardise safety.

Validating computer code is always a complex business. Last year researchers at the Australian research institute NICTA and the University of New South Wales thought it worthy of note that they had been able to show mathematically that 7500 lines of code for an operating system they had written was secure. The code in systems controlling modern cars runs to hundreds of millions of lines.

http://www.newscientist.com/article/mg20527536.900-electronic-car-bugs-what-drivers-need-to-know.html?full=true&print=true

Skin as a source of drug pollution

Sweat-tainted drugs may also explain the emergence of some antibiotic resistance, researchers say.
By Janet Raloff
Web edition : Friday, April 2nd, 2010

SAN FRANCISCO Traces of over-the-counter and prescription meds taint the environment. The presumption – and it's a good one – has been that most of these residues come from the urine and solid wastes excreted by treated patients. But in some instances, a leading source of a drug may be skin – either because the medicine was applied there or because people sweat it out. When either occurs, patients risk not only polluting the outdoor environment – via sewer inputs from showers and laundering – but also exposing their homes and families. Or so explained physician Ilene Ruhoy of the Touro University College of Osteopathic Medicine in Henderson, Nev., last week, at the American Chemical Society spring national meeting. Ruhoy reviewed calculations that she and Christian Daughton of the Environmental Protection Agency in Las Vegas made after poring over 177 papers for an encyclopedic, 27-page analysis that they published in Environmental Toxicology and Chemistry, last December. It was part of a special issue on the chemistry of pharmaceutical and personal-care products (like hand creams, shampoos and deodorants) in the environment.

Until now, Ruhoy and Daughton pointed out, "no formal discussion has ever been presented, to the best of our knowledge," on bathing, laundering or trash as a polluting source of drugs – including those, like drug-delivery skin patches, which may contain 95 percent or more of the original dose in the "used" patch. (The reason: Drug delivery via this route is so inefficient that manufacturers load up their patches with a whopping excess of a medication – much of which still remains in the patch when it's ready for disposal.)*Science News* readers will have encountered these ideas, including the risk of environmental contamination from very-polluting used drug patches. But the sweat angle: That's new.

Not to pharmacologists, of course. Some of them have been reporting for decades that health care workers can encounter substantial exposures to chemotherapy drugs and other pharmaceuticals while washing patients' clothes and bedding. I've included a few cites to such papers accompanying this blog. But the concern in those papers has been potential risks to workers' health. As Ruhoy and Daughton point out in their new analysis, family members and friends remain a largely ignored – and therefore uninformed – population that may also be at risk of coming into dangerous contact with sweated-out pharmaceuticals or skin-applied drugs.How big an environmental risk skin may pose depends on the drug, how it's administered and how the body does or doesn't break it down. Within an hour of being administered, pharmaceuticals may begin escaping in sweat, the researchers note, and continue to do so for days to weeks. In many cases, only 1 to 2 percent of ingested drugs will be released this way. Small potatoes.

But there are exceptions. Ruhoy and Daughton used published data from one 2008 paper and calculated that up to 47 percent of a 600 microgram daily dose of the powerful opiate pain killer fentanyl could be excreted in sweat. To people who have not built up a tolerance to this drug, sweat's release could be lethal – if they got enough at one time. (Clearly, my miniature dachshund could. He licks any arms, legs, and feet in tongue's reach – and does so every chance he gets.)Considering how little of this drug typically gets excreted via urine, the amount of sweat-released drug available for washing off and down the drain could be six times as much as would enter water from urine and feces sent down a toilet. And while much of any sweaty outpouring would undoubtedly end up absorbed by clothing or bedding, sweaty palms could leave residues on door knobs, faucet handles, book jackets, TV remotes, kitchen counters and sandwiches made for the kids. Or be transferred through a handshake. Or to a family member who holds the arms of an unsteady patient.The researchers also described antiobiotics-tainted sweat "as a possible major means of quickly promoting and spreading resistance." They cited papers that documented the excretion of antibiotics through skin and argue that this might "be an overlooked cause of transmission of multiresistance among bacteria in hospitals and other care facilities that routinely administer antibiotics."

http://www.sciencenews.org/view/generic/id/57874/title/Skin_as_a_source_of_drug_pollution

Inca cemetery holds brutal glimpses of Spanish violence

Skeletons provide first material evidence of conquest-related fatalities
By Bruce Bower
Web edition : Friday, April 2nd, 2010

VIOLENT CONTACT Skeletons such as this one unearthed in Peru have yielded the first direct evidence of Inca deaths caused by Spanish conquerors around 500 years ago.M. Murphy

If bones could scream, a bloodcurdling din would be reverberating through a 500-year-old cemetery in Peru. Human skeletons unearthed there have yielded the first direct evidence of Inca fatalities caused by Spanish conquerors.

European newcomers killed some Inca individuals with guns, steel lances or hammers, and possibly light cannons, scientists report online in the March 23 *American Journal of Physical Anthropology*.

Surprisingly, though, no incisions or other marks characteristic of sword injuries appear on these bones, according to a team led by anthropologist Melissa Murphy of the University of Wyoming in Laramie. Spanish documents from the 16th century emphasize steel swords as a favored military weapon.

Many Spaniards who helped Francisco Pizarro conquer the Incas were fortune-seekers, not soldiers, “so the absence of sword injuries makes some sense,” Murphy explains.

Skeletons in the Inca cemetery, as well as at another grave site about a mile away, display a gruesome array of violent injuries, many probably caused by maces, clubs and other Inca weapons, the researchers report. Those weapons may have been wielded by Inca from communities known to have collaborated with the Spanish, or might have been borrowed by the Spanish, they posit. “The nature and pattern of

these skeletal injuries were unlike anything colleagues and I had seen before," Murphy says. "Many of these people died brutal, horrible deaths."

Little is known about early European dealings with the Inca, remarks anthropologist Haagen Klaus of Utah Valley University in Orem.

"Murphy's data show the types of violence that emerged from the first moments of contact between Spaniards and the Inca," Klaus says. Pottery and artifacts at the sites date to between 1470 and 1540, placing the deaths close to when Spaniards captured the Inca emperor around 1532. It took the invaders nearly another 40 years to control all Inca lands.

Murphy's team assessed skeletons of 258 Inca individuals, age 15 or older, excavated several years ago at the two cemeteries.

In one cemetery, bodies had been hastily deposited in shallow graves. One-quarter of 120 skeletons displayed head and body injuries inflicted at the time of death, as indicated by a lack of healed bone and other clues. That's a conservative estimate, Murphy notes, since soft-tissue damage doesn't show up on bones.

"I'm struck by the severity of violence in certain individual cases, where the skull was essentially crushed, repeatedly stabbed or struck, or shot through by gunshot," comments archaeologist Steven Wernke of Vanderbilt University in Nashville. Whoever killed these individuals wanted to intimidate survivors as well, he asserts.

One man's skull contained two holes and radiating fractures consistent with damage produced by early guns that shot ammunition at low velocities.

Another male skull sported three small rectangular openings in the back of the head. These injuries resemble those on skulls from a 1461 battlefield cemetery in England, Murphy says. Medieval weapons tipped with steel spikes or sharp beaks probably caused these wounds, she proposes.

Three other skeletons exhibited injuries likely due to Spanish weapons. Other skeletons contained head and body fractures probably inflicted by attackers bearing Inca weapons.

Individuals placed in this cemetery may have been slain in a documented 1536 Inca uprising against Spanish rulers in nearby Lima, Murphy suggests. Family members collected their bodies and buried them quickly near previously deceased relatives, she speculates.

At the second Inca cemetery, 18 of 138 skeletons showed definite signs of violent death, all from Inca weapons. That supports a scenario in which social turmoil around the time Spaniards arrived triggered conflicts between Inca communities, Murphy says.

http://www.sciencenews.org/view/generic/id/57860/title/Inca_cemetery_holds_brutal__glimpses_of_Spanish_violence

Colony of Young Stars Shines in New Spitzer Image

A colony of hot, young stars is stirring up the cosmic scene in this new picture from NASA's Spitzer Space Telescope. (Credit: NASA/JPL-Caltech)

ScienceDaily (Apr. 2, 2010) — Astronomers have their eyes on a hot group of young stars, watching their every move like the paparazzi. A new infrared image from NASA's Spitzer Space Telescope shows the bustling star-making colony of the Orion nebula, situated in the hunter's sword of the famous constellation. Like Hollywood starlets, the cosmic orbs don't always shine their brightest, but vary over time. Spitzer is watching the stellar show, helping scientists learn more about why the stars change, and to what degree planet formation might play a role.

"This is an exploratory project. Nobody has done this before at a wavelength sensitive to the heat from dust circling around so many stars," said John Stauffer, the principal investigator of the research at NASA's Spitzer Science Center, located at the California Institute of Technology in Pasadena. "We are seeing a lot of variation, which may be a result of clumps or warped structures in the planet-forming disks."

The new image was taken after Spitzer ran out of its coolant in May 2009, beginning its extended "warm" mission. The coolant was needed to chill the instruments, but the two shortest-wavelength infrared channels still work normally at the new, warmer temperature of 30 Kelvin (minus 406 Fahrenheit). In this new phase of the mission, Spitzer is able to spend more time on projects that cover a lot of sky and require longer observation times.

One such project is the "Young Stellar Object Variability" program, in which Spitzer looks repeatedly at the same patch of the Orion nebula, monitoring the same set of about 1,500 variable stars over time. It has already taken about 80 pictures of the region over 40 days. A second set of observations will be made in fall 2010. The region's twinkling stars are about one million years old -- this might invoke thoughts of wrinkle cream to a movie star, but in the cosmos, it is quite young. Our middle-aged sun is 4.6 billion years old.

Young stars are fickle, with brightness levels that change more than those of adult, sun-like stars. They also spin around faster. One reason for the ups and downs in brightness is the existence of cold spots on their surfaces. Cold spots are the opposite of "age spots" -- the younger the star, the more it has. The cold spots come and go as a star whips around, changing the amount of light that reaches our telescopes.

Stellar brightness can also change due to hot spots, which are caused by gas accreting onto a young star from the material out of which it formed.

"In the 1950s and 60s, astronomers knew that younger stars varied, and they postulated this had something to do with the birthing process," said Stauffer. "Later, with improved technology, we could see a lot more and learned a great deal about the stars' spots."

Spitzer is particularly suited to study yet another reason why the stars are changing. The telescope's infrared sight can see the warm, dusty disks orbiting around them. These disks are where planets may eventually clump together and form. When the disks are young, they can have asymmetries, possibly caused by forming planets or gravitational disturbances from formed planets. As the skewed disks circle around a star, they block varying amounts of starlight.

By gathering more and more data on these varying disks, Stauffer and his team hope to learn more about how planets develop -- not exactly tabloid fodder, but an ongoing drama of one large, stellar family.

NASA's Jet Propulsion Laboratory in Pasadena, Calif., manages the Spitzer Space Telescope mission for NASA's Science Mission Directorate, Washington. Science operations are conducted at the Spitzer Science Center at the California Institute of Technology in Pasadena. Caltech manages JPL for NASA.

For more information about Spitzer, visit http://www.spitzer.caltech.edu/spitzer and http://www.nasa.gov/spitzer .

Story Source:

Adapted from materials provided by NASA/Jet Propulsion Laboratory.

Young Men Who Smoke Have Lower IQs, Study Finds

A new study has determined that young men who smoke are likely to have lower IQs than their nonsmoking peers. (Credit: iStockphoto)

ScienceDaily (Apr. 2, 2010) — "Only dopes use dope," goes the memorable warning about drugs. Now a Tel Aviv University researcher cautions that the same goes for cigarettes.

A study led by Prof. Mark Weiser of Tel Aviv University's Department of Psychiatry and the Sheba Medical Center at Tel Hashomer Hospital has determined that young men who smoke are likely to have lower IQs than their non-smoking peers. Tracking 18- to 21-year-old men enlisted in the Israeli army in the largest ever study of its kind, he has been able to demonstrate an important connection between the number of cigarettes young males smoke and their IQ.

The average IQ for a non-smoker was about 101, while the smokers' average was more than seven IQ points lower at about 94, the study determined. The IQs of young men who smoked more than a pack a day were lower still, at about 90. An IQ score in a healthy population of such young men, with no mental disorders, falls within the range of 84 to 116.

An addiction that doesn't discriminate

"In the health profession, we've generally thought that smokers are most likely the kind of people to have grown up in difficult neighborhoods, or who've been given less education at good schools," says Prof. Weiser, whose study was reported in a recent version of the journal *Addiction*. "But because our study included subjects with diverse socio-economic backgrounds, we've been able to rule out socio-economics as a major factor. The government might want to rethink how it allocates its educational resources on smoking."

Making the results more significant, the study also measured effects in twin brothers. In the case where one twin smoked, the non-smoking twin registered a higher IQ on average.

Although a lower IQ may suggest a greater risk for smoking addiction, the cross-sectional data on IQ and smoking found that most of the smokers investigated in the study had IQs within the average range nevertheless.

Obesity, drug addiction also at issue

In the study, the researchers took data from more than 20,000 men before, during and after their time in the military. All men in the study were considered in good health, since pre-screening measures for suitability in the army had already been taken. The researchers found that around 28 percent of their sample smoked one or more cigarettes a day, 3 percent considered themselves ex-smokers, and 68% said they never smoked.

Prof. Weiser says that the study illuminates a general trend in epidemiological studies. "People on the lower end of the average IQ tend to display poorer overall decision-making skills when it comes to their health," says Prof. Weiser. He adds that his finding can help address a serious concern among health counsellors at grade and high schools. Schoolchildren who have been found to have a lower IQ can be considered at risk to begin the habit, and can be targeted with special education and therapy to prevent them from starting or to break the habit after it sets in.

"People with lower IQs are not only prone to addictions such as smoking," Prof. Weiser adds. "These same people are more likely to have obesity, nutrition and narcotics issues. Our study adds to the evidence of this growing body of research, and it may help parents and health professionals help at-risk young people make better choices."

Story Source:

Adapted from materials provided by American Friends of Tel Aviv University.

Journal Reference:

1. Mark Weiser, Salman Zarka, Nomi Werbeloff, Efrat Kravitz, Gad Lubin. **Cognitive test scores in male adolescent cigarette smokers compared to non-smokers: a population-based study**. *Addiction*, 2010; 105 (2): 358 DOI: 10.1111/j.1360-0443.2009.02740.x

http://www.sciencedaily.com/releases/2010/04/100401151746.htm

Ocean Acidification: 'Evil Twin' Threatens World's Oceans, Scientists Warn

The rise in human emissions of carbon dioxide is driving fundamental and dangerous changes in the chemistry and ecosystems of the world's oceans, international marine scientists have warned. (Credit: iStockphoto/Alberto L. Pomares G.)

ScienceDaily (Apr. 1, 2010) — The rise in human emissions of carbon dioxide is driving fundamental and dangerous changes in the chemistry and ecosystems of the world's oceans, international marine scientists have warned.

"Ocean conditions are already more extreme than those experienced by marine organisms and ecosystems for millions of years," the researchers say in the latest issue of the journal *Trends in Ecology and Evolution*.

"This emphasises the urgent need to adopt policies that drastically reduce CO_2 emissions."

Ocean acidification, which the researchers call the 'evil twin of global warming', is caused when the CO_2 emitted by human activity, mainly burning fossil fuels, dissolves into the oceans. It is happening independently of, but in combination with, global warming.

"Evidence gathered by scientists around the world over the last few years suggests that ocean acidification could represent an equal -- or perhaps even greater threat -- to the biology of our planet than global warming," co-author Professor Ove Hoegh-Guldberg of the ARC Centre of Excellence for Coral Reef Studies and The University of Queensland says.

More than 30% of the CO_2 released from burning fossil fuels, cement production, deforestation and other human activities goes straight into the oceans, turning them gradually more acidic.

"The resulting acidification will impact many forms of sea life, especially organisms whose shells or skeletons are made from calcium carbonate, like corals and shellfish. It may interfere with the reproduction of plankton species which are a vital part of the food web on which fish and all other sea life depend," he adds.

The scientists say there is now persuasive evidence that mass extinctions in past Earth history, like the "Great Dying" of 251 million years ago and another wipeout 55 million years ago, were accompanied by ocean acidification, which may have delivered the deathblow to many species that were unable to cope with it.

"These past periods can serve as great lessons of what we can expect in the future, if we continue to push the acidity the ocean even further" said lead author, Dr. Carles Pelejero, from ICREA and the Marine Science Institute of CSIC in Barcelona, Spain.

"Given the impacts we see in the fossil record, there is no question about the need to immediately reduce the rate at which we are emitting carbon dioxide in the atmosphere," he said further.

"Today, the surface waters of the oceans have already acidified by an average of 0.1 pH units from pre-industrial levels, and we are seeing signs of its impact even in the deep oceans," said co-author Dr. Eva Calvo, from the Marine Science Institute of CSIC in Barcelona, Spain.

"Future acidification depends on how much CO_2 humans emit from here on -- but by the year 2100 various projections indicate that the oceans will have acidified by a further 0.3 to 0.4 pH units, which is more than many organisms like corals can stand," Prof. Hoegh-Guldberg says.

"This will create conditions not seen on Earth for at least 40 million years."

"These changes are taking place at rates as much as 100 times faster than they ever have over the last tens of millions of years" Prof. Hoegh-Guldberg says.

Under such circumstances "Conditions are likely to become very hostile for calcifying species in the north Atlantic and Pacific over the next decade and in the Southern Ocean over the next few decades," the researchers warn.

Besides directly impacting on the fishing industry and its contribution to the human food supply at a time when global food demand is doubling, a major die-off in the oceans would affect birds and many land species and change the biology of Earth as a whole profoundly, Prof. Hoegh-Guldberg adds.

Story Source:

Adapted from materials provided by ARC Centre of Excellence in Coral Reef Studies.

Journal Reference:

1. Carles Pelejero, Eva Calvo and Ove Hoegh-Guldberg. **Palaeo-perspectives on ocean acidification**. *Trends in Ecology and Evolution*, 30 March 2010 DOI: 10.1016/j.tree.2010.02.002

http://www.sciencedaily.com/releases/2010/03/100330092821.htm

Higher Fat at Breakfast May Be Healthier Than You Think

Bacon and egg bagel for breakfast? The age-old maxim "Eat breakfast like a king, lunch like a prince and dinner like a pauper" may in fact be the best advice to follow to prevent metabolic syndrome. (Credit: iStockphoto/Michael Gray)

ScienceDaily (Apr. 1, 2010) — The age-old maxim "Eat breakfast like a king, lunch like a prince and dinner like a pauper" may in fact be the best advice to follow to prevent metabolic syndrome, according to a new University of Alabama at Birmingham (UAB) study.

Metabolic syndrome is characterized by abdominal obesity, high triglycerides, insulin resistance and other cardiovascular disease-risk factors.

The study, published online March 30 in the *International Journal of Obesity*, examined the influence exerted by the type of foods and specific timing of intake on the development of metabolic syndrome characteristics in mice. The UAB research revealed that mice fed a meal higher in fat after waking had normal metabolic profiles. In contrast, mice that ate a more carbohydrate-rich diet in the morning and consumed a high-fat meal at the end of the day saw increased weight gain, adiposity, glucose intolerance and other markers of the metabolic syndrome.

"Studies have looked at the type and quantity of food intake, but nobody has undertaken the question of whether the timing of what you eat and when you eat it influences body weight, even though we know sleep and altered circadian rhythms influence body weight," said the study's lead author Molly Bray, Ph.D., professor of epidemiology in the UAB School of Public Health.

Bray said the research team found that fat intake at the time of waking seems to turn on fat metabolism very efficiently and also turns on the animal's ability to respond to different types of food later in the day. When the animals were fed carbohydrates upon waking, carbohydrate metabolism was turned on and seemed to stay on even when the animal was eating different kinds of food later in the day.

"The first meal you have appears to program your metabolism for the rest of the day," said study senior author Martin Young, Ph.D., associate professor of medicine in the UAB Division of Cardiovascular Disease. "This study suggests that if you ate a carbohydrate-rich breakfast it would promote carbohydrate

utilization throughout the rest of the day, whereas, if you have a fat-rich breakfast, you have metabolic plasticity to transfer your energy utilization between carbohydrate and fat."

Bray and Young said the implications of this research are important for human dietary recommendations. Humans rarely eat a uniform diet throughout the day and need the ability to respond to alterations in diet quality. Adjusting dietary composition of a given meal is an important component in energy balance, and they said their findings suggest that recommendations for weight reduction and/or maintenance should include information about the timing of dietary intake plus the quality and quantity of intake.

"Humans eat a mixed diet, and our study, which we have repeated four times in animals, seems to show that if you really want to be able to efficiently respond to mixed meals across a day then a meal in higher fat content in the morning is a good thing," Bray said. "Another important component of our study is that, at the end of the day, the mice ate a low-caloric density meal, and we think that combination is key to the health benefits we've seen."

Bray and Young said further research needs to test whether similar observations are made with different types of dietary fats and carbohydrates, and it needs to be tested in humans to see if the findings are similar between rodents and humans.

"We're also working on a study right now to determine if these feeding regimens adversely affect heart function," Young said.

Story Source:

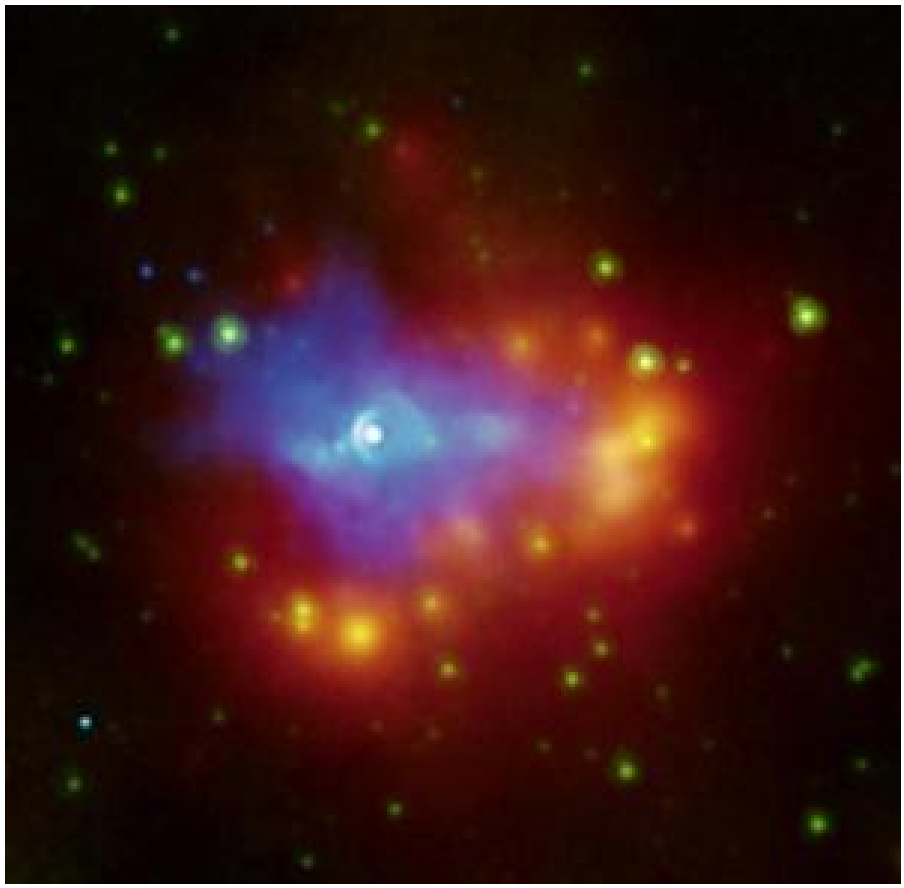
Adapted from materials provided by University of Alabama at Birmingham.

Journal Reference:

1. Bray et al. **Time-of-day-dependent dietary fat consumption influences multiple cardiometabolic syndrome parameters in mice**. *International Journal of Obesity*, 2010; DOI: 10.1038/ijo.2010.63

http://www.sciencedaily.com/releases/2010/03/100330161751.htm

Ashes to Ashes, Dust to Dust: Space Telescopes Image Remains of Collapsed Star



A composite image from NASA's Chandra (blue) and Spitzer (green and red-yellow) space telescopes shows the dusty remains of a collapsed star, a supernova remnant called G54.1+0.3. (Credit: NASA/CXC/JPL-Caltech/Harvard-Smithsonian CfA)

ScienceDaily (Apr. 1, 2010) — A new image from NASA's Chandra and Spitzer space telescopes shows the dusty remains of a collapsed star. The dust is flying past and engulfing a nearby family of stars.

"Scientists think the stars in the image are part of a stellar cluster in which a supernova exploded," said Tea Temim of the Harvard-Smithsonian Center for Astrophysics, Cambridge, Mass., who led the study. "The material ejected in the explosion is now blowing past these stars at high velocities."

The composite image of G54.1+0.3 is online at http://photojournal.jpl.nasa.gov/catalog/?IDNumber=pia12982 . It shows the Chandra X-ray Observatory data in blue, and data from the Spitzer Space Telescope in green (shorter wavelength) and red-yellow (longer). The white source near the center of the image is a dense, rapidly rotating neutron star, or pulsar, left behind after a core-collapse supernova explosion. The pulsar generates a wind of high-energy particles -- seen in the Chandra data -- that expands into the surrounding environment, illuminating the material ejected in the supernova explosion.

The infrared shell that surrounds the pulsar wind is made up of gas and dust that condensed out of debris from the supernova. As the cold dust expands into the surroundings, it is heated and lit up by the stars in the cluster so that it is observable in infrared. The dust closest to the stars is the hottest and is seen glowing in yellow in the image. Some of the dust is also being heated by the expanding pulsar wind as it overtakes the material in the shell.

The unique environment into which this supernova exploded makes it possible for astronomers to observe the condensed dust from the supernova that is usually too cold to emit in infrared. Without the presence of the stellar cluster, it would not be possible to observe this dust until it becomes energized and heated by a shock wave from the supernova. However, the very action of such shock heating would destroy many of the smaller dust particles. In G54.1+0.3, astronomers are observing pristine dust before any such destruction.

G54.1+0.3 provides an exciting opportunity for astronomers to study the freshly formed supernova dust before it becomes altered and destroyed by shocks. The nature and quantity of dust produced in supernova explosions is a long-standing mystery, and G54.1+0.3 supplies an important piece to the puzzle.

NASA's Marshall Space Flight Center in Huntsville, Ala., manages the Chandra program for NASA's Science Mission Directorate in Washington. The Smithsonian Astrophysical Observatory controls Chandra's science and flight operations from Cambridge, Mass.

The Spitzer observations were made before the telescope ran out of its coolant in May 2009 and began its "warm" mission. NASA's Jet Propulsion Laboratory in Pasadena, Calif., manages Spitzer for NASA's Science Mission Directorate, Washington. Science operations are conducted at the Spitzer Science Center at the California Institute of Technology in Pasadena. Caltech manages JPL for NASA.

More information on the Spitzer Space Telescope is online at: http://www.spitzer.caltech.edu/spitzer and http://www.nasa.gov/spitzer . More information on the Chandra X-ray Observatory is at: http://chandra.harvard.edu and http://chandra.nasa.gov .

Story Source:

Adapted from materials provided by NASA/Jet Propulsion Laboratory.

http://www.sciencedaily.com/releases/2010/03/100329153927.htm

Exploration in Toddlers Activated by Fathers

Toddler boy exploring in a park with mother and father looking on in approval. A new study has found that fathers give toddlers more leeway and that allows them to actively explore their environments. (Credit: iStockphoto/Bob Ingelhart)

ScienceDaily (Apr. 1, 2010) — A new study has found that fathers give toddlers more leeway and that allows them to actively explore their environments, according to a new study on parent-child attachment published inEarly Child Development and Care.

Daniel Paquette, a professor at the Université de Montréal School of Psychoeducation, says the 'activation theory' is just as important as the 'attachment theory.' The latter was the prevailing 20th-Century notion that children usually connect with their primary caregiver since they fulfill their emotional needs and guarantee their survival.

"In attachment theory, a child seeks comfort from a parent when he or she is insecure. This theory underestimates the importance of exploratory behavior in children," says Dr. Paquette, who completed his study with Marc Bigras of the Université du Québec à Montréal.

As part of the investigations, kids aged 12 to 18 months (accompanied by a parent) were placed in three different risky situations: social risk (a strange adult entered his or her environment), physical risk (toys were placed at the top of a stairway), and a forbidden activity (parents were forbidden to climb the stairs after the child succeeded the first time).

"We found fathers are more inclined than mothers to activate exploratory behavior by being less protective," says Paquette. "The less the parent is protective, the more activated is the exploratory behavior in the child. Children who were optimally stimulated, meaning they were exploratory yet respective of the rules, were 71 percent boys. Meanwhile, 70 percent of children who were risk averse were girls."

The parent's behavior was measured by the distance they kept from their child as he or she climbed the stairs. "For a child to become self-confident, the parent mustn't be too far or too close," says Paquette.

"The ideal distance seems to be an arm's length. This distance was statistically significant with fathers yet not with mothers."

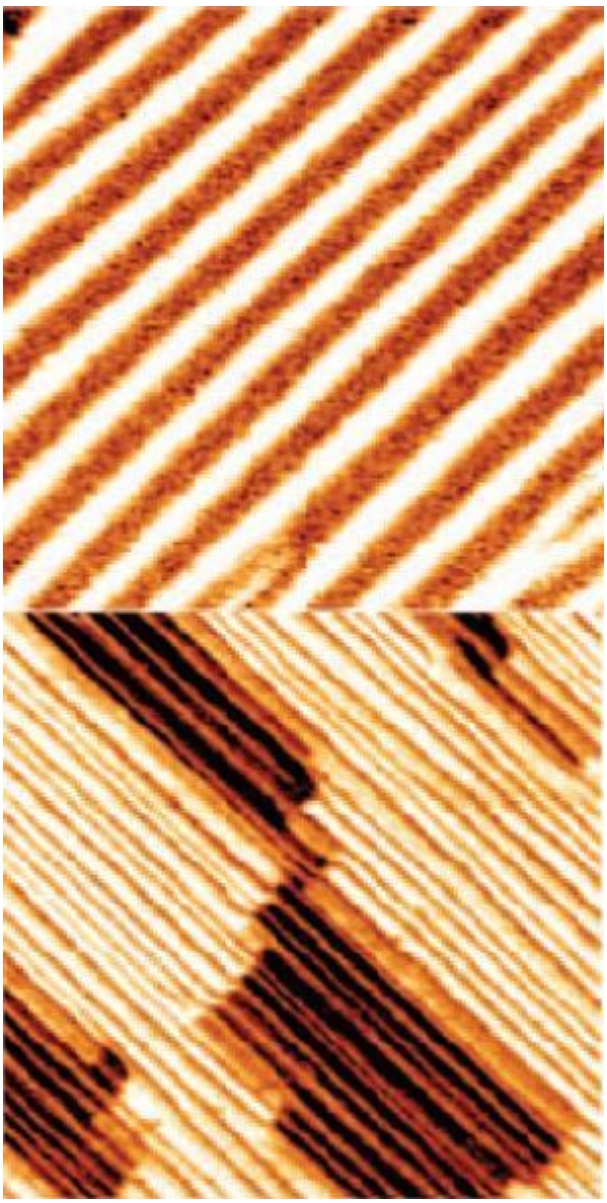
According to Paquette, classical attachment theory doesn't highlight these differences between boys and girls. This is why he feels his theory is better adapted to evaluate the role of the father while factoring in the temperament of the child and the level of protective parenting, both of which trigger the activation relationship.

Paquette is convinced that mothers and fathers intervene differently in the education of a child and these complementarities benefit a child. "Even if both parents change diapers and give the bottle, they don't do it the same way," says Paquette. "By stimulating exploration, controlled risk-taking and competition, fathers provide something different to the child who will benefit greatly from this singular contribution."

Story Source:

Adapted from materials provided by University of Montreal, via EurekAlert!, a service of AAAS.
http://www.sciencedaily.com/releases/2010/03/100331091145.htm

New Path to Solar Energy Via Solid-State Photovoltaics



These nanoscale images of bismuth ferrite thin films show ordered arrays of 71 degree domain walls (top) and 109 degree doman walls (bottom). By changing the polarization direction of the bismuth ferrite, these domain walls give rise to the photovoltaic effect. (Credit: Image from Seidel, et. al.)

ScienceDaily (Apr. 1, 2010) — A newly discovered path for the conversion of sunlight to electricity could brighten the future for photovoltaic technology. Researchers with Lawrence Berkeley National Laboratory (Berkeley Lab) have found a new mechanism by which the photovoltaic effect can take place in semiconductor thin-films. This new route to energy production overcomes the bandgap voltage limitation that continues to plague conventional solid-state solar cells.

Working with bismuth ferrite, a ceramic made from bismuth, iron and oxygen that is multiferroic -- meaning it simultaneously displays both ferroelectric and ferromagnetic properties -- the researchers discovered that the photovoltaic effect can spontaneously arise at the nanoscale as a result of the ceramic's rhombohedrally distorted crystal structure. Furthermore, they demonstrated that the application of an electric field makes it possible to manipulate this crystal structure and thereby control photovoltaic properties.

"We're excited to find functionality that has not been seen before at the nanoscale in a multiferroic material," said Jan Seidel, a physicist who holds joint appointments with Berkeley Lab's Materials Sciences Division and the UC Berkeley Physics Department. "We're now working on transferring this concept to higher efficiency energy-research related devices."

Seidel is one of the lead authors of a paper in the journal *Nature Nanotechnology* that describes this work titled, "Above-bandgap voltages from ferroelectric photovoltaic devices." Co-authoring this paper with Seidel were Seung-Yeul Yang, Steven Byrnes, Padraic Shafer,Chan-Ho Yang, Marta Rossell, Pu Yu, Ying-Hao Chu, James Scott, Joel Ager, Lane Martin and Ramamoorthy Ramesh.

At the heart of conventional solid-state solar cells is a p-n junction, the interface between a semiconductor layer with an abundance of positively-charged "holes," and a layer with an abundance of negatively charged electrons. When photons from the sun are absorbed, their energy creates electron-hole pairs that can be separated within a "depletion zone," a microscopic region at the p-n junction measuring only a couple of micrometers across, then collected as electricity. For this process to take place, however, the photons have to penetrate the material to the depletion zone and their energy has to precisely match the

energy of the semiconductor's electronic bandgap -- the gap between its valence and conduction energy bands where no electron states can exist.

"The maximum voltage conventional solid-state photovoltaic devices can produce is equal to the energy of their electronic bandgap," Seidel says. "Even for so called tandem-cells, in which several semiconductor p-n junctions are stacked, photovoltages are still limited because of the finite penetration depth of light into the material."

Working through Berkeley Lab's Helios Solar Energy Research Center, Seidel and his collaborators discovered that by applying white light to bismuth ferrite, a material that is both ferroelectric and antiferromagnetic, they could generate photovoltages within submicroscopic areas between one and two nanometers across. These photovoltages were significantly higher than bismuth ferrite's electronic bandgap.

"The bandgap energy of the bismuth ferrite is equivalent to 2.7 volts. From our measurements we know that with our mechanism we can get approximately 16 volts over a distance of 200 microns. Furthermore, this voltage is in principle linear scalable, which means that larger distances should lead to higher voltages."

Behind this new mechanism for photovoltage generation are domain walls -- two-dimensional sheets that run through a multiferroic and serve as transition zones, separating regions of different ferromagnetic or ferroelectric properties. In their study, Seidel and his collaborators found that these domain walls can serve the same electron-hole separation purpose as depletion zones only with distinct advantages.

"The much smaller scale of these domain walls enables a great many of them to be stacked laterally (sideways) and still be reached by light," Seidel says. "This in turn makes it possible to increase the photovoltage values well above the electronic bandgap of the material."The photovoltaic effect arises because at the domain walls the polarization direction of the bismuth ferrite changes, which leads to steps in the electrostatic potential. Through annealing treatments of the substrate upon which bismuth ferrite is grown, the material's rhombohedral crystals can be induced to form domain walls that change the direction of electric field polarization by either 71, 109 or 180 degrees. Seidel and his collaborators measured the photovoltages created by the 71 and 109 degree domain walls."The 71 degree domain walls showed unidirectional in-plane polarization alignment and produced an aligned series of potential voltage steps," Seidel says. "Although the potential step at the 109 degree domain was higher than the 71 degree domain, it showed two variants of the in-plane polarization which ran in opposite directions."

Seidel and his colleagues were also able to use a 200 volt electric pulse to either reverse the polarity of the photovoltaic effect or turn it off altogether. Such controllability of the photovoltaic effect has never been reported in conventional photovoltaic systems, and it paves the way for new applications in nano-optics and nano-electronics."While we have not yet demonstrated these possible new applications and devices, we believe that our research will stimulate concepts and thoughts that are based on this new direction for the photovoltaic effect," Seidel says.

Story Source:

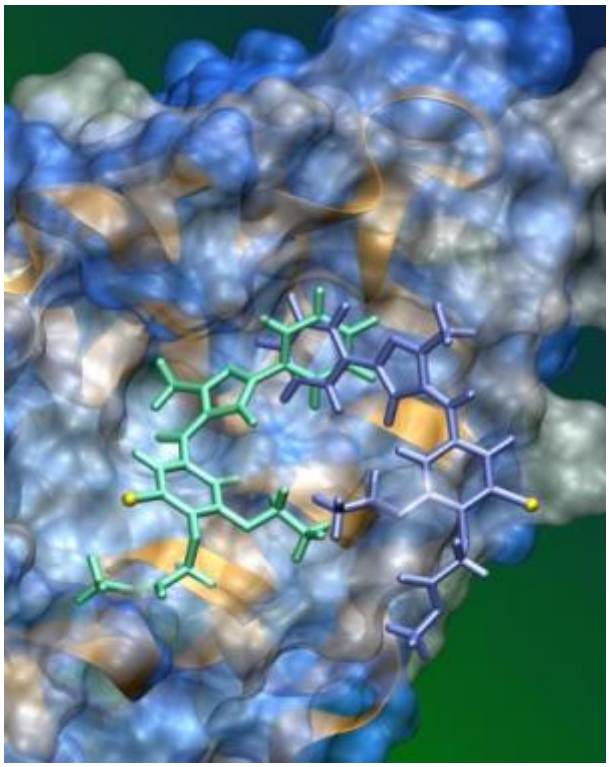
Adapted from materials provided by DOE/Lawrence Berkeley National Laboratory.

Journal Reference:

1. Yang et al. **Above-bandgap voltages from ferroelectric photovoltaic devices**. *Nature Nanotechnology*, 2010; 5 (2): 143 DOI: 10.1038/nnano.2009.451

http://www.sciencedaily.com/releases/2010/03/100331091147.htm

Advances Reported in Quest for Drugs Targeting Childhood Cancer



St. Jude Children's Research Hospital investigators recently identified the first small molecule inhibitor of the MDMX protein, which is implicated in a number of cancers. This illustration shows the inhibitor's predicted binding in a pocket of the MDMX protein. (Credit: Jennifer Robison, St. Jude Biomedical Communications)

ScienceDaily (Apr. 1, 2010) — Investigators believe they have identified the founding member of a chemical family they hope will lead to a new class of cancer drugs, the first designed specifically against a childhood tumor, according to research led by St. Jude Children's Research Hospital scientists.

The chemical is the first small-molecule inhibitor to target the MDMX protein. Excess MDMX is a hallmark of the childhood eye tumor retinoblastoma as well as certain cases of breast, lung, prostate and other cancers. Nationally about 300 new cases of retinoblastoma are identified each year.

The discovery was reported online in advance of the April 2 print edition of the *Journal of Biological Chemistry*. An overabundance of MDMX or its sister protein, MDM2, can promote tumor progression by binding and suppressing a protein called p53. The role of p53 in normal cells is to induce death in cells that begin the unchecked cell division that is a hallmark of cancer.

MDM2 and MDMX use different mechanisms to disrupt the p53 pathway. There is an emerging scientific consensus that restoring normal p53 function might require shutting down both MDMX and MDM2. A small-molecule inhibitor against MDM2 is already in Phase 1 pharmaceutical industry trials. In this study, St. Jude researchers reported that when the new St. Jude compound, known as SJ-172550, is combined with an MDM2 inhibitor there was a corresponding increase in retinoblastoma cells death.

Michael Dyer, Ph.D., Developmental Neurobiology and the paper's senior author, said several years of detailed chemical studies and additional work are likely needed before SJ-172550 might be ready for human trials.

Evidence suggests SJ-172550 works by binding in a reversible manner to a pocket in the MDMX molecule. With SJ-172550 sitting in the pocket, the p53 protein cannot bind to MDMX, Dyer explained. That makes p53 available to do its job and eliminate tumor cells. About 65 percent of retinoblastoma tumors feature extra copies of the MDMX gene as do nearly 20 percent of patients with breast, colon and lung cancer.

The finding expands on work from Dyer's laboratory into the genetic and biochemical missteps that give rise to retinoblastoma. The advance reflects the combined efforts of the St. Jude departments of Developmental Neurobiology; Chemical Biology and Therapeutics; and Structural Biology. The first authors are Damon Reed, M.D., formerly of St. Jude and now of St. Petersburg, Fla., and Ying Shen, Ph.D., of Developmental Neurobiology.

"We went from a discovery in childhood cancer, MDMX amplification, to characterizing this first inhibitor in about three-and one-half years," Dyer said. "This model is now being replicated over and over in other cancers we treat at St. Jude."

Dyer's laboratory developed the biochemical and cell-based tests used by colleagues in Chemical Biology and Therapeutics. Researchers checked a chemical library of nearly 300,000 compounds using high-throughput screening. Investigators searched for molecules likely to block MDMX activity.

Dyer said the new compound might help researchers studying the biology of MDMX. "It may also be useful for any tumor that has normal p53," he said. "The idea is that if you have normal p53 and you need to turn it on, maybe by giving a drug that hits MDM2 and another that hits MDMX; you free p53 up to kill the cell."

Investigators' predictions of exactly how SJ-172550 interacts with MDMX are based on mathematical and computer models. Work is underway to capture an X-ray crystal structure of SJ-172550 bound to MDMX.

Other St. Jude authors are Anang Shelat, Fangyi Zhu, David Smithson, Kip Guy, Samantha Cicero, Antonio Ferreira, Donald Bashford, and Brenda Schulman (St. Jude); Leggy A. Arnold, Catherine A. Regni and Nicholas Mills (formerly of St. Jude); and Aart Jochemsen (Leiden University Medical Center, Leiden, Netherlands).

The research was supported by grants from the National Institutes of Health, the National Cancer Institute, the American Cancer Society, Research to Prevent Blindness, the Pearle Vision Foundation, the International Retinal Research Foundation, the Pew Charitable Trust, Howard Hughes Medical Institute and ALSAC.

Story Source:

Adapted from materials provided by St. Jude Children's Research Hospital, via EurekAlert!, a service of AAAS.

http://www.sciencedaily.com/releases/2010/03/100329112155.htm

What If All Software Was Open Source? A Code to Unlock the Desktop

ScienceDaily (Apr. 1, 2010) — What if all software was open source? Anybody would then be able to add custom features to Microsoft Word, Adobe Photoshop, Apple iTunes or any other program. A University of Washington project may make this possible.

"Microsoft and Apple aren't going to open up all their stuff. But they all create programs that put pixels on the screen. And if we can modify those pixels, then we can change the program's apparent behavior," said James Fogarty, a UW assistant professor of computer science and engineering.

His approach hijacks the display to customize the user's interaction with the program. He will demonstrate his system April 14 in Atlanta at the Association for Computing Machinery's Conference on Human Factors in Computing Systems.

"We really see this as a first step toward a scenario where anybody can modify any application," Fogarty said. "In a sense, this has happened online. You've got this mash-up culture on the Web because everybody can see the HTML. But that hasn't been possible on the desktop."

These days a Web page might include a map from Google, an embedded video from YouTube and a list of recent headlines. This is not yet possible on the personal computer.

"Let's say I'm writing a paper in Microsoft Word but I want to listen to music at the same time," explained co-author Morgan Dixon, a UW doctoral student in computer science and engineering.

Right now he would have to click back and for the between Word and iTunes, but the system he helped create can simply add a few iTunes buttons to the Word toolbar.

"I'm using some program that I love," Dixon said, "and I'm going to stick in some features from some other program that I love, so I have a more unified interface."

More importantly, having more control over widely used programs would allow people to benefit from accessibility tools that have been gathering dust in academic research labs.

One example is target-aware pointing, which can make many interfaces easier for people with muscular dystrophy, Parkinson's disease, cerebral palsy or other motor-control disabilities. On such tool, the bubble cursor, highlights the button closest to it, making it easier for people with disabilities to click a button without having to hit it dead on. Fogarty and Dixon show the first implementation of a bubble cursor in various commercial applications.

"The human-computer interaction community has done 30 years of research on how to make computers more accessible to people with disabilities. But no one change is perfect for everybody," Fogarty said. "That's why you don't see these tools out there."

His research allows people to personalize programs based on their needs.

The UW tool, named Prefab, takes advantage of the fact that almost all displays are made from prefabricated blocks of code such as buttons, sliders, check boxes and drop-down menus. Prefab looks for those blocks as many as 20 times per second and alters their behavior.

The researchers are continuing to develop Prefab and are exploring options for commercialization.

Prefab unlocks previously inaccessible interfaces, allowing people to add the same usability tool to all the applications they run on their desktop. The system could translate a program's interface into a different language, or reorder menus to bump up favorite commands.

The authors hope Prefab will spur development of new innovations.

"If you come up with a new technology, too often it's evaluated in a test environment," Fogarty said. "This lets researchers put it into practice in something real, like Photoshop or iTunes."

Prefab can also produce more advanced effects. One demonstration that will be presented at the conference creates multiple previews of a single image in Photoshop. Behind the scenes, Prefab moves the sliders to different points, captures the output and then displays all of them on a single screen. This could save time by showing a range of effects the user frequently adjusts.

The system could also allow programs to move from computer screens to mobile devices, which do not have a standard operating system.

"It dramatically lowers the threshold to getting new innovation into existing, complex programs," Fogarty said.

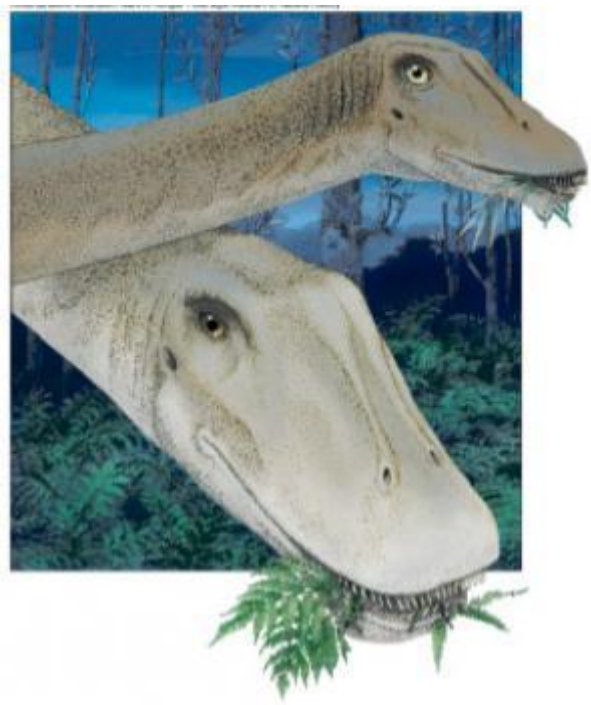
Research has been funded by the Hacherl Endowed Graduate Fellowship in the UW Department of Computer Science & Engineering, a fellowship from the Seattle chapter of the Achievement Rewards for College Scientists, and Intel.

More information about Prefab.

Story Source:

Adapted from materials provided by University of Washington.
http://www.sciencedaily.com/releases/2010/03/100330151947.htm

Dinosaur Skull Changed Shape During Growth



Diplodocus carnegii adult and juvenile feeding. (Credit: Reconstruction illustration: Mark A Klingler / Carnegie Museum of Natural History)

ScienceDaily (Apr. 1, 2010) — The skull of a juvenile sauropod dinosaur, rediscovered in the collections of Pittsburgh's Carnegie Museum of Natural History, illustrates that some sauropod species went through drastic changes in skull shape during normal growth.

University of Michigan paleontologists John Whitlock and Jeffrey Wilson, along with Matthew Lamanna from the Carnegie Museum, describe their find in the March issue of the Journal of Vertebrate Paleontology.

The fossil offers a rare chance to look at the early life history of *Diplodocus*, a 150 million-year-old sauropod from western North America.

"Adult sauropod skulls are rare, but juvenile skulls are even rarer," said Whitlock, a doctoral candidate in the U-M Museum of Paleontology. "What we do know about the skulls of sauropods like *Diplodocus* has been based entirely on adults so far."

"*Diplodocus* had an unusual skull," said Wilson, an assistant professor in the Department of Geological Sciences and an assistant curator at the U-M Museum of Paleontology. "Adults had long, square snouts, unlike the rounded or pointed snouts of other sauropods. Up until now, we assumed juveniles did too."

The small *Diplodocus* skull, however, suggests that major changes occurred in the skull throughout the animal's life.

"Although this skull is plainly that of a juvenile *Diplodocus*, in many ways it is quite different from those of the adults," Whitlock said. "Like those of most young animals, the eyes are proportionally larger, and the face is smaller. What was unexpected was the shape of the snout -- it appears to have been quite pointed, rather than square like the adults. This gives us a whole new perspective on what these animals may have looked like at different points in their lives."

The researchers believe these changes in skull shape may have been tied to feeding behavior, with adults and juveniles eating different foods to avoid competition. Young *Diplodocus*, with their narrower snouts, may also have been choosier browsers, selecting high quality plant parts.

The discovery also highlights the importance of museum collections for paleontological research.

"Fossils like this are a great example of why natural history museums like ours put so much time and effort into caring for our collections, said Lamanna, an assistant curator of vertebrate paleontology at Carnegie Museum of Natural History. "This little *Diplodocus* skull was discovered in 1921, and more than 80 years passed before we recognized its significance. If the Carnegie Museum hadn't preserved it for all that time, the important insight it has provided into the growth and ecology of this dinosaur would have been lost."

The actual juvenile *Diplodocus* skull, as well as a fully restored, mounted skeleton of an adult, is on display in Carnegie Museum of Natural History's "Dinosaurs in Their Time" exhibition.

Funding was provided by the U-M Department of Geological Sciences and the Geological Society of America.

Story Source:

Adapted from materials provided by University of Michigan.

Journal Reference:

1. Whitlock et al. **Description of a Nearly Complete Juvenile Skull of Diplodocus (Sauropoda: Diplodocoidea) from the Late Jurassic of North America**. *Journal of Vertebrate Paleontology*, 2010; 30 (2): 442 DOI: 10.1080/02724631003617647

http://www.sciencedaily.com/releases/2010/03/100331141621.htm

Leonardo Da Vinci's 'The Last Supper' Reveals More Secrets

The Last Supper – relentlessly studied, scrutinized, satirized and one the world's most famous paintings – is still revealing secrets. (Credit: Image courtesy of University of Montreal)

ScienceDaily (Apr. 1, 2010) — The Last Supper -- relentlessly studied, scrutinized, satirized and one the world's most famous paintings -- is still revealing secrets. Researchers Olivier Bauer, Nancy Labonté, Jonas Saint-Martin and Sébastien Fillion of the Université de Montréal Faculty of Theology have found new meaning to the food depicted by Leonardo Da Vinci's famous artwork."We asked ourselves why Da Vinci chose those particular foods, because they don't correspond to what the Evangelists described," says Bauer. "Why bread, fish, salt, citrus and wine? Why is the saltshaker tipped over in front of Judas? Why is the bread leavened?"The four researchers don't buy into the farfetched hypotheses introduced by Dan Brown in his best-selling book, The Da Vinci Code, yet they agree the artist included symbols and commentary in his depiction. He purposely attempted to confuse and fool the observer with contradictory symbols and double-meanings.

For instance, a fallen saltshaker is traditionally a sign of bad luck. The researchers question if instead of indicating the mischief of Judas, the fallen saltshaker could suggest his rehabilitation. He could have been chosen to play the role of the traitor. And why is he the only one with an empty plate? It could mean he is full and mischievous or that he is the only one who isn't fooled?The fish has also been the topic of several studies. It is clearly a reminder that Jesus spent most of his life around Lake Tiberias and that he selected his Apostles among local fishermen. Yet it isn't clear whether the fish is herring or eel. Some argue Da Vinci was deliberately ambiguous about the species of fish. Eel in Italian is aringa, although when it is spelled arringa it means indoctrination. And herring in northern Italy is renga, meaning he who denies religion.The painting continues to fascinate and mystify. Its restoration, which took place between 1979 and 1999, has brought to light new details that along with new technology has spurred a new wave of research and interpretation of one of the world's most famous artworks.

Story Source:

Adapted from materials provided by University of Montreal.

http://www.sciencedaily.com/releases/2010/03/100331091143.htm

Evidence-Based Medicine Theory Can Be Applied to Frequent Flying

Author Professor Leslie Citrome. (Credit: Image courtesy of Wiley - Blackwell)

ScienceDaily (Apr. 1, 2010) — When New York-based Professor Leslie Citrome sets off for his latest conference or speaking engagement, he isn't just armed with a stack of medical journals and his passport. He makes sure he packs a calculator and notebook as well!

The psychiatry expert, who has nearly 200 published papers to his name, is on a mission to test his new theory of evidence-based flying (EBF), which he hopes will help him to achieve minimum delays and maximum upgrades.

"I was on a flight from Los Angeles to Brisbane when it occurred to me that the evidence-based medicine theories that I use every day as an author and clinician could be applied to other areas of my life," he explains in a paper published online April 1 by IJCP, the *International Journal of Clinical Practice*.

"Evidence-based medicine encourages clinicians to incorporate the best available research evidence regarding efficacy and safety, together with individualised patient assessment and patient preferences, into their medical decision making" says Professor Citrome from the New York University School of Medicine and Nathan S Kline Institute for Psychiatric Research.

"Academics on the medical conference circuit already have their own extensive travel experience, albeit anecdotal. What has been missing in flyer decision-making to date is robust research evidence.

"Cut-throat competition between the airlines means that published rates of departure delays can now make my theory of EBF a reality."

Armed with the latest statistics on flight delays, Professor Citrome has already carried out initial calculations on the number needed to fly (NNF) -- the number of flights he needs to take with each of the

big six airlines before experiencing one delay. This is based on the medical equivalent of the number needed to treat (NNT), used by clinicians to see how many patients they could normally expect to treat before experiencing one outcome of interest.

Professor Citrome's initial analysis showed that departure delays ranged from 20 to 30 per cent, with the NNF ranging from 10 to 31 flights when comparisons were carried out against the top performing airline.

"I should point out that these figures were merely used to demonstrate the theory I have developed and the data used in the calculations were taken from an advertisement in USA Today" stresses Professor Citrome. "Further research is needed to validate and refine the statistics, but they provided a useful starting point."

But it doesn't end there. Professor Citrome suggests that other factors could be taken into account to determine number needed to upgrade (NNU) from coach to first class.

"NNU can be highly variable, depending on baseline factors such as the city one is flying from, time of day, day of the week, class of ticket purchased and individual traveller characteristics like frequent flyer loyalty club status level" he points out.

By working out the NNF and the NNU, Professor Citrome argues that it would be possible to come up with comparative values on the likelihood of being upgraded or delayed (LUD) on each airline.

Other factors that could be included in the equation include type of food served (free or not), pillow and blanket policy, cost considerations, charges for extra baggage and availability of flights.

"Using these baseline characteristics, in the same way as we would use factors in evidence-based medicine, could help us make the final estimates more precise" he argues.

Professor Citrome, who has frequent flyer platinum status on one airline and silver on another, looks forward to greater transparency by the airlines.

"The posting of delay and upgrade rates in publicly accessible airline registries will further enhance the amount of data available to help us make wise flying decisions" he says.

Story Source:

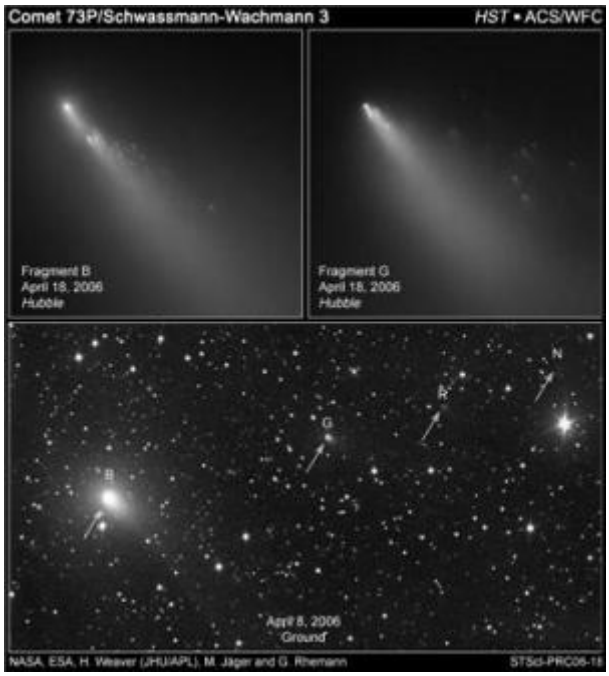
Adapted from materials provided by Wiley - Blackwell, via AlphaGalileo.

Journal Reference:

1. L. Citrome. **Evidence-based flying: a new paradigm for frequent flyers**. *International Journal of Clinical Practice*, 2010; DOI: 10.1111/j.1742-1241.2010.02409.x

http://www.sciencedaily.com/releases/2010/03/100331201751.htm

Was a Giant Comet Responsible for a North American Catastrophe in 11,000 BC?



05 Hubble Space Telescope image of the breakup of a comet (73/P Schwassmann-Wachmann 3). (Credit: NASA / ESA / H.Weaver (JHU/APL) / M. Mutchler / Z.Levay (STScI))

ScienceDaily (Apr. 1, 2010) — Some 13,000 years ago the Earth was struck by thousands of Tunguska-sized cometary fragments over the course of an hour, leading to a dramatic cooling of the planet, according to astronomer Professor Bill Napier of the Cardiff University Astrobiology Centre.

He presents his new model in the journal *Monthly Notices of the Royal Astronomical Society*.

The cooling, by as much as 8°C, interrupted the warming which was occurring at the end of the last ice age and caused glaciers to readvance. Evidence has been found that this catastrophic change was associated with some extraordinary extraterrestrial event. The boundary is marked by the occurrence of a "black mat" layer a few centimetres thick found at many sites throughout the United States containing high levels of soot indicative of continental-scale wildfires, as well as microscopic hexagonal diamonds (nanodiamonds) which are produced by shocks and are only found in meteorites or impact craters. These findings led to the suggestion that the catastrophic changes of that time were caused by the impact of an asteroid or comet 4 km across on the Laurentide ice sheet, which at that time covered what would become Canada and the northern part of the United States.

The cooling lasted over a thousand years, and its onset coincides with the rapid extinction of 35 genera of North American mammals, as well as the disruption of the Palaeoindian culture. The chief objection to the idea of a big impact is that the odds against the Earth being struck by an asteroid this large only 13,000 years ago are a thousand to one against. And the heat generated by the rising fireball would be limited by the curvature of the horizon and could not explain the continent-wide occurrence of wildfires.

Professor Napier has now come up with an astronomical model which accounts for the major features of the catastrophe without involving such an improbable event. According to his model, the Earth ran into a dense trail of material from a large disintegrating comet. He points out that there is compelling evidence that such a comet entered the inner planetary system between 20 000 and 30 000 years ago and has been fragmenting ever since, giving rise to a number of closely related meteor streams and comoving asteroids known as the Taurid Complex.

In the course of the giant comet's disintegration, the environment of the interplanetary system would have been hazardous and the Earth would probably have run through at least one dense swarm of cometary material. The new model indicates that such an encounter would last for about an hour during which thousands of impacts would take place over continental dimensions, each releasing the energy of a megaton-class nuclear bomb, generating the extensive wildfires which took place at that time. The nanodiamonds at the extinction boundary would then be explained as having come in with the comet swarm.

One recent meteorite is known which may have come from this giant comet progenitor: the Tagish Lake meteorite, which fell over Yukon Territory in January 2000. It has the highest abundance of nanodiamonds of any meteorite so far analysed.

Professor Napier sums up his model: "A large comet has been disintegrating in the near-Earth environment for the past 20,000 to 30,000 years, and running into thousands of fragments from this comet is a much more likely event than a single large collision. It gives a convincing match to the major geophysical features at this boundary."

Story Source:

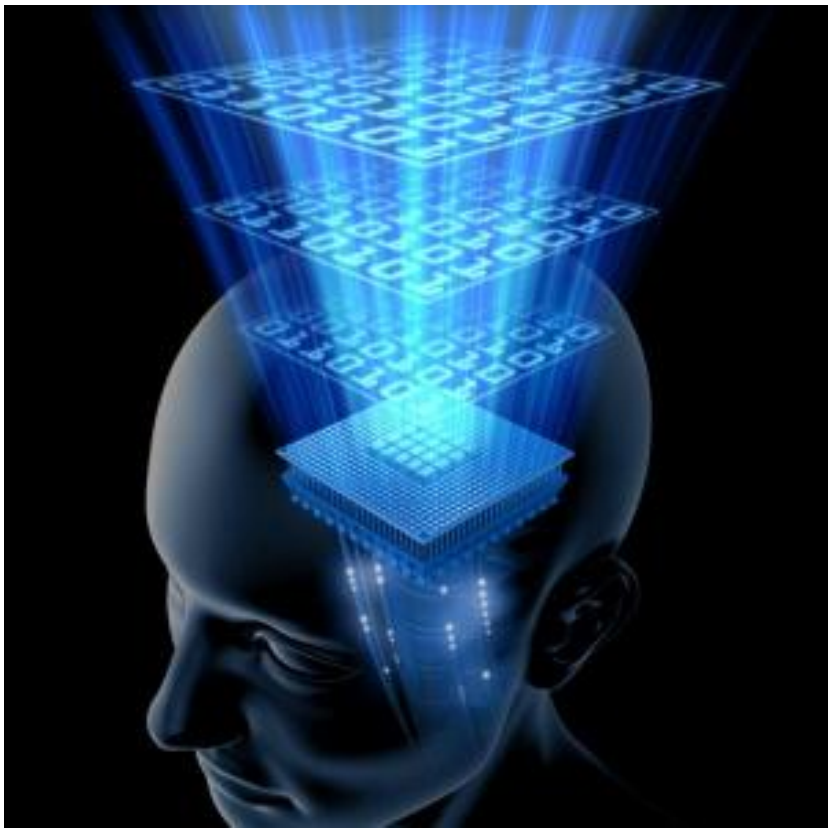
Adapted from materials provided by Royal Astronomical Society (RAS).

Journal Reference:

1. Napier W. M. **Paleolithic extinctions and the Taurid Complex**. *Monthly Notices of the Royal Astronomical Society*, 2010; (in press) [link]

http://www.sciencedaily.com/releases/2010/04/100401101527.htm

Grand Unified Theory of AI: New Approach Unites Two Prevailing but Often Opposed Strains in Artificial-Intelligence Research



A new way to model thought, developed by MIT research scientist Noah Goodman, could have broad implications for both AI and cognitive science. (Credit: iStockphoto)

ScienceDaily (Apr. 1, 2010) — In the 1950s and '60s, artificial-intelligence researchers saw themselves as trying to uncover the rules of thought. But those rules turned out to be way more complicated than anyone had imagined. Since then, artificial-intelligence (AI) research has come to rely, instead, on probabilities -- statistical patterns that computers can learn from large sets of training data.

The probabilistic approach has been responsible for most of the recent progress in artificial intelligence, such as voice recognition systems, or the system that recommends movies to Netflix subscribers. But Noah Goodman, an MIT research scientist whose department is Brain and Cognitive Sciences but whose lab is Computer Science and Artificial Intelligence, thinks that AI gave up too much when it gave up rules. By combining the old rule-based systems with insights from the new probabilistic systems, Goodman has found a way to model thought that could have broad implications for both AI and cognitive science.

Early AI researchers saw thinking as logical inference: if you know that birds can fly and are told that the waxwing is a bird, you can infer that waxwings can fly. One of AI's first projects was the development of a mathematical language -- much like a computer language -- in which researchers could encode assertions like "birds can fly" and "waxwings are birds." If the language was rigorous enough, computer algorithms would be able to comb through assertions written in it and calculate all the logically valid inferences. Once they'd developed such languages, AI researchers started using them to encode lots of commonsense assertions, which they stored in huge databases.

The problem with this approach is, roughly speaking, that not all birds can fly. And among birds that can't fly, there's a distinction between a robin in a cage and a robin with a broken wing, and another distinction between any kind of robin and a penguin. The mathematical languages that the early AI researchers developed were flexible enough to represent such conceptual distinctions, but writing down all the distinctions necessary for even the most rudimentary cognitive tasks proved much harder than anticipated.

Embracing uncertainty

In probabilistic AI, by contrast, a computer is fed lots of examples of something -- like pictures of birds -- and is left to infer, on its own, what those examples have in common. This approach works fairly well with concrete concepts like "bird," but it has trouble with more abstract concepts -- for example, flight, a capacity shared by birds, helicopters, kites and superheroes. You could show a probabilistic system lots of pictures of things in flight, but even if it figured out what they all had in common, it would be very likely to misidentify clouds, or the sun, or the antennas on top of buildings as instances of flight. And even flight is a concrete concept compared to, say, "grammar," or "motherhood."

As a research tool, Goodman has developed a computer programming language called Church -- after the great American logician Alonzo Church -- that, like the early AI languages, includes rules of inference. But those rules are probabilistic. Told that the cassowary is a bird, a program written in Church might conclude that cassowaries can probably fly. But if the program was then told that cassowaries can weigh almost 200 pounds, it might revise its initial probability estimate, concluding that, actually, cassowaries probably can't fly.

"With probabilistic reasoning, you get all that structure for free," Goodman says. A Church program that has never encountered a flightless bird might, initially, set the probability that any bird can fly at 99.99 percent. But as it learns more about cassowaries -- and penguins, and caged and broken-winged robins -- it revises its probabilities accordingly. Ultimately, the probabilities represent all the conceptual distinctions that early AI researchers would have had to code by hand. But the system learns those distinctions itself, over time -- much the way humans learn new concepts and revise old ones.

"What's brilliant about this is that it allows you to build a cognitive model in a fantastically much more straightforward and transparent way than you could do before," says Nick Chater, a professor of cognitive and decision sciences at University College London. "You can imagine all the things that a human knows, and trying to list those would just be an endless task, and it might even be an infinite task. But the magic trick is saying, 'No, no, just tell me a few things,' and then the brain -- or in this case the Church system, hopefully somewhat analogous to the way the mind does it -- can churn out, using its probabilistic calculation, all the consequences and inferences. And also, when you give the system new information, it can figure out the consequences of that."

Modeling minds

Programs that use probabilistic inference seem to be able to model a wider range of human cognitive capacities than traditional cognitive models can. At the 2008 conference of the Cognitive Science Society, for instance, Goodman and Charles Kemp, who was a PhD student in BCS at the time, presented work in which they'd given human subjects a list of seven or eight employees at a fictitious company and told them which employees sent e-mail to which others. Then they gave the subjects a short list of employees at another fictitious company. Without any additional data, the subjects were asked to create a chart depicting who sent e-mail to whom at the second company.

If the e-mail patterns in the sample case formed a chain -- Alice sent mail to Bob who sent mail to Carol, all the way to, say, Henry -- the human subjects were very likely to predict that the e-mail patterns in the test case would also form a chain. If the e-mail patterns in the sample case formed a loop -- Alice sent mail to Bob who sent mail to Carol, and so on, but Henry sent mail to Alice -- the subjects predicted a loop in the test case, too.

A program that used probabilistic inference, asked to perform the same task, behaved almost exactly like a human subject, inferring chains from chains and loops from loops. But conventional cognitive models predicted totally random e-mail patterns in the test case: they were unable to extract the higher-level concepts of loops and chains. With a range of collaborators in the Department of Brain and Cognitive Sciences, Goodman has conducted similar experiments in which subjects were asked to sort stylized drawings of bugs or trees into different categories, or to make inferences that required guessing what another person was thinking. In all these cases -- several of which were also presented at the Cognitive Science Society's conference -- Church programs did a significantly better job of modeling human thought than traditional artificial-intelligence algorithms did.

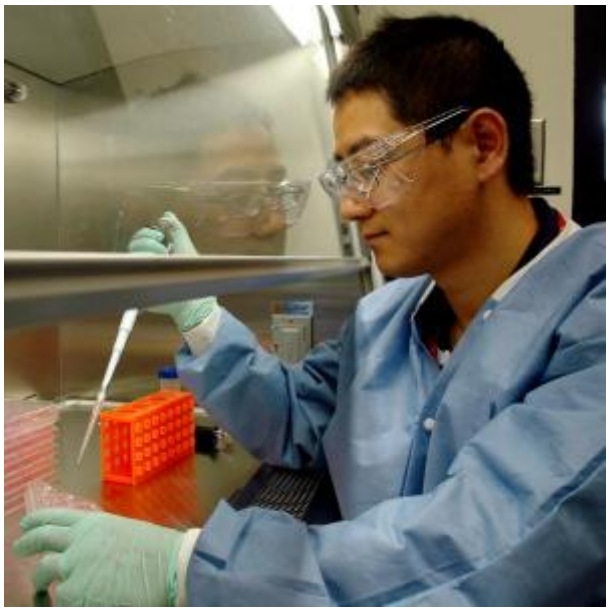
Chater cautions that, while Church programs perform well on such targeted tasks, they're currently too computationally intensive to serve as general-purpose mind simulators. "It's a serious issue if you're going to wheel it out to solve every problem under the sun," Chater says. "But it's just been built, and these things are always very poorly optimized when they've just been built." And Chater emphasizes that getting the system to work at all is an achievement in itself: "It's the kind of thing that somebody might produce as a theoretical suggestion, and you'd think, 'Wow, that's fantastically clever, but I'm sure you'll never make it run, really.' And the miracle is that it does run, and it works."

More information about the Church system can be found at:
http://projects.csail.mit.edu/church/wiki/Church

Story Source:

Adapted from materials provided by Massachusetts Institute of Technology. Original article written by Larry Hardesty, MIT News Office.
http://www.sciencedaily.com/releases/2010/03/100331221414.htm

Carbon Nanostructures: Elixir or Poison?



Los Alamos National Laboratory toxicologist Jun Gao works in his laboratory using a protective fume hood. (Credit: Photo by James R. Rickman)

ScienceDaily (Apr. 1, 2010) — A Los Alamos National Laboratory toxicologist and a multidisciplinary team of researchers have documented potential cellular damage from "fullerenes" -- soccer-ball-shaped, cage-like molecules composed of 60 carbon atoms. The team also noted that this particular type of damage might hold hope for treatment of Parkinson's disease, Alzheimer's disease, or even cancer.

The research recently appeared in *Toxicology and Applied Pharmacology* and represents the first-ever observation of this kind for spherical fullerenes, also known as buckyballs, which take their names from the late Buckminster Fuller because they resemble the geodesic dome concept that he popularized.

Engineered carbon nanoparticles, which include fullerenes, are increasing in use worldwide. Each buckyball is a skeletal cage of carbon about the size of a virus. They show potential for creating stronger, lighter structures or acting as tiny delivery mechanisms for designer drugs or antibiotics, among other uses. About four to five tons of carbon nanoparticles are manufactured annually.

"Nanomaterials are the 21st century revolution," said Los Alamos toxicologist Rashi Iyer, the principal research lead and coauthor of the paper. "We are going to have to live with them and deal with them, and the question becomes, 'How are we going to maximize our use of these materials and minimize their impact on us and the environment?'"

Iyer and lead author Jun Gao, also a Los Alamos toxicologist, exposed cultured human skin cells to several distinct types of buckyballs. The differences in the buckyballs lay in the spatial arrangement of short branches of molecules coming off of the main buckyball structure. One buckyball variation, called the "tris" configuration, had three molecular branches off the main structure on one hemisphere; another variation, called the "hexa" configuration, had six branches off the main structure in a roughly symmetrical arrangement; the last type was a plain buckyball.

The researchers found that cells exposed to the tris configuration underwent premature senescence -- what might be described as a state of suspended animation. In other words, the cells did not die as cells normally should, nor did they divide or grow. This arrest of the natural cellular life cycle after exposure to

the tris-configured buckyballs may compromise normal organ development, leading to disease within a living organism. In short, the tris buckyballs were toxic to human skin cells.

Moreover, the cells exposed to the tris arrangement caused unique molecular level responses suggesting that tris-fullerenes may potentially interfere with normal immune responses induced by viruses. The team is now pursuing research to determine if cells exposed to this form of fullerenes may be more susceptible to viral infections.

Ironically, the discovery could also lead to a novel treatment strategy for combating several debilitating diseases. In diseases like Parkinson's or Alzheimer's, nerve cells die or degenerate to a nonfunctional state. A mechanism to induce senescence in specific nerve cells could delay or eliminate onset of the diseases. Similarly, a disease like cancer, which spreads and thrives through unregulated replication of cancer cells, might be fought through induced senescence. This strategy could stop the cells from dividing and provide doctors with more time to kill the abnormal cells.

Because of the minute size of nanomaterials, the primary hazard associated with them has been potential inhalation -- similar to the concern over asbestos exposure.

"Already, from a toxicological point of view, this research is useful because it shows that if you have the choice to use a tris- or a hexa-arrangement for an application involving buckyballs, the hexa-arrangement is probably the better choice," said Iyer. "These studies may provide guidance for new nanomaterial design and development."

These results were offshoots from a study (Shreve, Wang, and Iyer) funded to understand the interactions between buckyballs and biological membranes. Los Alamos National Laboratory has taken a proactive role by initiating a nanomaterial bioassessmnet program with the intention of keeping its nanomaterial workers safe while facilitating the discovery of high-function, low-bioimpact nanomaterials with the potential to benefit national security missions. In addition to Gao and Iyer, the LANL program includes Jennifer Hollingsworth, Yi Jiang, Jian Song, Paul Welch, Hsing Lin Wang, Srinivas Iyer, and Gabriel Montaño.

Los Alamos National Laboratory researchers will continue to attempt to understand the potential effects of exposure to nanomaterials in much the same way that Los Alamos was a worldwide leader in understanding the effects of radiation during the Lab's early history. Los Alamos workers using nanomaterials will continue to follow protocols that provide the highest degree of protection from potential exposure.

Meantime, Los Alamos research into nanomaterials provides a cautionary tale for nanomaterial use, as well as early foundations for worker protection. Right now, there are no federal regulations for the use of nanomaterials. Disclosure of use by companies or individuals is voluntary. As nanomaterial use increases, understanding of their potential hazards should also increase.

Story Source:

Adapted from materials provided by DOE/Los Alamos National Laboratory.

Journal Reference:

1. Jun Gao, Hsing Lin Wang, Andrew Shreve, Rashi Iyer. **Fullerene derivatives induce premature senescence: A new toxicity paradigm or novel biomedical applications**. *Toxicology and Applied Pharmacology*, 2010; 244 (2): 130 DOI: 10.1016/j.taap.2009.12.025

http://www.sciencedaily.com/releases/2010/03/100331151146.htm

Fabled 'Vegetable Lamb' Plant Contains Potential Treatment for Osteoporosis

This illustration from an 1887 book shows the fabled "Vegetable Lamb of Tartary," a plant once believed to ripen into a baby sheep. The plant now shows promise for treating osteoporosis. (Credit: Wikimedia Commons)

ScienceDaily (Apr. 1, 2010) — The "vegetable lamb" plant -- once believed to bear fruit that ripened into a living baby sheep -- produces substances that show promise in laboratory experiments as new treatments for osteoporosis, the bone-thinning disease. That's the conclusion of a new study in ACS' monthly *Journal of Natural Products*.

Young Ho Kim and colleagues point out that osteoporosis is a global health problem, affecting up to 6 million women and 2 million men in the United States alone. Doctors know that the secret to strong bones involves a delicate balance between two types of bone cells: Osteoblasts, which build up bone, and osteoclasts, which break down bone.

Seeking potential medications that might tip the balance in favor of bone building, the researchers turned to the "vegetable lamb" plant as part of a larger study plants used in folk medicine in Vietnam. In the 16th and 17th centuries, some of the world's most celebrated scientists believed the plant (*Cibotium barmoetz*) fruited into a newly born lamb, which then grazed on nearby grass and weeds. Kim's group isolated compounds from *C. barmoetz* and showed that they blocked formation of bone-destroying osteoclasts formation in up to 97 percent of the cells in laboratory cultures without harmful effects on other cells.

The substances "could be used in the development of therapeutic targets for osteoporosis," the article notes.

Story Source:

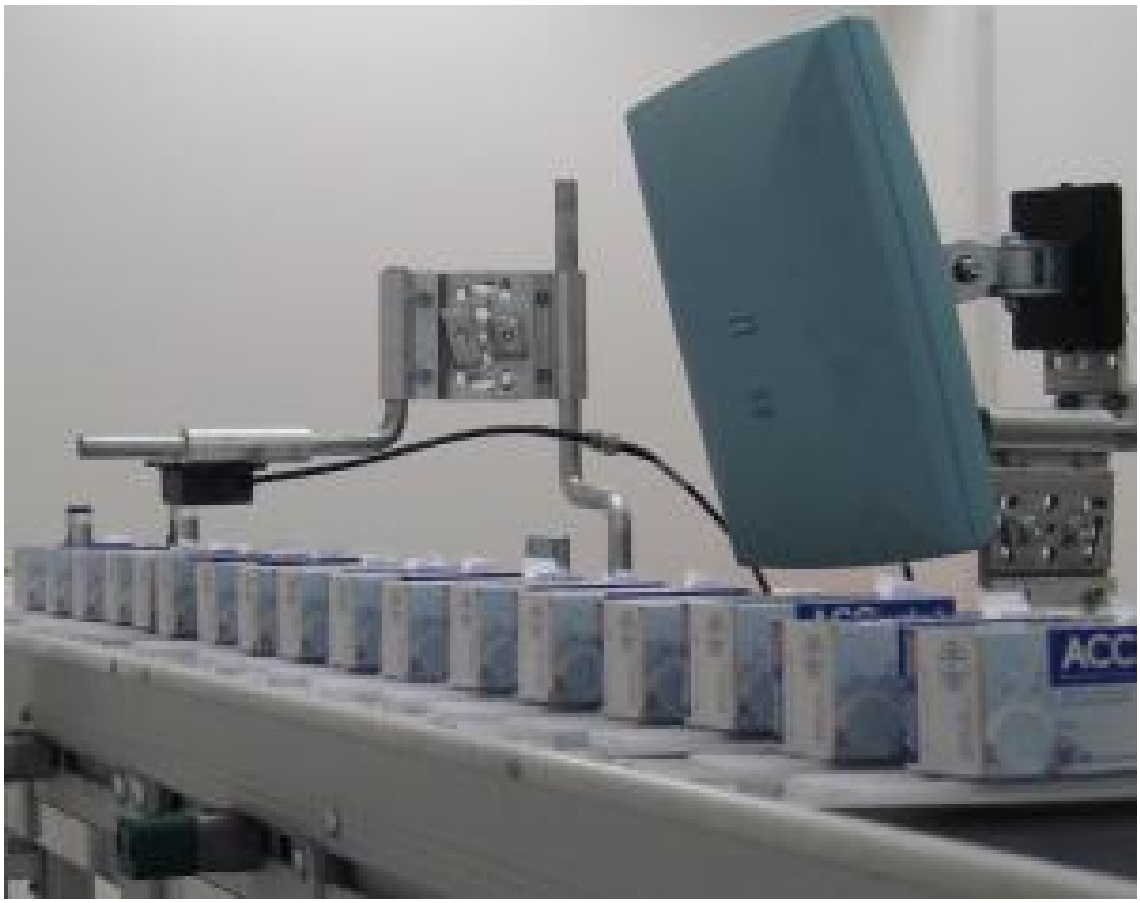
Adapted from materials provided by American Chemical Society, via EurekAlert!, a service of AAAS.

Journal Reference:

1. Nguyen Xuan Cuong, Chau Van Minh, Phan Van Kiem, Hoang Thanh Huong, Ninh Khac Ban, Nguyen Xuan Nhiem, Nguyen Huu Tung, Ji-Won Jung, Hyun-Ju Kim, Shin-Yoon Kim, Jeong Ah Kim, Young Ho Kim. **Inhibitors of Osteoclast Formation from Rhizomes ofCibotium barometz**. *Journal of Natural Products*, 2009; 72 (9): 1673 DOI: 10.1021/np9004097

http://www.sciencedaily.com/releases/2010/03/100331122652.htm

Anti-Counterfeit Drugs With Help of RFID



On the test rig it is determined, if the new pharmaceutical information system is able to reliably identify the transponders of the packaging items. (Credit: Image courtesy of University of Stuttgart)

ScienceDaily (Apr. 1, 2010) — A detailed product proof and improved security against counterfeiting pharmaceutical products become more and more important, especially nowadays when customers can order their drugs online. The legislative pressure increases primarily for reasons of patient safety, incorrect medications, and drug counterfeiting. These issues can be prohibited by absolute traceability of the drug's packaging.

Modern identification procedures such as RFID (radio frequency identification) are able to provide transparency in the pharmaceutical logistics. However, the metal packaging, like blister or tubes, that is often used complicate the identification. Scientists of the Institute of Mechanical Handling and Logistics (IFT) at the University of Stuttgart explore opportunities for a practicable and entirely detectable identification within the research project "RadioPharm."

In industrial practice of the pharmaceutical industry, especially in small and middle sized companies, RFID is rarely implemented or not at all. The main reason is the difficult technical implementation and the resulting high costs. The researchers of Stuttgart work pharmaceutical companies, pharmacies (one of which is located in Stuttgart and one which operates online), and others to be prepared for possible legislative changes in context of obligations regarding the product proof and the development of cost efficient implementation of the RFID technology. They analyze the whole supply chain of chosen drugs from manufacturer to wholesaler, up to the pharmacy, and on to the customer.

The logistics experts planned and implemented an identification system for different drug packaging. The most innovative is the tagging of transponders on item-level (incl. write and read processes), not only on case or pallet level. It was aimed to get an identification of every single transponder, despite the disturbing influences of liquids and metals. This requirement creates new challenges, especially for the RFID technology that occurs in the pharmaceutical area. The co-workers of the IFT built a test rig for multiple test scenarios as a demonstrator to proof the technical realization of the developed system.

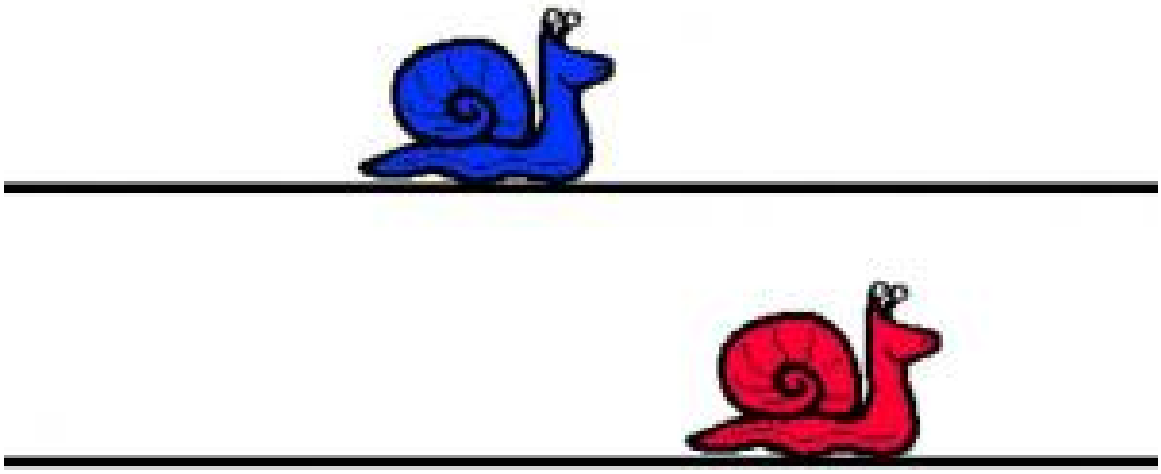
With this test rig, it can be determined if the transponders could be reliably accessed independent from the dosage form (like liquids, tablets, ointments), both for item identification and bulk identification. As a result, it is possible not only to illustrate a production line of a pharmaceutical manufacturer, but also the verification process after order picking at the wholesaler. By the use of these systems customers will have a higher security when buying drugs.

The research project RadioPharm is promoted by the German Federation of Industrial Research Associations „Otto von Guericke" e. V. (AiF) and Federal Ministry of Economics and Technology (BMWi). It is mentored by the German Logistics Academy (BVL).

Story Source:

Adapted from materials provided by University of Stuttgart, via AlphaGalileo.
http://www.sciencedaily.com/releases/2010/03/100331152648.htm

Children Use Space to Think About Time



New research shows that children use space to measure the passage of time. (Credit: Image courtesy of Max-Planck-Gesellschaft)

ScienceDaily (Apr. 1, 2010) — Space and time are intertwined in our thoughts, as they are in the physical world. For centuries, philosophers have debated exactly how these dimensions are related in the human mind. According to a paper to appear in the April, 2010 issue of *Cognitive Science*, children's ability to understand time is inseparable from their understanding of space.

To probe the relationship between space and time in the developing mind, MPI researcher Daniel Casasanto and colleagues at the Aristotle University of Thessaloniki and Stanford University showed children movies of two snails racing along parallel paths for different distances or durations. The children judged either the spatial or temporal aspect of each race, reporting which animal went for a longer distance or a longer time.

When asked to judge distance, children had no trouble ignoring time. But when asked to judge time, they had difficulty ignoring the spatial dimension of the event. Snails that moved a longer distance were mistakenly judged to have traveled for a longer time. Children use physical distance to measure of the passage of time.

Time in language and mind

When English speakers talk about time, they can hardly avoid using spatial words. They hope for *short* meetings and *long* vacations. Was children's confusion the result of using words that have both spatial and temporal meanings? Importantly, this study was conducted in Greek-speaking children. Greek tends to use a different kind of spatial vocabulary for time, describing time as accumulating in 3-dimensional space, rather than extending in linear space. In Greek, it was possible to phrase questions naturally while avoiding any ambiguous words like 'long' or 'short'.

Children's responses were not caused by superficial confusions in wording, rather they reflect deeper conceptual links between space and time.

Relativity of psychological time

If time is judged relative to space, do our minds intuitively grasp the same relationship between these dimensions found modern physics? 'Einstein posed a similar question to the child psychologist, Piaget', says Casasanto. 'But it's unlikely that our intuitions about time are shaped by something as

counterintuitive as Einstein's Relativity.' Rather, this research shows a different relationship. In the physical world, space and time are theorised to be mutually inseparable. In the mind, however, they are *asymmetrically separable*. Children can think about space independent of time, but it appears they cannot conceptualise time independent of space.

Story Source:

Adapted from materials provided by Max-Planck-Gesellschaft.

Journal Reference:

1. Daniel Casasanto, Olga Fotakopoulou, Lera Boroditsky. **Space and Time in the Child's Mind: Evidence for a Cross-Dimensional Asymmetry**. *Cognitive Science*, 2010; 34 (3): 387 DOI: 10.1111/j.1551-6709.2010.01094.x

http://www.sciencedaily.com/releases/2010/03/100331141009.htm

New eco-threat: falling population

By Rebecca Tuhus-Dubrow | March 28, 2010

In 1968, Stewart Brand founded the legendary Whole Earth Catalog, whose tagline promised simply "access to tools." Luring an audience that sought self-sufficiency, it quickly became a counterculture must-read. Though often associated with hippies, the Whole Earth crowd might be more aptly characterized as geeks. Reverential of science and suspicious of dogma, Brand helped forge a modern green ethos, centered on alternative technologies and smart design.

In the decades since, Brand has written a number of books and founded several organizations. His recent manifesto, "Whole Earth Discipline," is a lucid and provocative polemic, focusing on large-scale fixes for a planet in jeopardy. Some of his conclusions will strike many environmentalists as betrayals. But Brand sees them as outgrowths of the same pro-science pragmatism that informed his earlier work. He endorses, for example, nuclear power and genetic engineering, arguing that their potential benefits — for people and the environment — outweigh their exaggerated perils.

Another unorthodox view involves human population. As a Stanford University undergraduate, Brand studied biology with Paul Ehrlich, author of "The Population Bomb," a controversial warning that overpopulation would soon lead to mass starvation as well as ecological crisis. In 1969, Brand, alarmed, organized a "starve-in" where he and a few dozen others fasted for a week to dramatize the expected famines. Since then, agricultural and demographic changes have created a different picture. Brand and some other analysts predict a population peak at 9 billion by midcentury, followed by a decline, possibly a steep one. There is vigorous debate about projections of total population, but it is clear that fertility rates are dropping in large swaths of the world. And, surprisingly, Brand believes depopulation could be bad news for the environment. He talked to Ideas about this issue by telephone from his office, a landlocked fishing boat in Sausalito, Calif.

IDEAS: It's hard, I think, for a lot of people, especially environmentalists, to believe that overpopulation isn't a threat.

BRAND: It's a funny mix of good news and bad news. The bad news is population is continuing to increase, and the last doubling is going from a large number to a doubly large number. The good news is it's leveling off. And then the bad news is maybe it's leveling off too fast and headed down in a destructive way in certain parts of the world.

IDEAS: So now birth rates are dropping even in some developing countries?

BRAND: Yeah. And that's sort of a surprise.

IDEAS: In 1969, you staged a "starve-in" to publicize the dangers of overpopulation described in Paul Ehrlich's book. What changed in the aftermath of that?

BRAND: Paul Ehrlich did not know that at the very moment he was writing that book, Norman Borlaug was really cranking up with what became known as the Green Revolution, which was dramatically higher-yield crops....Borlaug bought the idea that professional demographers had by then, which was a thing called a demographic transition, which is that when people get a certain distance from desperate poverty, they start to have fewer children, and as they become more affluent, they have fewer children still. And the way to cut down on too many children in the world is to introduce prosperity generally....And lo and behold, that set in motion the sequence of events that then were further multiplied by the takeoff of urbanization.

IDEAS: So as people start to have fewer kids and those kids have fewer kids, you're expecting that there might be a rapid decline and that this could actually lead to a crisis at some point.

BRAND: Everybody in the world was scared of Japan economically 20 years ago. And one of the reasons they were so powerful was that they were getting the demographic bonus, which is when you start having fewer kids, the parents — or not parents after all — are a lot freer to be productive economically. So you have a youngish generation which is working like hell and not being distracted taking care of kids. And so, you get a boom....But then you pay for it later because the next generation of hard-working kids isn't there. And as the hard-working generation, that cohort, gets older, they start to move from being productive to being dependent, and there's not too many people for them to be dependent on, in the younger generation. And then you start to get a nation that looks like Florida.

And that's why I wind up being mildly pro-natal as an environmentalist, because I think when an economy's really cracked, you get in a situation where taking care of the environment — the natural infrastructure, as I call it — tends to go down the old priority list. And it sometimes falls right off it.

IDEAS: Do you think there's an ideal global population?

BRAND: You know, I don't know. Carrying capacity turns out to be so negotiable. Of hunter-gatherers, there's no way in the world to have 6.8 billion hunter-gatherers. There's not enough mushrooms [laughs]. And squirrels and wild fish. So humans change carrying capacity by inventing agriculture. They change carrying capacity by inventing cities....Anyway, I say it's negotiable because these carrying capacity issues are things that humans are affecting. Often in our favor but sometimes, like with climate change, in our disfavor.

IDEAS: So if disasters from climate change do lower carrying capacity, does that render these arguments moot? Would you still support a mildly pro-natal policy?

BRAND: That's a good question. It may well be that dealing with a lot of the issues we'll be facing, you'll want young people to do it. And so you'll need to be pro-natal enough to have some.

IDEAS: The obvious question from a green perspective is, wouldn't a big drop in population mean less impact on the environment, especially lower greenhouse gas emissions?

BRAND: It would play out not as, "Oh, look how much more paradise we've got to wander around in here," but "How is our society broken and what can we do about it?" kind of thing. So yeah, in strict terms of greenhouse gases, fewer people are better. In those terms the best thing for the world would be an all-out nuclear exchange between the US and Russia. And that's not on anybody's...[laughs] There are a few *really* misanthropic greens who would like something like that. I'm not one of them.

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The Rules About How Parents Should Make Rules

by Alix Spiegel

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In general, researchers have found that kids understand the need for some rules, particularly safety rules like not hitting other children. But when it comes to parents dictating what a child should wear or who they should play with, many kids resist.

In general, researchers have found that kids understand the need for some rules, particularly safety rules like not hitting other children. But when it comes to parents dictating what a child should wear or who they should play with, many kids resist.

The rules in 8-year-old Cameron Slaughter's house are clear: Children must do their homework when they get home from school; bedtime is 7:30; and stabbing one's brother with a pencil is not permitted.

Though Cameron, like most 8-year-olds, doesn't always execute these rules perfectly, when pressed, he does say that he appreciates them. They keep you safe, he explains, so they are good.

But if you linger too long on the topic of rules, you will eventually find that there are some rules that Cameron doesn't think are fair or worthwhile — rules he thinks it might be OK to disobey. For example, he doesn't think that it would be OK for his mother to regulate his personal relationships — the kids he likes and spends time with. "I can pick my own friends," he says with a nod.

According to Larry Nucci, a research psychologist at the Institute of Human Development at the University of California, Berkeley, Cameron's position on rules is typical. Nucci believes that if you look closely at which rules children obey and which they reject, there are clear patterns to be found.

Kids Pick And Choose Which Rules To Obey

"Kids don't just resist parents across the board," Nucci says. "It isn't the situation where kids are just driven by their impulses, and they simply reject all the rules that parents have."

Instead, Nucci argues, rules can be broken down into four distinct categories.

Even though Cameron doesn't always follow the rules perfectly, he says he understands why rules are important for safety.

There are moral rules: Don't hit, do share. There are safety rules: Don't cross the street alone, don't run with scissors. There are rules of social convention: You must say "sir" and "madam."

"And then there is this fourth category, which has to do with what children consider to be their own business and that they consider to be private," says Nucci. "Friendships, playmates, who they want to play with, who they want to be around. Some leisure time activities like what sport they want to do or toys they want to play with. And some ways in which you express yourself through your appearance — clothing, for example."

And it is this fourth category, Nucci argues, in which the vast majority of conflicts between parents and children occur.

"Kids don't argue at all with parents — or very little argument with parents — when parents come up with reasonable safety rules or rules about not stealing from other children or not hitting other kids," says Nucci. "Virtually all of the conflicts that parents are having with kids are over these personal areas."

Seeking Some Autonomy

In fact, Nucci says that in observational studies — studies in which researchers go into a home environment and code the interactions between parents and their children — children seem to resist moral rules only about 10 percent of the time; 70 percent of their resistance is in areas that they perceive to fall within their personal domain, Nucci says.

Now this is a little tricky, because it turns out that children and parents don't always see eye to eye about what constitutes personal business.

Nucci offers the example of bathing.

"The kids see it as: 'It's my body, it's my life, I'm happy how I am, I don't want to take a bath.' And mom is saying, 'No, it's unhealthy, and you're smelly, and you need to take a bath,' " he says.

"What the kid is doing is arguing for an area of discretion and autonomy. And the mother is arguing, 'No, this is part of the general conventions of the family.' "

Nucci says researchers have found that these kinds of conflicts over control of personal domain take place in every culture. And, in fact, Nucci believes that it's important for parents to respect a child's personal domain, because it's ultimately important to psychological well-being.

"What we find is that it's tied into requirements that people have for a sense of self and psychological integrity," he says.

Nucci points to cross-cultural studies of adolescents: "We know that when parents over-intrude, when they start controlling things that are really, truly personal — like keeping your diary private and [other] aspects of your self-expression — that kids even in rural China self-report depression."

Control Vs. Perception Of Control

But the idea that parents shouldn't intrude with rules regarding certain areas of children's lives isn't universally shared by child psychologists.

"It's not what you shouldn't intervene on — it's all about the how," says Alan Kazdin, director of the Yale Parenting Center.

Kazdin doesn't believe that there are just spheres of life where children must have autonomy. He says that if parents are looking for compliance, the primary thing is to frame rules properly and not approach children in an authoritarian mode, because that tends to set off oppositional behavior.

"When you want a child to do something, no matter what the rule domain, what the research shows is that it's the tone of voice in the making of your request, and whether you include choice in there," says Kazdin.

"So if you say to your 4-year-old child, 'We're going outside! Put on your red coat! It's cold out!' You gave the child an ultimatum kind of thinking that is likely to lead to oppositional behavior," he says.

"If you say the same thing: 'We're going to go outside. Please put on your red coat or green jacket.' That presentation greatly increases the likelihood of compliance in any child."

One basic difference between these two approaches is this: Nucci will argue that it's important for children to actually have control over a part of their lives, while Kazdin says that it's only important for them to have the perception of control.

That's true not just for children, he says, but for all people. Parents included.

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Are We Overselling The Sunshine Vitamin?

by Richard Knox

March 29, 2010

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Vitamin D is called the "sunshine vitamin" with good reason. Sitting in the sun for 20 to 30 minutes — sans sunscreen — can produce about 10,000 units of it, according to the Vitamin D Council.

Vitamin D Council.

Dr. Cliff Rosen of Portland, Maine, knows a lot about vitamin D. It's necessary for strong bones, and Rosen is a leading bone specialist. So he was surprised recently when his wife's new physician thought she might be deficient in vitamin D.

"She's a runner. She's in great shape," Rosen says. "She drinks dairy. She gets a lot of sun exposure." Sun exposure is key for vitamin D, known as the sunshine vitamin. When skin is exposed to sun, it makes vitamin D.

Still, the doctor wanted to run a blood test to see if Rebecca Rosen had adequate vitamin D.

"So my wife said, 'Well, why do I need to have a vitamin D [test]?' And the physician said, 'Well, that's part of our measurement for wellness.' "

It's not just Rebecca's doctor, and it's not just in Portland, Maine. Increasingly, doctors all over the country are convinced that checking patients' vitamin D levels is as important as monitoring their cholesterol.

A Surge In Attention

Medicare payments for vitamin D testing, at $40 a pop, nearly quadrupled between 2006 and 2008, to $129 million. A decade ago, Medicare payments were only about $1 million. The figures for 2009 and this year are bound to be higher.

"There's overwhelming evidence ... that increasing your vitamin D intake can make substantial improvement in your overall health and welfare," says Dr. Michael Holick of Boston University. "And

there is no downside to increasing your vitamin D intake. As a result I think that most people are now getting on the bandwagon."

Holick is leading the band. Forty years ago, he discovered the active form of the vitamin, 1,25-dihydroxyvitamin D. He has written several popular books on the subject and has another one, *The Vitamin D Solution*, coming out next month. Its cover calls vitamin D deficiency "our most common health problem."

"In my opinion, everybody should be taking either a vitamin D supplement, take a prescription that the doctor recommends," Holick says. "All adults should be taking at least 1,000 to 1,500 international units a day." Dietary intake, mainly through sources such as vitamin D-fortified dairy products and juice, may add up to 200 to 400 units a day.

Holick is convinced that if people boost their vitamin D levels, they'll be substantially less likely to develop not only osteoporosis but also many types of cancer, heart attack, diabetes (both types), autoimmune diseases such as multiple sclerosis and rheumatoid arthritis, Alzheimer's, autism, even tuberculosis and the flu.

Not so fast, other experts say.

A Tricky Thing To Measure

Dr. JoAnn Manson, chief of preventive medicine at Harvard-affiliated Brigham and Women's Hospital, points out that nearly all of the proliferating studies involving vitamin D are what scientists call "observational." That is, they compare people with high and low levels of vitamin D and correlate those levels with whether or not the person has a disease.

But these studies, she points out, are fraught with possible error. People with higher vitamin D levels may be healthier because they exercise more, have better diets, are out in the sun more. Those who are sick may have low levels because they don't have those healthy habits.

"We don't yet have the large-scale, randomized clinical trials showing benefits in terms of prevention of cardiovascular disease, cancer, diabetes, hypertension, cognitive decline, depression, autoimmune disease," Manson says.

Manson and her colleagues are launching such a trial. The National Institutes of Health is devoting $22 million for a five-year study. Twenty-thousand people across the country will be randomly assigned to take daily doses of vitamin D, omega-3 fatty acid — also linked in many studies to lower levels of heart disease — together or alone. Others will be assigned to take inert placebo pills. Neither study subjects nor investigators will know until the end which regimen they are on.

'Promising But Not Yet Proven'

Manson says she thinks there is promising evidence that vitamin D supplements may protect against heart disease and perhaps some cancers. The evidence is strongest for colorectal cancer, she says. The fact that the government is funding the study is an indicator that the idea has traction.

Until those results are in, Manson advises patients and doctors to view vitamin D claims as "promising but not yet proven."

"We need to keep in mind the lessons of history," she says. "It was believed that megadoses of vitamin E, beta-carotene, selenium, folic acid and the B vitamins would confer a large array of health benefits. And in fact, the trials were very disappointing for all those nutrients."

In the case of beta-carotene, scientists were surprised to find that when the results of randomized trials were in, those taking the supplement actually had a higher risk of lung cancer.

Holick and others say there is little or no downside to ingesting even high levels of vitamin D.

"I've been treating patients with 50,000 units of vitamin D once a week for eight weeks followed by 50,00 every other week for over a decade, and I've not seen any untoward toxicity," Holick says.

He says he has seen dramatic results in patients he has treated with vitamin D supplements for disorders such as fibromyalgia, involving generalized muscular aches and pains, and multiple sclerosis. He is convinced that the vitamin D supplements lower patients' risk of cancer and heart disease, although he acknowledges that's harder to show.

How Much Is Enough?

Holick himself takes 3,000 international units of vitamin D every day.

Set by the National Institute of Medicine in 1997, the current recommended intake is 400 units a day for adults ages 50 to 70, and 200 units a day for younger adults. The American Academy of Pediatrics currently recommends 400 units a day for infants.

The recommendations may change soon. An Institute of Medicine panel is working on a vitamin D update, which may come out this summer. The panel may raise the Dietary Reference Intake, which has replaced the old Recommended Dietary Allowance. But the group is not expected to embrace the newer claims being made for vitamin D supplementation.

The Institute of Medicine panel has a difficult task. "We don't know exactly where to draw the line in terms of calling someone deficient in vitamin D," says Manson, who is a member of the committee, as is Rosen, the Maine bone specialist.

Meanwhile, an increasing number of patients are getting their vitamin D levels tested, and more are being told they need to take supplements.

"I've been surprised at the number of patients who are significantly vitamin D deficient," says Dr. Elizabeth Ross, a cardiologist in Washington, D.C., who has been testing patients routinely for the past year. "Whether or not we'll affect the incidence of cardiovascular disease or other diseases remains to be seen. But it appears to be a relatively benign intervention, and we may be benefiting people."

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For Hoarders, The Mess Begins In The Mind

by Patti Neighmond

April 5, 2010

Grap/Wikimedia Commons

Many people with a hoarding anxiety disorder need to take baby steps in order to cope with organization — like cleaning a bit at a time, rather than getting rid of everything at once.

April 5, 2010

We've all seen the TV shows and heard the stories: people who collect so much stuff they can hardly move in their own home. Some even sleep in the car or yard because their homes are so crammed.

Researchers now believe these people have always been hoarders, and that compulsive hoarding is an anxiety disorder that gets worse with time. Frequently, the problem first emerges in childhood or adolescence. But people often aren't "found out" until they're older, often when their homes present fire hazards or neighbors complain. Unfortunately, there aren't any proven treatments to help them.

Therapy Aims To Cut The Hoarding Habit

At the University of California, San Diego Department of Psychiatry, psychologist Catherine Ayers specializes in anxiety disorders and late-life hoarding. She's researching treatments for older hoarders. Right now, she's using a form of behavior therapy and cognitive remediation that focuses on building concrete skills.

Ayers says classic cognitive behavior therapy (CBT) — therapy based on the idea that our thoughts cause our feelings and behaviors — doesn't work well with older adults who hoard. In large part, that's because CBT relies on abstract thinking, which can be difficult for seniors, especially those with certain mental deficits. So in therapy, Ayers focuses on concrete skill building. "We're teaching people how to plan, how to prioritize, how to do basic to-do lists, how to use a calendar, do problem solving," she says.

Armed with these new organizational skills, Ayers hopes her patients will be better able to tackle treatment for their hoarding disorder, which, of course, requires an ability to prioritize, problem solve and, ultimately, make decisions about whether to discard an item.

Ayers practices these organizational skills with patients in therapy over and over again. She helps her patients ask appropriate questions about the practical value and utility of various items. By repeatedly discussing how to sort through items, Ayers says, patients not only learn decision-making skills about items they hoard, they also learn how to tolerate the distress of getting rid of them.

Keeping Memories, Not Things

One of Ayers' patients, Cheryl Sherrell, 65, says one of her biggest challenges was a white, fake fur jacket. It was way too small, and she hadn't worn it for maybe 30 years.

Through the process of questioning why she values it and keeps it, Sherrell realized it was not the coat itself, but the memory of being a young mother with babies and toddlers. "I loved being a mom," she says. "I loved having kids home."

But with her children grown, Sherrell learned how to keep memories without keeping the coat. "I did realize that I can keep those memories with pictures," she says, and the coat was therefore relegated to the discard box. Sherrell is proud of her decision, in large part because it was "her choice."

And "choice" is the operative word here. Sherrell says she couldn't just let someone else organize for her and throw out her stuff. "One of the things that I knew intuitively but didn't really understand until it was taught to me here, is that I have to be in control. I can't just let people come in and take over. My anxiety just goes off the wall," Sherrell says.

'Baby Steps' Toward Organization

Emily Saltz is a geriatric social worker in Boston who had a client who was cited by the health department because her condo was dangerously packed with stuff. The condo cleaned out under legal supervision, but within six months, the condo was filled up again.

"And now, a year later, I've been called in because again the health department is involved," says Saltz. "Condemnation is near, and the apartment is absolutely floor-to-ceiling bags, belongings, clutter, junk, bottles and food. And the client herself is actually sleeping in her car somewhere because she can no longer fit into her unit."

When patients are resistant to treatment, Saltz says there are things that can be done to help. She describes harm reduction techniques, where patients agree to some minor changes such as putting all of their stuff in one room and closing the door, or clearing narrow pathways through the clutter to allow access to the kitchen or the living room couch. "Baby steps," says Saltz, "as opposed to we're getting rid of everything! We're gonna make this place safe again!" Drastic overhauls, she says, just don't work.

Sherrell, for one, says her home now looks "normal." But most importantly, Sherrell says she has her life back. She now feels comfortable welcoming her children and grandchildren to her home.

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Seeking Emotional Clues Without Facial Cues

By BENEDICT CAREY

MEDFORD, Mass. — The woman was afraid and alone, a fragile soul in a wheelchair who had managed to stuff a few possessions into a plastic garbage bag before being evacuated.

Like many of the Hurricane Katrina refugees who straggled into Baton Rouge, La., in the summer of 2005, she needed more than food and shelter. She needed company, sympathy — someone, anyone, to see and feel her loss — and searched the face of her assigned social worker in vain.

But the social worker, barely out of college, seemed somehow emotionally removed. Something was missing.

“I could see the breakdown in the emotional connection between us, could see it happening and there was nothing I could do,” said Kathleen Bogart, 28, the social worker who is now a psychology researcher at Tufts University here. Ms. Bogart has Moebius syndrome, a rare congenital condition named for a 19th-century neurologist that causes facial paralysis.

When the people she helped made a sad expression, she continued, “I wasn’t able to return it. I tried to do so with words and tone of voice, but it was no use. Stripped of the facial expression, the emotion just dies there, unshared. It just dies.”

Researchers have long known that facial expressions are crucial to social interaction and have categorized them in great detail. They know which expressions are universal; they can distinguish slight differences in expression, for example between a polite smile and a genuine one.

Still, a central question remains: How does the brain interpret others’ expressions so quickly and accurately? The answer is likely to be enormously important, experts say, both for understanding how social interactions can go smoothly and how they can go off track.

Studies so far point to what psychologists call facial mimicry. During a social exchange, people subconsciously mirror each other’s surprise, disgust or delight — and, in effect, interpret the emotion by sensing what’s embodied on their own face. Interfere with the ability to mimic, these studies suggest, and people are less adept at reading others’ expressions.

But what if a person cannot mimic any expressions, at all?

In a new study, the largest to date of Moebius syndrome, Ms. Bogart and David Matsumoto, a psychologist at San Francisco State, found that people with the disorder, whatever their social struggles, had no trouble at all recognizing others' expressions. They do just as well as anyone else in identifying emotions in photographed faces, despite having no way to mimic.

The findings strongly suggest that the brain has other systems to recognize facial expressions, and that people with facial paralysis learn to take advantage of those. "It seems likely they would develop compensatory strategies in response to the long-term impairment," said Tanya Chartrand, a psychologist at Duke University who is not involved in the Moebius Syndrome study, in an e-mail message. "Ones that don't rely on the mimicry process and allow them to understand emotion through a different route."

If such strategies are teachable, experts say, they could help others with social awkwardness, whether because of anxiety, developmental problems like autism, or common causes of partial paralysis, like Bell's palsy.

"I had no special interest in studying facial paralysis, even though I had it; there were many other things I could have done," Ms. Bogart said, in her office at Tufts. "But in college I looked to see what psychologists had to say about it, and there was nothing. Very, very little on facial paralysis at all. And I was just — well, I was angry."

The emotion tightened her fist, straightened her frame and ran up into her eyes, bypassing her face: "Angry. I thought, I might as well do it because certainly no one else is."

Moebius syndrome has no known cause; it strikes less than one in 100,000 children at birth, resulting in total, or nearly total, facial paralysis. In most cases the eyes don't blink, and the irises move only up and down, robbing people of sideways glances and an entire vocabulary of gazes, squints and eye-rolls. The taunts tend to start early in childhood and pile up, and no one can see the embarrassment or pain in the target. "Like having a deformity and not being able to communicate, all in one," Ms. Bogart said.

Most people with the condition adapt. "Just like for blind people, whose senses of touch, smell, hearing become sharper," Dr. Matsumoto said. "Same thing here, I think, only it's in the domain of nonverbal communication."

In the first of two studies, Ms. Bogart and Dr. Matsumoto had 36 people with Moebius syndrome look at 42 standardized photographs online of expressions, like anger, happiness and sadness. The participants correctly identified the emotions about three-quarters of the time — the same rate as adults without the condition. Their level of impairment was not related to their score.

The results do not imply that socializing is easy or natural for people with such paralysis; most do struggle, Ms. Bogart and Dr. Matusmoto found in a follow-up study. The main reason for this (beyond the immobile features, which distract some people) has little to do with a deficit in recognizing emotions in others, the studies suggest.

It most likely comes back to mimicry, or the lack thereof. In a series of studies, psychologists have found that social bonding between conversation partners is highly dependent on a rhythmic and usually subconscious give and take of gestures and expressions that creates a kind of shared good will. "Part of that could be the buying in on the interaction itself," Dr. Chartrand said.

If the timing is not just right — the Moebius study did not account for timing — then the buy-in can feel uncertain, and interaction fizzles. The way that many people with complete, or near complete, paralysis overcome this problem is by relying on channels other than the face: eye contact, hand gestures, posture

and voice tone. Many people with paralysis can make that expressive instrument as subtle and potent as a string section.

“I found my voice, figuratively and literally, in speech therapy,” said Matthew S. Joffe, the director of student services at LaGuardia Community College and a therapist in private practice, who has Moebius syndrome. Dr. Joffe described his paralysis as pronounced, “with a mouth that hangs open, and a lower lip that protrudes downward.”

“I use humor a lot,” he said. “It’s a way of showing my humanity, for one thing, and over the years people have said I have a great laugh. And I’m old enough now — I can agree. I laugh from the innards of my belly, I have many different laughs for different occasions, each one looks distinct in my body. I learned pretty early on that, given the fairly harsh standards society imposes, that if I didn’t laugh at stuff I would probably just collapse.”

Ms. Bogart, too, has a distinctive laugh. Her jaw drops,, her lips stretch and lift slightly, and her entire torso shakes. The need to rely on these peripheral channels makes people with paralysis especially sensitive to such cues in others. “At a party, I feel like I can tell whether someone will be worth talking to within seconds,” she said. “I can read people’s comfort level, or whether they can work through discomfort, very quickly.”

Taken together, some psychologists say, the evidence from people with paralysis and those without it suggests that the brain is tuning into several channels at once when it reads others’ emotional vibes. Mimicry is surely one — but it needs help.

In an experiment published last year, Dutch researchers had 46 students at Leiden University pair off for a three-minute interaction with a fellow student who was either lying or telling the truth about a donation to charity. Those students told not to mimic the expressions of their conversation partner were significantly better at determining who was telling the truth than students told to mimic, or given no instructions. “Mimicry, whether spontaneous or the product of instruction, hinders observers in objectively assessing” people’s true feelings.

The gestures and tones that people with paralysis are so adept at using add more information. “And we think there may be other systems as well, in pre-motor areas of the brain, that are compiling all of this information” so that the cortex can make a judgment on the emotion, Dr. Matsumoto said.

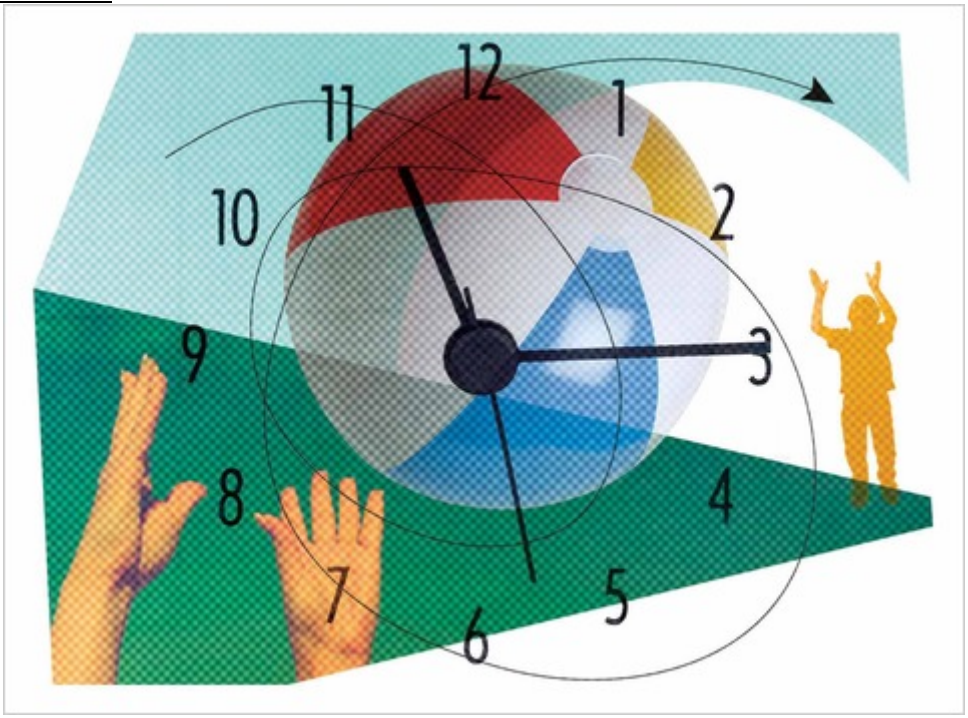
In her current research project, Ms. Bogart is videotaping dozens of social interactions with people with all variety of paralysis, not just Moebius, but Bell’s palsy, which often stills half the face, and nerve injuries.

“The plan is to show the interviews to people to see what their impressions are, to tease apart all the elements of face, voice, gestures to see what is perceived by people as positive or negative,” she said. “The idea is that if we could learn what the best nonverbal communication techniques are, we could teach those to people who are socially awkward for any reason.”

http://www.nytimes.com/2010/04/06/health/06mind.html?nl=health&emc=healthupdateema1

Surprisingly, Family Time Has Grown

By TARA PARKER-POPE



Stuart Bradford

Working parents perpetually agonize that they don't see enough of their children. But a surprising new study finds that mothers and fathers alike are doing a better job than they think, spending far more time with their families than did parents of earlier generations.

The study, by two economists at the University of California, San Diego, analyzes a dozen surveys of how Americans say they use their time, taken at different periods from 1965 to 2007. It reports that the amount of child care time spent by parents at all income levels — and especially those with a college education — has risen "dramatically" since the mid-1990s. (The findings by the husband-and-wife economist team of Garey Ramey and Valerie A. Ramey appear in a discussion paper presented in March at a Brookings Institution conference in Washington.)

Before 1995, mothers spent an average of about 12 hours a week attending to the needs of their children. By 2007, that number had risen to 21.2 hours a week for college-educated women and 15.9 hours for those with less education.

Although mothers still do most of the parenting, fathers also registered striking gains: to 9.6 hours a week for college-educated men, more than double the pre-1995 rate of 4.5 hours; and to 6.8 hours for other men, up from 3.7, according to an additional analysis by Betsey Stevenson and Dan Sacks, economists at the Wharton School of the University of Pennsylvania.

Family researchers say the news should offer relief to guilt-stricken working parents.

"Parents are feeling like they don't have enough time with their children," said Ellen Galinsky, president of the Families and Work Institute in New York, which conducts research on the work force. "It's a function of people working so hard, and they are worried they're shortchanging their children. I've never found a group of parents who believe they are spending enough time with their kids."

Although previous studies have shown increases in parenting time starting in the 1990s, the study by the Rameys is important because it links so many time-use surveys and also breaks the data down by age of the child and education level.

The rise in child-centered time is just one of the ways the American family is changing. Couples are typically waiting longer to get married and begin having children. Divorce rates are dropping with each generation.

And notably, children are no longer so widely viewed as essential to a happy marriage. In 1990, 65 percent of Americans said that children were “very important” to a successful marriage, but by 2007, the number of adults who agreed with that statement had dropped to 41 percent, according to a survey by the Pew Research Center.

In fact, the surge in parenting time may say more about modern marriage than about modern child care practices, Dr. Stevenson said. She notes that among college-educated parents, two- to two-and-a-half hours of the increased time takes place when both parents are together. “Everybody gets in the car,” she said, “and mom and dad both cheer on the kid.”

That may reflect a rise in what Dr. Stevenson calls the “hedonic marriage,” in which couples share home and work responsibilities so they can spend more time together.

By contrast, couples from earlier generations typically had “specialized” roles that tended to keep them apart — the husband working at a job to support the family, the wife staying home to raise the children.

“We’re seeing a rise in marriages where we’re picking people we like to do activities with,” Dr. Stevenson said. “So it’s not surprising we’re going to see that some of the activities we want do together involve our children.”

So where is the extra time coming from? Women, in particular, are spending less time cooking and cleaning their homes, while men are putting in fewer hours at the office. A 2007 report in The Quarterly Journal of Economics showed that leisure time among men and women surged four to eight hours a week from 1965 to 2003.

Notably, the data in the Ramey study do not count the hours mothers and fathers spend “around” their children — at the dinner table, for example, or in solitary play. Instead, the survey tracks specific activities in which the parent is directly involved in the child’s care.

“It’s taking them to school, helping with homework, bathing them, playing catch with them in the back yard,” said a co-author of the leisure-time paper, Erik Hurst, an economist at the University of Chicago Booth School of Business. “Those are the activities that have increased over the last 15 to 20 years.”

Dr. Galinsky notes that although working parents typically feel guilty for not spending more time at home, children often have a different reaction. In a landmark study published as “Ask the Children” (Harper, 2000), she asked more than 1,000 children about their “one wish” for their parents. Although parents expected their children would wish for more family time, the children wanted something different.

“Kids were more likely to wish that their parents were less tired and less stressed,” Dr. Galinsky said.

http://well.blogs.nytimes.com/2010/04/05/surprisingly-family-time-has-grown/?nl=health&emc=healthupdateema1

Pregnancy exercise 'slims babies'

Light exercise during pregnancy may improve the future health of a child by controlling weight in the womb, New Zealand and US researchers say.

Overweight or obese mums are more likely to have larger babies which could be at higher risk of health problems later in life.

A study of 84 first-time mothers found exercise was associated with slightly lighter babies.

UK guidelines recommend regular light exercise for pregnant women.

" **Given that large birth size is associated with increased risk of obesity, a modest reduction in birth weight may have long-term health benefits for offspring by lowering this risk later in life** "
Dr Paul Hofman, University of Auckland

The rising weight of the UK population over the years has led to a rise in the number of overweight mothers.

There is increasing evidence that the future metabolism of a child may be influenced by its environment in the womb, and that babies who are relatively heavy for their length may be more likely to be obese in future years.

Official guidance in the UK tells doctors to encourage women not to overeat during pregnancy, and to, wherever possible, take light exercise on a regular basis.

The joint study between the University of Auckland and Northern Arizona University recruited pregnant women, half of whom were asked to use exercise bikes for five 40 minute sessions each week.

They were asked to maintain the programme until at least the 36th week of pregnancy.

Extra fat

On average, the exercising women had babies who were no shorter than their non-exercising counterparts, but who were 0.32 lb (143 grams) lighter on average.

This suggested that the regime did not stunt growth in the womb, but reduced the amount of extra fat laid down by the babies.

In addition, the exercise did not appear to interfere with the natural changes in the mother's response to the hormone insulin, a necessary mechanism in pregnancy to make sure the foetus is properly nourished.

The findings are published in the Journal of Clinical Endocrinology & Metabolism.

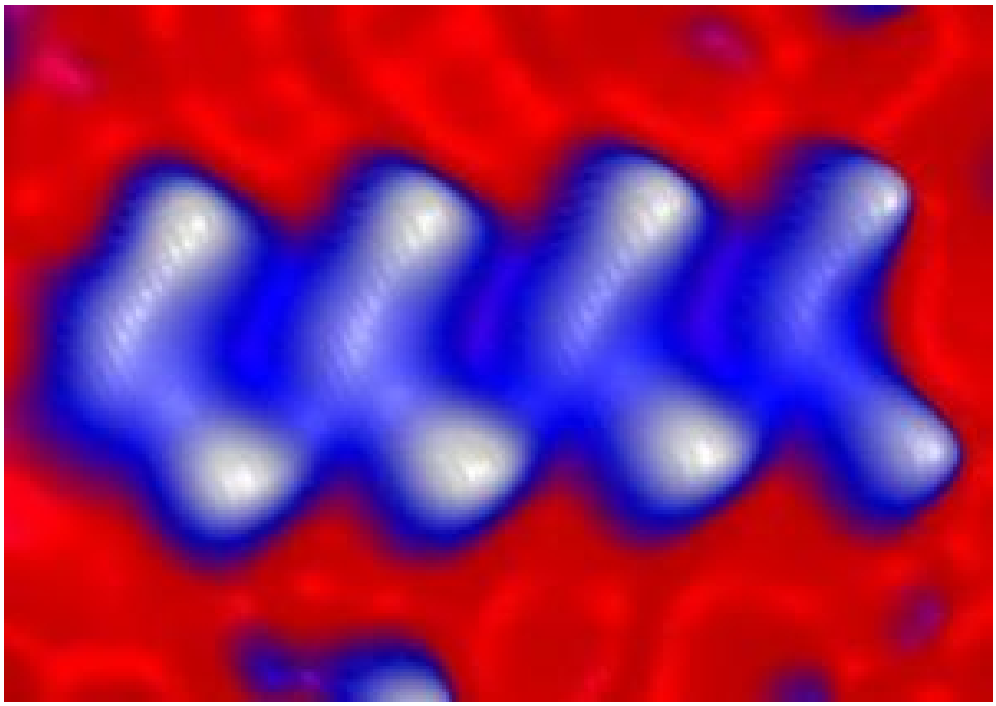
Dr Paul Hofman, who led the study, said: "Given that large birth size is associated with increased risk of obesity, a modest reduction in birth weight may have long-term health benefits for offspring by lowering this risk later in life."

Dr Anne Dornhorst, who specialises in research into the metabolism of pregnant women, said that it was becoming clear that exercise during pregnancy could aid the health of mother and child.

Story from BBC NEWS:
http://news.bbc.co.uk/go/pr/fr/-/2/hi/health/8599793.stm

Published: 2010/04/05 11:17:07 GMT

World's Smallest Superconductor Developed: Sheet of Four Pairs of Molecules Less Than One Nanometer Wide



This image shows the smallest superconductor, which is only .87 nanometer wide. (Credit: Image courtesy of Saw-Wai Hla and Kendal Clark, Ohio University)

ScienceDaily (Mar. 30, 2010) — Scientists have discovered the world's smallest superconductor, a sheet of four pairs of molecules less than one nanometer wide. The Ohio University-led study, published March 29 as an advance online publication in the journal *Nature Nanotechnology*, provides the first evidence that nanoscale molecular superconducting wires can be fabricated, which could be used for nanoscale electronic devices and energy applications.

"Researchers have said that it's almost impossible to make nanoscale interconnects using metallic conductors because the resistance increases as the size of wire becomes smaller. The nanowires become so hot that they can melt and destruct. That issue, Joule heating, has been a major barrier for making nanoscale devices a reality," said lead author Saw-Wai Hla, an associate professor of physics and astronomy with Ohio University's Nanoscale and Quantum Phenomena Institute.

Superconducting materials have an electrical resistance of zero, and so can carry large electrical currents without power dissipation or heat generation. Superconductivity was first discovered in 1911, and until recently, was considered a macroscopic phenomenon. The current finding suggests, however, that it exists at the molecular scale, which opens up a novel route for studying this phenomenon, Hla said. Superconductors currently are used in applications ranging from supercomputers to brain imaging devices.

In the new study, which was funded by the U.S. Department of Energy, Hla's team examined synthesized molecules of a type of organic salt, (BETS)2-GaCl4, placed on a surface of silver. Using scanning tunneling spectroscopy, the scientists observed superconductivity in molecular chains of various lengths. For chains below 50 nanometers in length, superconductivity decreased as the chains became shorter. However, the researchers were still able to observe the phenomenon in chains as small as four pairs of molecules, or 3.5 nanometers in length.

To observe superconductivity at this scale, the scientists needed to cool the molecules to a temperature of 10 Kelvin. Warmer temperatures reduced the activity. In future studies, scientists can test different types of materials that might be able to form nanoscale superconducting wires at higher temperatures, Hla said.

"But we've opened up a new way to understand this phenomenon, which could lead to new materials that could be engineered to work at higher temperatures," he said.

The study also is noteworthy for providing evidence that superconducting organic salts can grow on a substrate material.

"This is also vital if one wants to fabricate nanoscale electronic circuits using organic molecules," Hla added.

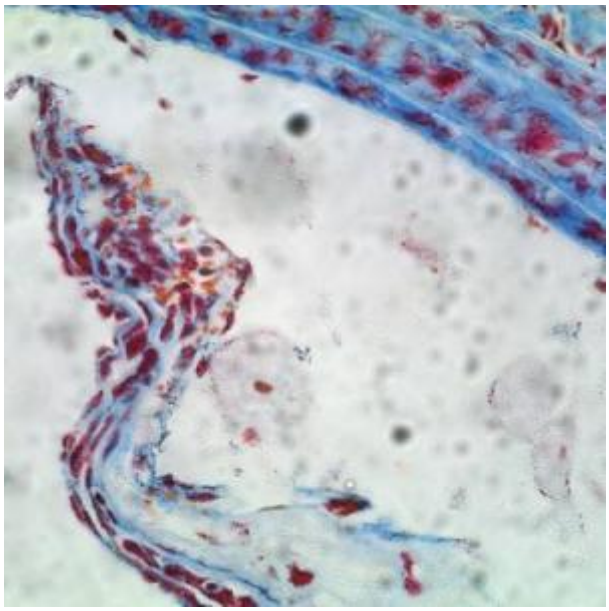
Collaborators on the paper include Kandal Clark, a doctoral student in the Russ College of Engineering and Technology at Ohio University; Sajida Khan, a graduate student in the Department of Physics and Astronomy at Ohio University; Abdou Hassanien, a researcher with the Nanotechnology Research Institute, Advanced Industrial Science and Technology (AIST) and the Japan Science and Technology Agency's Core Research of Evolutional Science & Technology (JST-CREST) in Japan who conducted the work as a visiting scientist at Ohio University; Hisashi Tanaka, a scientist at AIST and JST-CREST who synthesized the molecules; and Kai-Felix Braun, a scientist with the Physikalisch Technische Bundesanstalt in Braunschweig, Germany, who conducted the calculations at the Ohio Supercomputing Center.

Story Source:

Adapted from materials provided by Ohio University. Original article written by Andrea Gibson.

http://www.sciencedaily.com/releases/2010/03/100329112151.htm

Dangerous Plaques in Blood Vessels Rupture by Overproducing Protein-Busting Enzymes



This close-up image of a ruptured plaque in the interior lining of the artery of an experimental mouse shows red cell accumulation in the plaque (left side of image) and a disrupted fibrous cap (upper left of image). (Credit: Jie Hong Hu)

ScienceDaily (Mar. 30, 2010) — University of Washington (UW) researchers have gathered evidence that dangerous plaques in blood vessels can rupture by overproducing protein-digesting enzymes. Plaques are fat-laden rough spots in the otherwise smooth walls of arteries. When a plaque ruptures, blood accumulates inside of it, a process known as plaque hemorrhage. The plaque enlarges and artery-blocking clots can form. If the flow of oxygen-rich blood is restricted, a heart attack, stroke, or damage to other organs can occur.

Most adults have some degree of plaque in their arteries. The condition, known as atherosclerosis or "hardening of the arteries," generally progresses with age. Not all plaques have a tendency to break open.

"Why plaques become unstable in certain people, and why some plaques become unstable but others plaques in the same person remain stable have been the objects of much conjecture," said Dr. David A. Dichek, the senior researcher on the study, "Some scientists have suspected that an excessive production of protein-digesting enzymes might be linked to 'vulnerable plaque' -- blood vessel lesions prone to rupture. The findings of our study offer the best cause and effect evidence to date that this is likely the case."

The study is published March 29 in *Circulation,* a scientific journal of the American Heart Association.

Dichek holds the UW Medicine John Locke, Jr. Family Endowed Chair in Cardiovascular Research and Treatment and is a professor of medicine in the Division of Cardiology. He practices general cardiology at the UW Medicine Regional Heart Center.

People start life with clean arteries. Plaques appear when white blood cells burrow into the lining of arteries and engulf harmful cholesterol and lipids. Plaques begin as fatty streaks. Fatty streaks can attract several kinds of cells, including clean-up cells called macrophages. The plaques can enlarge until their cores are filled with dead cells, fats, and other debris. UW researchers learned that, inside some advanced plaques, macrophages churn out an overload of protein-digesting enzymes.

In a mouse study, Dickek and his team transplanted bone marrow containing macrophages that overproduce a protein-digesting enzyme known as urokinase into aged, atherosclerotic mice. These macrophages accumulated in some of the plaques. Compared to atherosclerotic mice of the same age, atherosclerotic mice with macrophages in overdrive had a much greater prevalence (61 percent versus 13 percent) of hemorrhage inside the plaques as well as more disruption of the fibrous caps covering the plaques.

"These same features -- hemorrhage and cap disruption -- are associated with ruptured plaques that cause heart attacks and strokes in humans," Dichek noted.

Urokinase was already known to be abundant in ruptured human plaques.

"But automatically blaming urokinase as the culprit without experimental evidence that it destabilized otherwise stable plaques would have been like seeing bright red trucks and firefighters at every flaming building and assuming they had set the blazes," Dichek said "In fact urokinase does have a protective effect at the right place and the right time, and we use it therapeutically as a clot-buster."

The researchers also observed that the increase in urokinase upped the activity of other protein-digesting enzymes that can eat away at the structural proteins that hold a plaque together. These other enzymes can weaken the framework of the plaque and also promote the self-destruction of nearby smooth muscle cells in the artery. These enzymes belong to a large family of remodeling enzymes called matrix metalloproteinases, or MMPs. The exact form of MMP implicated in this study hasn't been determined. Like urokinase, MMPs have helpful roles, depending on the location and circumstances in the body.

Urokinase also activates a substance in blood vessels called plasminogen and turns it into plasmin, another protein-destroying enzyme. In several studies, patients whose blood tests showed a high level of plasminogen activation had an elevated risk of future heart attacks and strokes. The new mouse study, the researchers noted, helps explain this somewhat puzzling clinical finding. Their data suggests that high levels of urokinase in plaque, leading to increases in plasminogen activation, may be causally related to plaque rupture and major cardiovascular events.

An improved understanding of the underlying cellular and molecular mechanisms that cause plaques to rupture puts medical scientists in a better position to develop preventive approaches and more effective treatments for vulnerable plaque

"Our findings point to both diagnostic and therapeutic strategies," Dichek noted. "We eventually may be able to identify patients who are more at risk for heart attacks and strokes than are others. At present this is very difficult to do simply by imaging plaques. We might find ways to prevent plaque rupture in these high- risk patients and thereby prevent many life-threatening or disabling cardiovascular events."

Perhaps, he said, this would be through interventions that decrease production of protein-destroying enzymes in the artery wall or that block their activities. A caveat for this approach would be taking steps to avoid toxicity to the patient.

"On the other hand, if we discover that a specific MMP enzyme is found only this disease state, it would make an ideal treatment target," Dichek added. Other options might be transferring genes into the blood vessel wall to lessen the manufacture of protein-digesting enzymes.

"But we have quite a long way to go before developing an effective gene transfer method and making it practical," he said.

However, he added, "I hope it might eventually be possible to transform atherosclerosis into a condition that -- like grey hair -- is associated with aging, but which rarely (if ever) kills anyone. Atherosclerosis itself is a relatively low-risk condition: almost everyone over age 60 has it to some extent. Plaque rupture

is what converts it from a chronic, indolent disease to an acute, life-threatening emergency. That is why plaque rupture is an important process to understand, track and control."

In addition to Dichek, other scientists on this study, all from the UW, were Jie Hong Hu, acting instructor of medicine, Division of Cardiology; Liang Du, UW acting instructor of medicine; Talyn Chu, research scientist in cardiology; Goro Otsuka and Nagadhara Dronadula, both senior fellows in medicine and cardiology; Mia Jaffe, undergraduate student in biochemistry; Sean E. Gill, senior fellow in pulmonary and critical care medicine; and William C. Parks, professor of medicine and director of the UW Center for Lung Biology.

The study was supported by a grant from the National Heart, Lung, and Blood Institute of the National Institutes of Health, a training grant for the student researcher from the Howard Hughes Medical Institute through the Undergraduate Science Education Program, and the John L. Locke, Jr. Charitable Trust.

Story Source:

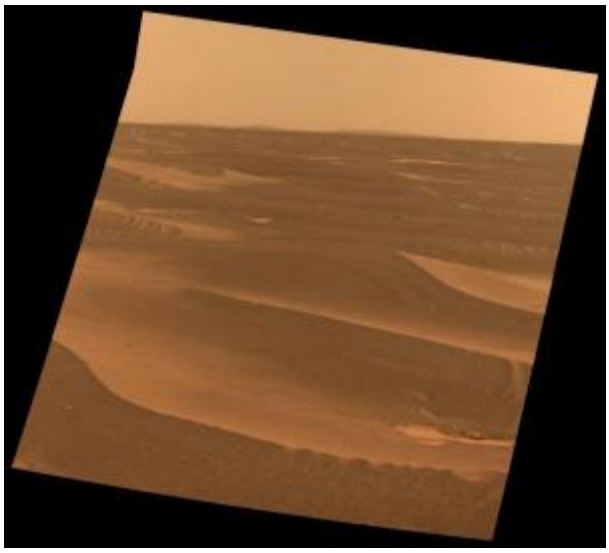
Adapted from materials provided by University of Washington.

Journal Reference:

1. Jie Hong Hu, Liang Du, Talyn Chu, Goro Otsuka, Nagadhara Dronadula, Mia Jaffe, Sean E. Gill, William C. Parks and David A. Dichek. **Overexpression of Urokinase by Plaque Macrophages Causes Histogical Features of Plaque Rupture and Increases Vascular Matrix Metalloproteinase Activity in Aged Apolipoprotein E-Null Mice**. *Circulation*, 2010; DOI: 10.1161/CIRCULATIONAHA.109.914945

http://www.sciencedaily.com/releases/2010/03/100329203543.htm

Opportunity Surpasses 20 Kilometers of Total Driving



NASA's Mars Exploration Rover used its panoramic camera to record this view of the rim of a crater about 65 kilometers (40 miles) in the distance, on the southwestern horizon. (Credit: NASA/JPL-Caltech/Cornell University)

ScienceDaily (Mar. 30, 2010) — NASA's Mars Exploration Rover Opportunity has now surpassed 20 kilometers (12.43 miles) of total driving since it landed on Mars 74 months ago.

The drive taking the rover past that total covered 67 meters (220 feet) southward as part of the rover's long-term trek toward Endeavour Crater to the southeast. It was on the 2,191st Martian day, or sol, of the mission and brought Opportunity's total odometry to 20.0433 kilometers. To reach Endeavour, the healthy but aging rover will need to drive about 12 kilometers (7.5 miles) farther.

Opportunity's mission on Mars was originally planned to last for three months with a driving-distance goal of 600 meters (less than half a mile).

Since landing, Opportunity has examined a series of craters on the plain of Meridiani, and the journey so far has covered a portion of the plain with negligible tilt. Now, the rover is approaching a portion tilting slightly southward. Recent images toward the southwest show the rim of a crater named Bopolu, about 65 kilometers (40 miles) away.

Meanwhile, Spirit, Opportunity's twin, is continuing minimal operations due to declining solar energy with the approach of winter in Mars' southern hemisphere. Spirit has been communicating on schedule once per week. It is expected to drop to a low-power hibernation mode soon that could prevent communications for weeks at a time during the next several months.

Story Source:

Adapted from materials provided by NASA/Jet Propulsion Laboratory.

http://www.sciencedaily.com/releases/2010/03/100329133016.htm

Did Climate Influence Angkor's Collapse? Evidence Suggests Changing Environment Can Bring Down a Civilization

The religious complex of Angkor Wat was center of a civilization that depended for irrigation on a vast network of canals, embankments and reservoirs. (Credit: Charles J. Sharp)

ScienceDaily (Mar. 30, 2010) — Decades of drought, interspersed with intense monsoon rains, may have helped bring about the fall of Cambodia's ancient Khmer civilization at Angkor nearly 600 years ago, according to an analysis of tree rings, archeological remains and other evidence. The study, published in the journal *Proceedings of the National Academy of Sciences*, may also shed light on what drives -- and disrupts -- the rainy season across much of Asia, which waters crops for nearly half the world's population.

Historians have offered various explanations for the fall of an empire that stretched across much of Southeast Asia between the 9th and 14th centuries, from deforestation to conflict with rival kingdoms. But the new study offers the strongest evidence yet that two severe droughts, punctuated by bouts of heavy monsoon rain, may have weakened the empire by shrinking water supplies for drinking and agriculture, and damaging Angkor's vast irrigation system, which was central to its economy. The kingdom is thought to have collapsed in 1431 after a raid by the Siamese from present-day Thailand. The carved stone temples of its religious center, Angkor Wat, are today a major tourist destination, but much of the rest of the civilization has sunk back into the landscape.

"Angkor at that time faced a number of problems -- social, political and cultural. Environmental change pushed the ancient Khmers to the limit and they weren't able to adapt," said the study's lead author, Brendan Buckley, a climate scientist and tree-ring specialist at Columbia University's Lamont-Doherty Earth Observatory. "I wouldn't say climate caused the collapse, but a 30-year drought had to have had an impact."

Scientists led by Buckley were able to reconstruct 759 years of past climate in the region surrounding Angkor by studying the annual growth rings of a cypress tree, Fokienia hodginsii, growing in the highlands of Vietnam's Bidoup Nui Ba National Park, about 700 kilometers away. By hiking high into the mountain cloud forests, the researchers were able to find rare specimens over 1,000 years old that had not been touched by loggers. After extracting tiny cores of wood showing the trees' annual growth rings, researchers reconstructed year-to-year moisture levels in this part of Southeast Asia from 1250 to 2008. The tree rings revealed evidence of a mega-drought lasting three decades -- from the 1330s to 1360s-- followed by a more severe but shorter drought from the 1400s to 1420s. Written records corroborate the latter drought, which may have been felt as far away as Sri Lanka and central China.

The droughts may have been devastating for a civilization dependent on farming and an irrigation system of reservoirs, canals and embankments sprawling across more than a thousand square kilometers. The

droughts could have led to crop failure and a rise in infectious disease, and both problems would have been exacerbated by the density of the population, Buckley says.

The study also finds that the droughts were punctuated by several extraordinarily intense rainy seasons that may have damaged Angkor's hydraulic system. During a normal monsoon season, Angkor's hydraulic network could have handled heavy downpours, but after extended droughts, the system may have been vulnerable to massive siltation and clogging, the study suggests. Layers of coarse debris and other sediments found blocking some canals appear to have been laid down suddenly. In other spots, apparently sudden erosion cut canals as much as 8 meters below the surrounding landscape, potentially destabilizing the hydraulic system. Archeologists have found additional evidence that canals were rebuilt and rerouted to cope with water shortages.

In compiling the longest tropical tree ring record to date, researchers found that the third-driest, and the driest, years in the last 760 years occurred back to back in 1402 and 1403, about three decades before Angkor's fall. The second driest was 1888, which coincided with the 1888-1889 El Niño, a cyclical warming of the tropical Pacific Ocean. By correlating known El Niño cycles measured with modern instruments, researchers have documented how the cyclical warming and cooling of the tropical Pacific Ocean brings rain to some places and drought to others. The authors of the current study and other researchers suggest that El Niño, possibly abetted by longer, decades-long cycles across the Pacific basin, may have played an important role in shutting down the monsoon rains in this region, creating withering droughts in the past. Some scientists suspect that warming of the global climate may intensify these cycles in the future, raising the possibility of alternating Angkor-like droughts and destructive floods that could affect billions of people.

Similar studies suggest that abrupt environmental changes may have pushed other ancient civilizations over the edge, including the Anasazi people of the southwestern United States; the Maya people of Central America, and the Akkadian people of Mesopotamia. There is some evidence that other once-powerful kingdoms in what is now Vietnam and Myanmar may have fallen during the late 1700s, following extreme dry and wet periods.

"Both human society and the erth's climate system are complex systems capable of unexpected behavior. Through the long-term perspective offered by climate and archaeological records, we can start to identify and understand the myriad ways they may interact," said study coauthor Kevin Anchukaitis, a tree ring scientist at Lamont. "The evidence from monsoon Asia should remind us that complex civilizations are still quite vulnerable to climate variability and change."

Story Source:

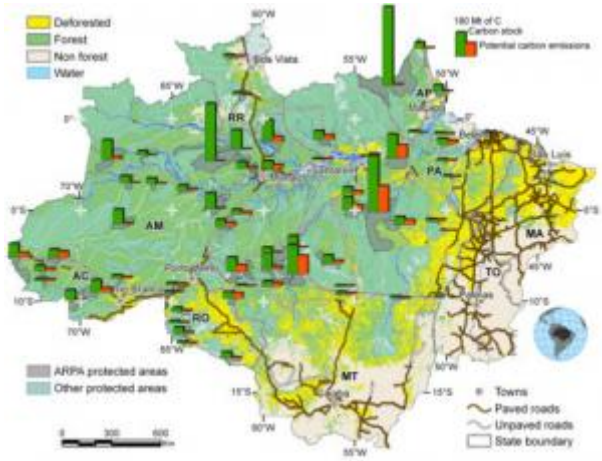
Adapted from materials provided by The Earth Institute at Columbia University.

Journal Reference:

1. Brendan M. Buckley, Kevin J. Anchukaitis, Daniel Penny, Roland Fletcher, Edward R. Cook, Masaki Sano, Le Canh Nam, Aroonrut Wichienkeeo, Ton That Minh, and Truong Mai Hong. **Climate as a contributing factor in the demise of Angkor, Cambodia**. *Proceedings of the National Academy of Sciences*, 2010; DOI: 10.1073/pnas.0910827107

http://www.sciencedaily.com/releases/2010/03/100329203547.htm

Protected Forest Areas May Be Critical Strategy for Slowing Climate Change



Map shows carbon stocks and potential emissions of selected forest protected areas in the Brazilian Amazon. (Credit: WWF)

ScienceDaily (Mar. 30, 2010) — A new study involving scientists from 13 different organizations, universities and research institutions states that forest protection offers one of the most effective, practical, and immediate strategies to combat climate change. The study was published in *PLoS Biology* and makes specific recommendations for incorporating protected areas into overall strategies to reduce emissions of greenhouse gasses from deforestation and degradation (nicknamed REDD).

"Deforestation leads to about 15 percent of the world's greenhouse gas emissions, more than all the cars, trucks, trains, ships, and planes on earth. If we fail to reduce it, we'll fail to stabilize our climate," said Taylor Ricketts, director of World Wildlife Fund's science program and lead author of the study. "Our paper emphasizes that creating and strengthening indigenous lands and other protected areas can offer an effective means to cut emissions while garnering numerous additional benefits for local people and wildlife."

The authors highlight analyses showing that since 2002, deforestation in the Brazilian Amazon has been 7 to 11 times lower inside of indigenous lands and other protected areas than elsewhere. Simulation models suggest that protected areas established between 2003 and 2007 could prevent an estimated area of 100,000 square miles of deforestation through 2050. That is roughly the size of the state of Colorado, representing enough carbon to equal 1/3 of the world's annual CO2 emissions. Within these efforts, location matters; protected areas in regions that face deforestation pressures would be most effective at truly reducing emissions.

"This study reinforces the wisdom behind global investments in protected areas," says Gustavo A.B. da Fonseca, co-author of the study and Team Leader Natural Resources of the Global Environment Facility (GEF). "In addition to protecting globally important species and ecosystems, the 2,302 protected areas supported by the GEF alone span over 634 million hectares and together store an impressive 30 billion tons of CO2"

International policies for compensating forest nations for REDD are under active negotiation. To access the resulting funds, developing countries will need to develop programs and institutions to reduce forest emissions. "Protected areas represent a valuable component of national REDD programs since they already contain the necessary institutions and infrastructure to handle funds, strengthen protection and generate results," said Claudio Maretti, Conservation Director, WWF Brazil. "Establishing protected areas usually clarifies land tenure and the associated carbon rights, which has been a sticking point in some negotiations."

In addition, the study estimates that the cost of creating and better managing protected areas is lower than many other options to reduce emissions from deforestation. Completing and managing a network of protected areas in the developing world might require $4 billion USD annually, which is roughly 1/10 of the capital that could be mobilized by international REDD policies.

According to the study, forest nations can strengthen the role of protected areas in their REDD strategies by:

- Identifying where Indigenous Lands and Protected Areas would most effectively reduce deforestation rates and associated emissions;
- Establishing national monitoring to measure deforestation rates and quantify carbon emissions reductions;
- Establishing insurance mechanisms for illegal logging or forest fires;
- Providing indigenous groups and local communities the information and capacities they need to participate;
- Distributing payments transparently to reward those responsible for reducing emissions.

Story Source:

Adapted from materials provided by World Wildlife Fund, via EurekAlert!, a service of AAAS.

Journal Reference:

1. Ricketts et al. **Indigenous Lands, Protected Areas, and Slowing Climate Change**. *PLoS Biology*, 2010; 8 (3): e1000331 DOI: 10.1371/journal.pbio.1000331

http://www.sciencedaily.com/releases/2010/03/100316083719.htm

Atlantic 'Conveyor Belt' Not Slowing, NASA Study Finds

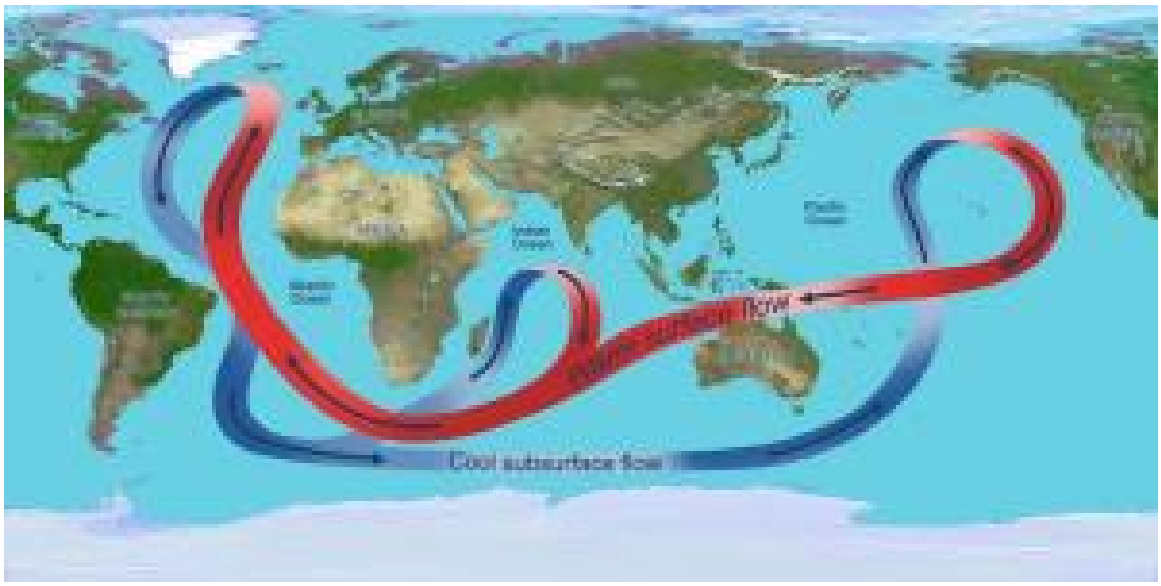


Illustration depicting the overturning circulation of the global ocean. Throughout the Atlantic Ocean, the circulation carries warm waters (red arrows) northward near the surface and cold deep waters (blue arrows) southward. (Credit: NASA/JPL)

ScienceDaily (Mar. 29, 2010) — New NASA measurements of the Atlantic Meridional Overturning Circulation, part of the global ocean conveyor belt that helps regulate climate around the North Atlantic, show no significant slowing over the past 15 years. The data suggest the circulation may have even sped up slightly in the recent past.

The findings are the result of a new monitoring technique, developed by oceanographer Josh Willis of NASA's Jet Propulsion Laboratory in Pasadena, Calif., using measurements from ocean-observing satellites and profiling floats. The findings are reported in the March 25 issue of *Geophysical Research Letters*.

The Atlantic overturning circulation is a system of currents, including the Gulf Stream, that bring warm surface waters from the tropics northward into the North Atlantic. There, in the seas surrounding Greenland, the water cools, sinks to great depths and changes direction. What was once warm surface water heading north turns into cold deep water going south. This overturning is one part of the vast conveyor belt of ocean currents that move heat around the globe.

Without the heat carried by this circulation system, the climate around the North Atlantic -- in Europe, North America and North Africa -- would likely be much colder. Scientists hypothesize that rapid cooling 12,000 years ago at the end of the last ice age was triggered when freshwater from melting glaciers altered the ocean's salinity and slowed the overturning rate. That reduced the amount of heat carried northward as a result.

Until recently, the only direct measurements of the circulation's strength have been from ship-based surveys and a set of moorings anchored to the ocean floor in the mid-latitudes. Willis' new technique is based on data from NASA satellite altimeters, which measure changes in the height of the sea surface, as well as data from Argo profiling floats. The international Argo array, supported in part by the National Oceanic and Atmospheric Administration, includes approximately 3,000 robotic floats that measure temperature, salinity and velocity across the world's ocean.

With this new technique, Willis was able to calculate changes in the northward-flowing part of the circulation at about 41 degrees latitude, roughly between New York and northern Portugal. Combining satellite and float measurements, he found no change in the strength of the circulation overturning from 2002 to 2009. Looking further back with satellite altimeter data alone before the float data were available, Willis found evidence that the circulation had sped up about 20 percent from 1993 to 2009. This is the longest direct record of variability in the Atlantic overturning to date and the only one at high latitudes.

The latest climate models predict the overturning circulation will slow down as greenhouse gases warm the planet and melting ice adds freshwater to the ocean. "Warm, freshwater is lighter and sinks less readily than cold, salty water," Willis explained.

For now, however, there are no signs of a slowdown in the circulation. "The changes we're seeing in overturning strength are probably part of a natural cycle," said Willis. "The slight increase in overturning since 1993 coincides with a decades-long natural pattern of Atlantic heating and cooling."

If or when the overturning circulation slows, the results are unlikely to be dramatic. "No one is predicting another ice age as a result of changes in the Atlantic overturning," said Willis. "Even if the overturning was the Godzilla of climate 12,000 years ago, the climate was much colder then. Models of today's warmer conditions suggest that a slowdown would have a much smaller impact now.

"But the Atlantic overturning circulation is still an important player in today's climate," Willis added. "Some have suggested cyclic changes in the overturning may be warming and cooling the whole North Atlantic over the course of several decades and affecting rainfall patterns across the United States and Africa, and even the number of hurricanes in the Atlantic."

With their ability to observe the Atlantic overturning at high latitudes, Willis said, satellite altimeters and the Argo array are an important complement to the mooring and ship-based measurements currently being used to monitor the overturning at lower latitudes. "Nobody imagined that this large-scale circulation could be captured by these global observing systems," said Willis. "Their amazing precision allows us to detect subtle changes in the ocean that could have big impacts on climate."

Story Source:

Adapted from materials provided by NASA/Jet Propulsion Laboratory.

Journal Reference:

1. Josh K. Willis. **Can in situ floats and satellite altimeters detect long-term changes in Atlantic Ocean overturning?** *Geophysical Research Letters*, 2010; 37 (6): L06602 DOI: 10.1029/2010GL042372

http://www.sciencedaily.com/releases/2010/03/100329132405.htm

Cutting Fat -- And Calories -- From Cakes and Frostings

The FANTESK that food technologist Mukti Singh (foreground) examines as it comes off a drum dryer was prepared by plant physiologist Frederick Felker (background, left) and chemist George Fanta (background, right) using a steam jet cooker. Singh uses FANTESK to cut the fat and calories in cake and frosting. (Credit: Photo by Stephen Ausmus)

ScienceDaily (Mar. 29, 2010) — Delicious new cakes and frostings may someday contain less fat and fewer calories, thanks to work by Agricultural Research Service (ARS) scientists such as Mukti Singh. She's based at the ARS National Center for Agricultural Utilization Research (NCAUR) in Peoria, Ill.

In experiments at her Peoria laboratory, Singh is formulating low-fat cake mixes and frostings with Fantesk™ -- microdroplets of trans-fat-free cooking oil, encapsulated in cornstarch or wheat flour. Fantesk was developed in the 1990s by NCAUR chemists George Fanta and the late Kenneth Eskins.

Singh's experiments have shown that, when making a cake with a mix that contains Fantesk, cooking oil doesn't have to be added. And, the mixes containing Fantesk produce low-fat cakes that have better texture and a higher volume.

What's more, the lower-fat frostings that Singh and Peoria chemical engineer Jeffrey Byars are creating with Fantesk have the smooth texture and spreadability of buttercream favorites, yet contain up to 50 percent less fat.

Story Source:

Adapted from materials provided by USDA/Agricultural Research Service. Original article written by Marcia Wood.

http://www.sciencedaily.com/releases/2010/03/100329103656.htm