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Ancient climate change 'link' to CO2

Page last updated at 18:03 GMT, Thursday, 17 June 2010 19:03 UK

By Victoria Gill
Science reporter, BBC News

CO2 could have caused Ice Ages in the Northern Hemisphere to intensify

A "global pattern" of change in the Earth's climate began 2.7 million years ago, say scientists.

Researchers found that, at this point, temperature patterns in the tropics slipped into step with patterns of Ice Ages in the Northern Hemisphere.

They report in the journal Science that atmospheric CO2 could be the "missing link" to explain this global pattern.

The findings, they say, reveal a "feedback process" that could have been magnified by greenhouse gases.

This loop of feedback could have intensified both the Ice Ages in the Northern Hemisphere, and temperature fluctuations in the tropics.

Professor Timothy Herbert from Brown University in Rhode Island, US, led the research.

This reveals a feedback process that has magnified climate change

Dr Carrie Lear Cardiff University

He and his colleagues, in the US and China, analysed mud cores from the seabed in the four tropical ocean basins - the Arabian Sea, the South China Sea, the eastern Pacific and the equatorial Atlantic Ocean.

These mud cores are laid down over millions of years - as sediments of dead plant and animal material sink to the ocean floor.

So by analysing the chemical composition of this material - specifically the chemical remains of one ancient and tiny marine organism - the scientists were able to produce a timeline of temperature changes.

The team "found a fingerprint in the sequence of temperature changes" - a pattern that began 2.7 million years ago, Professor Herbert explained.

He told BBC News: "The timing and the amplitude of temperature changes [in the Northern Hemisphere] are reproduced in the tropical temperatures. The patterns are incredibly similar."

He added that the study provided the first direct evidence of a global pattern in climate change that dated back almost three million years.

Ancient greenhouse

Professor Herbert added that the "best global mechanism" to explain this link was the level of atmospheric greenhouse gases.

Dr Carrie Lear, a palaeoclimate scientist from Cardiff University in the UK, agreed that carbon dioxide was the likely "culprit".

She told BBC News: "This study reveals a feedback process that has magnified climate change since the inception of Northern Hemisphere glaciation 2.7 million years ago.

"It seems the tropical warming caused by high CO2 levels set off a chain of events resulting in additional greenhouse gases, including water vapour, being released to the atmosphere, thus causing further warming."

Dr Lear said that such studies of past climate change were "invaluable in understanding the current climate system, and hence predicting future change".

http://news.bbc.co.uk/2/hi/science_and_environment/10342318.stm

Tea and coffee 'protect against heart disease'

Page last updated at 22:00 GMT, Friday, 18 June 2010 23:00 UK

It is still not clear what difference milk makes to the health benefits

Drinking several cups of tea or coffee a day appears to protect against heart disease, a 13-year-long study from the Netherlands has found.

It adds to a growing body of evidence suggesting health benefits from the most popular hot drinks.

Those who drank more than six cups of tea a day cut their risk of heart disease by a third, the study of 40,000 people found.

Consuming between two to four coffees a day was also linked to a reduced risk.

While the protective effect ceased with more than four cups of coffee a day, even those who drank this much were no more likely to die of any cause, including stroke and cancer, than those who abstained.

The Dutch tend to drink coffee with a small amount of milk and black tea without. There have been conflicting reports as to whether milk substantially affects the polyphenols - believed to be the most beneficial substance in tea.

Having a cigarette with your coffee could completely cancel any benefits

Ellen Mason British Heart Foundation

Coffee has properties which could in theory simultaneously increase and reduce risk - potentially raising cholesterol while battling the inflammatory damage associated with heart disease.

But the study in the Journal of the American Heart Association finds those who drank between two and four cups a day lowered the risk of the disease by 20%.

"It's basically a good news story for those who like tea and coffee. These drinks appear to offer benefits for the heart without raising the risk of dying from anything else," said Professor Yvonne van der Schouw, the lead researcher.

Ellen Mason, Senior Cardiac Nurse at the British Heart Foundation, said: "This study adds further weight to the evidence that drinking tea and coffee in moderation is not harmful for most people, and may even lower your risk of developing, or dying, from heart disease.

"However, it's worth remembering that leading a healthy overall lifestyle is the thing that really matters when it comes to keeping your heart in top condition.

"Having a cigarette with your coffee could completely cancel any benefits, while drinking lots of tea in front of the TV for hours on end without exercising is unlikely to offer your heart much protection at all."

http://news.bbc.co.uk/2/hi/health/10350373.stm

'More and more rules' on pregnancy

Page last updated at 23:29 GMT, Wednesday, 16 June 2010 00:29 UK

By Clare Murphy
Health reporter, BBC News

Pregnancy has become ever more "policed", with a litany of rules for parents-to-be on how to behave, a parenting conference is due to hear.

Men are increasingly encouraged to be involved in a partner's pregnancy

Researchers at the two-day seminar at Kent University will present fresh analysis of the decision to advise pregnant women to avoid any alcohol.

There have been mixed messages about drinking in pregnancy in recent years.

The impact of mounting efforts to involve fathers in the antenatal period will also be explored.

The Changing Parenting Culture conference next week is to explore the emergence of what it sees as new, often contradictory rules shaping pregnancy and pregnancy planning.

These include the role of stress in pregnancy, amid conflicting reports on the impact of the way a mother feels on the wellbeing of the growing foetus.

Some studies have suggested that stress in pregnancy can cause anything from physical abnormalities to behavioural problems.

Elizabeth Mitchell Armstrong, professor of sociology at Princeton University, will argue that maternal emotions are being "medicalised".

"To the list of pregnancy prescriptions and proscriptions comes another mandate: be happy, be calm. Pregnant women are exhorted to avoid stress and to moderate their emotions in order to produce a healthy baby.

"Yet the evidence behind this recommendation is exceedingly weak."

Drinking up

The conference will also look at the issue of Foetal Alcohol Syndrome (FAS) and accompanying disorders - the reason why pregnant women are advised to abstain from alcohol in many countries - including the UK, US, France and Australia.

The relationship between sustained heavy drinking in pregnancy and health problems such as growth and mental retardation is well-established - although alcoholic mothers will not necessarily have affected children - but evidence is lacking that low to moderate intake is harmful.

They have decided it is preferable that pregnant women take no risk even if there is no evidence of harm

Dr Ellie Lee University of Kent

However concerns that some women may underestimate their drinking, as well as fears that a lack of evidence did not mean moderate consumption was safe, are thought to have informed the 2007 decision to advise pregnant women in England to abstain.

Dr Ellie Lee, a lecturer in social policy at the University of Kent, suggests that in "advocating abstinence without an evidence base, policy makers formalise a connection between uncertainty and danger".

She adds: "They have decided it is preferable that pregnant women take no risk even if there is no evidence of harm.

"But there are dangers associated with this approach, not least that such hyper risk-aversion sits uneasily with advice to parents against 'cotton wooling' or worrying too much about their children's health.

His and hers

Fathers meanwhile are being increasingly encouraged to curb their drinking, stop smoking and eat well when a partner is pregnant, on the basis that his behaviour is likely to influence hers.

Attendance at ante-natal sessions, as well as the birth, is now widely expected.

But research to be presented by Jonathan Ives and Heather Draper of the Centre for Biomedical Ethics at Birmingham University will question this mantra

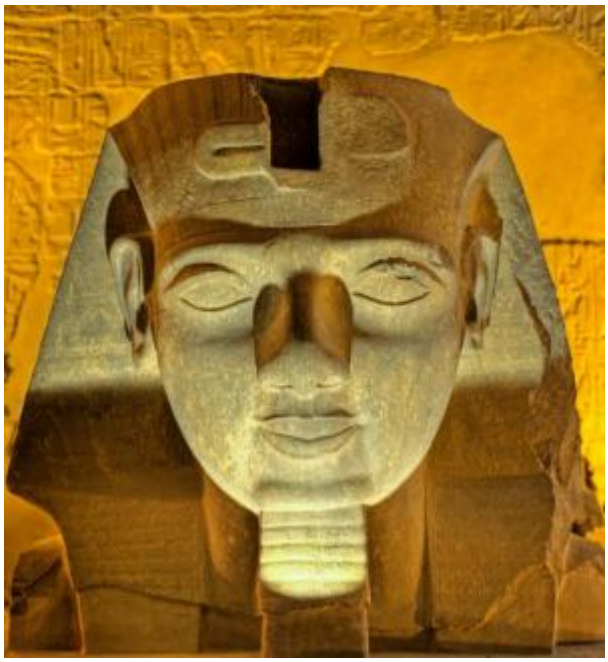
They suggest that involving men in the very medicalised aspects of their partner's pregnancy and labour - where their contribution is inevitably limited - is not necessarily the best preparation for all fathers.

"It's a good and positive step to promote male involvement, and we are not seeking to undermine that," says Dr Ives.

"But we are getting to a point where society has to ask if we are going about this the right way. It's time for debate."

http://news.bbc.co.uk/2/hi/health/10318039.stm

Constraining the Reign of Ancient Egypt: Radiocarbon Dating Helps to Nail Down the Chronology of Kings, Researchers Say



Statue of the head of Ramses II at Luxor temple at night. (Credit: iStockphoto/Paul Vinten)

ScienceDaily (June 18, 2010) — For several thousands of years, ancient Egypt dominated the Mediterranean world -- and scholars across the globe have spent more than a century trying to document the reigns of the various rulers of Egypt's Old, Middle and New Kingdoms. Now, a detailed radiocarbon analysis of short-lived plant remains from the region is providing scientists with a long and accurate chronology of ancient Egyptian dynasties that agrees with most previous estimates but also imposes some historic revisions.

Although previous chronologies have been precise in relative ways, assigning absolute dates to specific events in ancient Egyptian history has been an extremely contentious undertaking. This new study tightly constrains those previous predictions, especially for the Old Kingdom, which was determined to be slightly older than some scholars had believed. The study will also allow for more accurate historical comparisons to surrounding areas, like Libya and Sudan, which have been subject to many radiocarbon dating techniques in the past.

Christopher Bronk Ramsey and colleagues from the Universities of Oxford and Cranfield in England, along with a team of researchers from France, Austria and Israel, collected radiocarbon measurements from 211 various plants -- obtained from museum collections in the form of seeds, baskets, textiles, plant stems and fruits -- that were directly associated with particular reigns of ancient Egyptian kings. They then combined their radiocarbon data with historical information about the order and length of each king's reign to make a complete chronology of ancient Egyptian dynasties.

Their research is published in the June 18 issue of *Science*, the peer-reviewed journal published by AAAS, the nonprofit science society.

"My colleague, Joanne Rowland, went to a lot of museums, explaining what we were doing and asking for their participation," Bronk Ramsey said. "The museums were all very helpful in providing material we were interested in -- especially important since export of samples from Egypt is currently prohibited. Fortunately, we only needed samples that were about the same size as a grain of wheat."

The researchers' new chronology does indicate that a few events occurred earlier than previously predicted. It suggests, for example, that the reign of Djoser in the Old Kingdom actually started between 2691 and 2625 B.C. and that the New Kingdom began between 1570 and 1544 B.C.

Bronk Ramsey and his colleagues also found some discrepancies in the radiocarbon levels of the Nile Valley, but they suggest that these are due to ancient Egypt's unusual growing season, which is concentrated in the winter months.

For the most part, the new chronology simply narrows down the various historical scenarios that researchers have been considering for ancient Egypt.

"For the first time, radiocarbon dating has become precise enough to constrain the history of ancient Egypt to very specific dates," said Bronk Ramsey. "I think scholars and scientists will be glad to hear that our small team of researchers has independently corroborated a century of scholarship in just three years."

This report by Bronk Ramsey *et al*. was funded by the Leverhulme Trust with additional financial support from the German-Israeli Foundation for Scientific Research and Development, NERC, CNRS, CEA, IRSN, IRD, and Ministère de La Culture.

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **American Association for the Advancement of Science**, via EurekAlert!, a service of AAAS.

Journal Reference:

1. Christopher Bronk Ramsey, Michael W. Dee, Joanne M. Rowland, Thomas F. G. Higham, Stephen A. Harris, Fiona Brock, Anita Quiles, Eva M. Wild, Ezra S. Marcus, and Andrew J. Shortland. **Radiocarbon-Based Chronology for Dynastic Egypt**. *Science*, 2010; 328 (5985): 1554-1557 DOI: 10.1126/science.1189395

http://www.sciencedaily.com/releases/2010/06/100617143926.htm

Low Calcium Intake Linked With Increased Risk of Osteoporosis and Hypertension in Postmenopausal Women

ScienceDaily (June 18, 2010) — Italian postmenopausal women who have a low calcium intake show a higher risk of developing both osteoporosis and hypertension (a chronic medical condition in which arterial blood pressure is elevated) than those who consume higher levels of calcium according to research presented at EULAR 2010, the Annual Congress of the European League Against Rheumatism in Rome, Italy.

In this Italian study of 825 postmenopausal women with hypertension, a significantly increased proportion of women (35.4%) who consumed a lower amount of calcium through intake from dairy sources, had a concurrent diagnosis of both hypertension and osteoporosis, compared with women who consumed a higher amount of calcium (19.3% $p<0.001$).

Further statistical analyses revealed that a lower calcium intake was associated with an increased risk of developing hypertension or osteoporosis over time when compared with controls (Odds Ratio (OR) hypertension: 1.43; 95%CI: 1.12-1.82, osteoporosis: OR 1.46; CI: 1.15-1.85). Women who consumed a lower amount of calcium were shown to be most likely to develop both conditions over time compared with women consuming a higher amount of calcium (OR 1.60; CI: 1.09-2.34).

"Our study confirms that there may be a link between hypertension and low bone mass and that a low calcium intake could be a risk factor for the development of osteoporosis in postmenopausal women" said Professor Maria Manara, Department of Rheumatology, Gaetano Pini Institute, Milan, Italy, and lead author of the study. "Our study has also shown that a low calcium intake from dairy foods may be involved in this association and could be considered a risk factor for the development of hypertension and osteoporosis."

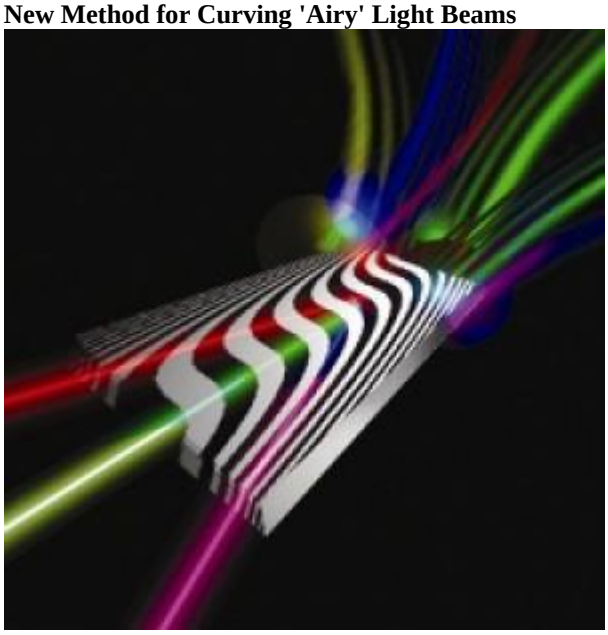
The 825 subjects involved in the study were recruited from a cohort of 9,898 postmenopausal women referred to the Osteometabolic unit of the Gaetano Pini Institute in Italy, from 2002. Calcium intake from dairy sources was assessed by the number of standard servings of ~300mg calcium consumed by women in a week and subjects were stratified into 'quartiles'(lower 25%, median 50% and upper 25%). For each case, three controls were selected and matched for age. Women who had been treated with diuretics (drugs known to affect the generation of new bone material) were excluded from the study.

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **European League Against Rheumatism**, via EurekAlert!, a service of AAAS.

http://www.sciencedaily.com/releases/2010/06/100617102412.htm

Shining Light Around Corners: Scientists Explore New Method for Curving 'Airy' Light Beams



Artist's conception of simultaneous multiple nonlinear generations of Airy beams. (Credit: Image courtesy of American Friends of Tel Aviv University)

ScienceDaily (June 18, 2010) — We learned in science class that light beams travel in straight lines and spread through a process known as diffraction -- and they can't go around corners. But now researchers at ***Tel Aviv University*** are investigating new applications for their recent discovery that small beams of light can indeed be bent in a laboratory setting, diffracting much less than a "regular" beam.

These rays, called "Airy beams," were named after English astronomer Sir George Biddell Airy, who studied the parabolic trajectories of light in rainbows, and were first created at the University of Central Florida. Now, the fortuitously-named Prof. Ady Arie and his graduate students Tal Ellenbogen, Noa Voloch-Bloch, Ayelet Ganany-Padowicz and Ido Dolev of Tel Aviv University's Faculty of Engineering have demonstrated new ways to generate and control Airy beams. Employing new algorithms and special nonlinear optical crystals, their research is reported in a recent issue of the scientific journal *Nature Photonics*.

Some of these new applications, such as a light source to generate beams that can turn around corners, or lighted spaces that contain no apparent light source, are still five or ten years away, says Prof. Arie. But his research has immediate applications as well. For example, because small particles are attracted to the highest intensities of a beam, the pharmaceutical and chemical industries can use the new beam to sort molecules according to size or quality, filtering impurities from drug formulations that might otherwise lead to toxicity and death.

A light that can twist around curves

Until now, reports an editorial review in the same issue of *Nature Photonics*, Airy beams have been generated through "linear diffraction" using tools that project a single color of light through glass plates of varying thicknesses. But using crystals they built in the lab, Tel Aviv University's approach uses another technique: nonlinear optics. Sent through crystals, light waves bounce inside the crystal, changing their wavelength and

color. It is through this process, the researchers say, that the door is opened for creating new light beams at new wavelengths with greater control of their trajectories.

"We've found a way to control whether an Airy beam curves to the left or to the right, for example," says Prof. Arie. He has also found a way to control the peak intensity location of the beams, which are generated through a nonlinear optical process.

Nonlinear optics is a sub-field of optics that deals with the response of materials to high intensities of light. The strong interaction between light and material results in the generation of new colors, which are half the wavelength of the original input light frequency. For example, a nonlinear response to infrared light can generate visible light -- which is how those bright, green "laser pointers," often used in presentations given in large rooms, generate their light.

Airy beams promise remarkable advances for engineering. They could form the technology behind space-age "light bullets" -- as effective and precise defense technologies for police and the military, but also as a new communications interface between transponders. As tiny, tight packets of information, these Airy beams could be used out in the open air, researchers hope.

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **American Friends of Tel Aviv University**.

Journal References:

1. Tal Ellenbogen, Noa Voloch-Bloch, Ayelet Ganany-Padowicz, Ady Arie. **Nonlinear generation and manipulation of Airy beams**. *Nature Photonics*, 2009; 3 (7): 395 DOI: 10.1038/nphoton.2009.95
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http://www.sciencedaily.com/releases/2010/06/100616122120.htm

Gut-Residing Bacteria Trigger Arthritis in Genetically Susceptible Individuals

A single species of bacteria that lives in the gut is able to trigger a cascade of immune responses that can ultimately result in the development of arthritis. (Credit: iStockphoto)

ScienceDaily (June 18, 2010) — A single species of bacteria that lives in the gut is able to trigger a cascade of immune responses that can ultimately result in the development of arthritis.

Our gut, like that of most mammals, is filled with thousands of species of bacteria, many of which are helpful and aid in the development of a normal, healthy immune system. Gut-residing bacteria can also play a role in disorders of the immune system, especially autoimmune disorders in which the body attacks its own cells.

It turns out that rheumatoid arthritis is one such disorder. Researchers in the laboratories of Christophe Benoist and Diane Mathis at Harvard Medical School and Dan Littman at New York University made this discovery while working in mice prone to arthritis.

"In the absence of all bacteria, these mice didn't develop arthritis, but the introduction of a single bacterium was enough to jump-start the immune process that leads to development of the disease," says Mathis, an HMS professor of pathology.

The findings appear in the June 25 issue of the journal *Immunity*.

The researchers began by raising arthritis-prone mice in a germ-free environment. The mice had much lower levels of arthritis-causing autoantibodies than mice raised in a non-germ-free facility. The germ-free mice also showed strong attenuation in the onset and severity of clinical arthritis.

At three weeks of age, some mice were transferred to a non-germ-free facility and the researchers introduced segmented filamentous bacteria into their systems. When they introduced this normally-occurring bacteria into the mice, the animals rapidly began producing autoantibodies and developed arthritis within four days.

First author Hsin-Jung Wu emphasizes that these bacteria do not cause the mice to "catch" arthritis. "It's more that they have the genetic susceptibility, and this bacterium creates an environment that allows this genetic susceptibility to play out," says Wu, a postdoctoral researcher at Harvard Medical School. "It's an interaction between genetics and the environment."

The team mapped out the complex chain of events leading to arthritis. The segmented filamentous bacteria cause the animals to produce more of a particular subset of T cells. The immune system reacts to the activity of the T cells as if to a foreign threat and produces autoantibodies that trigger the devastating disease.

One surprising finding was that bacteria in the gut could influence the development of an autoimmune disease affecting tissues distant from the gut. Diseases such as irritable bowel syndrome have been linked to gut-residing bacteria, but this study is unique in showing the mechanism by which a bacterium in the gut can influence the development of an autoimmune response that ends in inflammation and pain in the joints.

The team will continue to use this mouse model of arthritis to answer questions about the link between the disease and autoimmune response. Next, they plan on tackling the molecular explanation of how these bacteria promote the development of this particular subset of T cells and to explore connections with other autoimmune diseases, in particular type-1 diabetes.

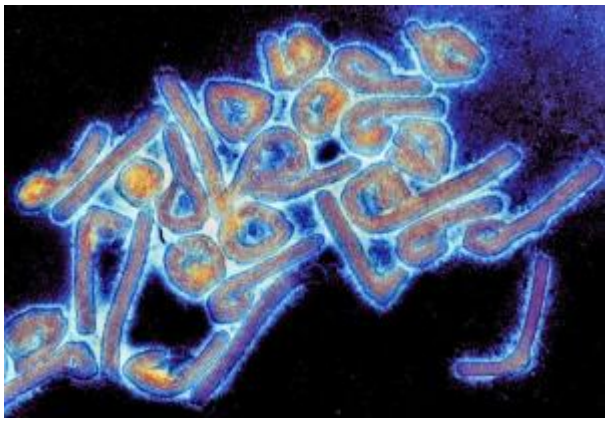
This research was funded by the National Institutes of Health.

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Harvard Medical School**. The original article was written by Mary Bates.

http://www.sciencedaily.com/releases/2010/06/100617120716.htm

Experimental Marburg Vaccine Prevents Disease Two Days After Infection



Colorized Marburg virus particles viewed with a transmission electron microscope. (Credit: Image courtesy of Dr. Tom Geisbert)

ScienceDaily (June 18, 2010) — An experimental vaccine developed to prevent outbreaks of Marburg hemorrhagic fever continues to show promise in monkeys as an emergency treatment for accidental exposures to the virus that causes the disease. There is no licensed treatment for Marburg infection, which has a high fatality rate.

In a study of rhesus macaques, 5 of 6 monkeys survived a lethal dose of Marburg virus when treated 24 hours after infection, and 2 of 6 survived when treated 48 hours after infection. Because rhesus macaques typically succumb to Marburg infection faster than humans, the post-exposure treatment window might be extended even further in humans, the study authors say.

The study, overseen by a scientific team from the National Institutes of Health and three other groups with expertise in viral hemorrhagic fevers, was posted online by the journal *Emerging Infectious Diseases*.

Marburg and Ebola are the only members of the filovirus family. They are hemorrhagic fever pathogens, meaning the infection may lead to shock, bleeding and multi-organ failure. According to the World Health Organization, Marburg hemorrhagic fever has a fatality rate of up to 80 percent, while Ebola fever has a fatality rate of up to 90 percent. Confirmed cases of these hemorrhagic fevers have been reported in about a half-dozen African nations, according to the Centers for Disease Control and Prevention. Cases of Marburg have occurred outside Africa, though infrequently. Ebola is not known to be native to other continents, such as North America.

"Developing safe, effective, and rapidly deployable post-exposure treatments for filoviruses is an important scientific priority for our Institute," says Anthony S. Fauci, M.D., director of NIH's National Institute of Allergy and Infectious Diseases (NIAID). "The vaccine used in this study is among several novel approaches to treating filoviruses that show great potential."

In the study, the scientists sought to answer a question that lingered from research they published in 2006: How long after a usually lethal Marburg virus dose could the experimental vaccine be administered and still provide protection? The 2006 study, also conducted in rhesus macaques, showed 100 percent protection, but the vaccine was given within 30 minutes of lethal exposure.

The timing question is particularly relevant for scientists who study this virus under strict biosafety laboratory guidelines. One such scientist is Heinz Feldmann, M.D., Ph.D., chief of the Laboratory of Virology at NIAID's Rocky Mountain Laboratories in Hamilton, Mont. Dr. Feldmann and his colleagues developed the candidate Marburg vaccine while working for the Public Health Agency of Canada. Collaborators on the current study came from that agency, Boston University and the U.S. Army Medical Research Institute of Infectious Diseases, where most of the animal work was done in 2008-09.

The experimental Marburg vaccine is based on a weakened vesicular stomatitis virus (VSV) used to carry and display a component of the Marburg virus. VSV is an infectious disease of horses, cattle and pigs. Dr. Feldmann and his colleagues also have developed a similar experimental VSV-based vaccine against Ebola. Both vaccines are recognized by the same immune cells in the body as Ebola and Marburg viruses, activating the immune system to fight off the target virus.

The fact that three of the rhesus macaques in the current study showed evidence of Marburg virus in periodic blood tests, but later cleared the virus from their systems and survived, is particularly satisfying to Dr. Feldmann and his main collaborator, Tom Geisbert, Ph.D., of Boston University. In addition, 14 days after infection, all of the rhesus macaques that survived showed moderate to high levels of antibodies against Marburg virus. The scientists view this as proof that the vaccine worked as hoped.

"The results demonstrate that the vaccine can interfere with the Marburg infection and activate the immune system, both protecting the animals and preventing the virus from spreading," says Dr. Feldmann. Dr. Geisbert believes the study data justify rapid development of VSV-based vaccines for the treatment of filovirus-infected patients either in outbreaks or accidental laboratory exposures.

In 2009, Drs. Feldmann and Geisbert were part of an international group of experts that recommended using the same post-exposure treatment strategy for the first time in a human. A researcher who accidentally was stuck with an Ebola-contaminated needle voluntarily received the experimental VSV Ebola vaccine 40 hours after the exposure. The researcher, who never showed signs of infection, survived. The scientists have not yet found a way to determine whether an Ebola infection occurred in this case, however, and whether the vaccine played a role in the outcome.

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **NIH/National Institute of Allergy and Infectious Diseases**.

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http://www.sciencedaily.com/releases/2010/06/100616122114.htm

New Evidence That Smokeless Tobacco Damages DNA and Key Enzymes

ScienceDaily (June 18, 2010) — Far from having adverse effects limited to the mouth, smokeless tobacco affects the normal function of a key family of enzymes found in almost every organ in the body, according to the first report on the topic in the American Chemical Society's monthly journal *Chemical Research in Toxicology*.

The enzymes play important roles in production of hormones, including the sex hormones estrogen and testosterone; production of cholesterol and vitamin D; and help the body breakdown prescription drugs and potentially toxic substances. Smokeless tobacco also damages genetic material in the liver, kidney and lungs.

Krishan Khanduja and colleagues note widespread recognition of smokeless tobacco's harmful effects on the mouth, which include an increased risk of gum disease and oral cancer. The potential carcinogens and other chemicals in chewing tobacco and other smokeless products are absorbed into the blood and travel throughout the body. However, scientists have little information on smokeless tobacco's effects on other parts of the body. To fill that knowledge gap, the scientists evaluated changes in enzymes and genetic material in laboratory rats using extracts of smokeless tobacco.

In addition to damage to the genetic material DNA, they found that smokeless tobacco extracts alter the function of the so-called CYP-450 family of enzymes. "These products are used around the world but are most common in Northern Africa, Southeast Asia, and the Mediterranean region," the report says. "Most of the users seem to be unaware of the harmful health effects and, therefore, use smokeless tobacco to 'treat' toothaches, headaches, and stomachaches. This false impression only promotes tobacco use among youth. The use of smokeless tobacco and its new products is increasing not only among men but also among children, teenagers, women, and immigrants of South Asian origin and medical and dental students."

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **American Chemical Society**, via EurekAlert!, a service of AAAS.

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http://www.sciencedaily.com/releases/2010/06/100616122122.htm

Awe and the Machine

Christine Rosen | Posted on 06/14/10

Today we are less likely to feel awe in the presence of our machines than we are to experience what historian Jacques Barzun called "machine-made helplessness."

Visiting the Paris Exhibition in 1900, the American writer Henry Adams saw something so remarkable he compared its influence to that of the Virgin Mary. It was a hall filled with machines - early power generators known as dynamos. Watching them at work, he "began to feel the forty-foot dynamos as a moral force, much as the early Christians felt the Cross," he wrote in *The Education of Henry Adams*. "The planet itself seemed less impressive, in its old-fashioned, deliberate, annual or daily revolution, than this huge wheel, revolving within arm's-length at some vertiginous speed, and barely murmuring." Adams wondered if he should pray to it.

Such awe and the attendant feelings of humility it inspired in Adams were not uncommon at the time, particularly in the United States, where technological enthusiasm ran high. In the 1850s, the U.S. Commissioner of Patents was so overtaken with excitement about the country's many new machines that he declared, "A steamer is a mightier epic than the *Iliad.*" A writer in *DeBow's Review* opined, "The great Mississippi Valley may emphatically be said to be the creation of the steam engine, for without its magic power ... what centuries must have elapsed before the progress of arts and of enterprise could have swept away the traces of savage life." Perhaps these machines had to be viewed with awe; industrialization was such a culturally disruptive force that people had to find a way to cope with its effects. Investing supernatural powers in the machines that ushered in that revolution was one way of doing this.

By the twentieth century, some cynicism had crept into descriptions of the newest machines. Writing about the impact of radio on his rural Maine community, E. B. White observed, "One of the chief pretenders to the throne of God is radio itself, which has acquired a sort of omniscience." In the lives of the people in his town, the radio exerted a "pervading and somewhat godlike presence." But it was also something to which they turned daily for advice and instruction. As White wryly noted, "The church merely holds out the remote promise of salvation: the radio tells you if it's going to rain tomorrow."

Today, we no longer approach our many machines with awe; in fact, the more personalized and individualized our machines have become, the less humility we feel in using them. No longer the large, rare dynamos of Adams's day, our machines are often portable and are such a central part of our everyday lives that we barely notice their presence. Rather than awe-inspiring symbols of man's power, they are merely extensions of ourselves, like the cell phone that helps us communicate or the microwave that speeds the cooking of our dinner. They are servants of our whims rather than objects of reverence.

Of course there is a danger in romanticizing the machine, not least of which is becoming so credulous that we believe they can do anything. In an infamous example in the early nineteenth century, an inventor claimed he had created a chess-playing machine, an automaton that could best any human being at the game. It proved to be a hoax (a man was hidden inside the machine) and was immortalized in Edgar Allan Poe's 1836 story "Maelzel's Chess Player." Today, when the chess game on an average computer can and does regularly outsmart its human opponents, we believe ourselves free from such gullibility. But while we might be less gullible, we are far more dependent on our machines than were the awestruck audiences of the chess-playing automaton.

In the early age of machines, they inspired awe by proving capable of doing what man could never do alone

(such as power an entire factory), or what we once believed only man could do (play chess). Now we expect our machines to do just about everything for us, from organizing our finances to writing our grocery lists. Our machines not only ease the mundane burdens of daily life (cooking, cleaning, working), but also serve, increasingly, as both our primary source of entertainment and the means for maintaining intimate relationships with others. Henry Adams's dynamo has been replaced by Everyman's iPod, and awe has given way to complacence and dependence. Your computer's e-mail program doesn't inspire awe; it is more like a dishwasher than a dynamo. Nineteenth-century rhapsodies to the machines that tamed nature, such as the steam engine, have given way to impatience with the machines that don't immediately indulge our whims.

The decline in humility toward our machines comes at a time when we know almost nothing about how or why they work. Although overwhelmed by its power, Henry Adams nevertheless had a basic understanding of how the dynamo operated. Most of us know very little about how our laptop computers run or how to repair our washing machines. Today we are less likely to feel awe in the presence of our machines than we are to experience what historian Jacques Barzun called "machine-made helplessness." This, too, is a form of blind faith, like the people who, devotedly following the instructions of their car's GPS device, drive right off a hill, all the while certain that this must be impossible - how could their perfectly calibrated machine be wrong?

The awe experienced by earlier generations was part of a different worldview, one that demonstrated greater humility about many things, not least of which concerned their own human limits and frailties. Today we believe our machines allow us to know a lot more, and in many ways they do. What we don't want to admit - but should - is that they also ensure that we directly experience less. Updating your Facebook page is a lot easier than venturing out into the world to confront a dynamo, as Adams did. But it is also, in the end, likely to be a lot less awe-inspiring.

http://incharacter.org/observation/1awe-and-the-machine/

Do Good Things Happen to Good People?

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Posted on 06/14/10

So caring for other alcoholics, the disinhibition of self-giving love, doubles the likelihood of recovery during this one-year period. That's big news, especially since there are probably 350 to 400 12-step groups based on the 12-step paradigm.

"Giving is the most potent force on the planet and will protect you your whole life," says Dr. Stephen Post. Post is director of the Center for Medical Humanities, Compassionate Care, and Bioethics and president of the Institute for Research on Unlimited Love, which studies the relationship between altruism and happiness. It was established with a grant from the John Templeton Foundation. He is also coauthor of *Why Good Things Happen to Good People* (Broadway Books), which makes the case that altruistic people are happier, healthier, and even live longer.

IC: *Many people might think it's odd to have an institute doing research in the fields of love, goodness, and how these can lead to a happier life. So tell us a bit about the kinds of studies you have supported.*

POST: We've looked carefully at the role of self-giving love, especially in the spiritual and religious contexts, with respect to the healing of the giver. That's been a big theme. For example, researchers supported by the institute have studied the 12-step program of Alcoholics Anonymous. We've followed people who've gone dry for a few months after detox and are in a 12-step program. The ones who fulfill the 12-step program by very clear measures that were developed and who also engaging themselves in the care of other alcoholics through various mechanisms have a 40 per cent recovery rate a year later. The ones who do all the other steps-surrender; let go, let God, however understood; take a moral inventory; make amends and the like-have a 22 per cent rate of recovery after a year. So caring for other alcoholics, the disinhibition of self-giving love, doubles the likelihood of recovery during this one-year period. That's big news, especially since there are probably 350 to 400 12-step groups based on the 12-step paradigm.

Our researchers have also studied the neuroscience of people's experiences of divine love as reported by themselves. We've looked at this developmentally. We've tried to understand whether people's perceptions, experiences, and beliefs in divine love protect them from post-traumatic stress and even allow them to experience post-traumatic growth, which isn't as often studied as post-traumatic stress. We focused on veterans returning from the Middle East through the VA system in California. It turns out that there is a lot of positive benefit from having a belief in divine love and even more so in having a self-reported experience of some kind of love in this universe that is higher than our own. We've studied so many elements of this in more than 70 universities around the U.S. and a little bit in Canada that the Institute has in a very brief time become the most often-cited venue for this sort in the world.

We also have looked at what you might call the humane substrate. Our studies have examined everything from attachment theory in early life and newborn development to the extent to which in later life they are able to become efficient sources of unconditional love. We studied the kinds of factors that will indicate whether some individuals will become rescuers, or not, in difficult, even genocidal situations.

IC: *What determines whether someone will become a rescuer?*

POST: We have supported the work of Samuel Oliner, a sociology professor and Holocaust survivor, in this field. He's the world's leading expert. There are two important factors in whether somebody will later in life become a rescuer. One is whether the individual can look back in life and report high levels of empathy and care in the family, especially on the parent-child axis. There other thing is that rescuers report at very high levels that they were not browbeaten but rather that their parents engaged them in conversation around things like the positive version of the golden rule-not the negative but the positive version. Do unto others what you would have them do unto you. These two factors alone were the strongest predictors of who would become a rescuer, including in the Holocaust.

IC: *You have also studied patients in hospitals...*

POST: Yes, we have supported research into the extent to which compassionate care benefits patients in the health-care system-whether or not they heal faster, whether they are compliant, whether they adhere to treatment, whether the diagnosis they receive is clearer, which it is. When patients feel the tender care of a physician, who might just say a line or two-"This must be tough. How are you handling it?"-then they tend to divulge more information more freely, and it tends to be information you could never have probed for or anticipated. The healing art requires something at its heart that we call medical love.

We've also studied the role of spirituality in organ donation. We funded a study by Robert Emmons of the Gratitude Institute at the University of California at Davis, called The Gift of One's Self: Expressions of Unlimited Love and Gratitude in Organ Donors and Recipients. Emmons has come out with some exciting conclusions about the relationship between people who have and experience or belief in unlimited love and they extent to which they are willing to become living donors, to give a kidney or part of a liver to someone they don't know-so-called anonymous donation. He also found that recipients who feel gratitude function at a higher level.

IC: *The eminent scientist and geneticist Francis Collins gave your book a blurb saying that your book "convincingly demonstrates that 'love your neighbor as yourself'" can make your life happier. Explain.*

POST: Happiness is a byproduct of living generously. People who are self-described as being people of generosity and self-giving love, people who are concerned for others in their actions or in affect are happier than people who don't fall into these categories. The chief predictor of self-reported happiness is not material wellbeing. It is not the power we hold over others, the accumulation of accolades or prestige. The single most important predictor of happiness is whether a person is living as much for others as for self. A national survey (one we didn't conduct) found three indicators of whether people in America are happy. Friendships came first. Seventy-six percent of those surveyed said that friendships made them happy. They described friendship in benevolent rather than selfish terms. Seventy-five percent said that-quote-contributing to the lives of others-end quote-made them happy. Sixty-two percent said that religion or spirituality made them happy. They might go to a church or synagogue and hear a message about doing unto others or being engaged in certain kinds of altruistic activities, Habitat or whatever, with other congregants.

IC: *What about altruism and longevity?*

POST: A remarkable fact is that giving, even in later years, can delay death. The impact of giving is just as significant as not smoking and avoiding obesity. A 2005 study conducted by Alex Harris and Carl Thoresen of Stanford University found that frequent volunteering is strongly linked to later mortality. Called the

Longitudinal Study on Aging, it followed more than 7,500 older people for six years. Volunteering was a powerful protector of mental and physical health. Another study, a 1992 survey of older people by Neal Krause of the University of Michigan found that helping others lowers depression. Krause found that, for older men, ten years of volunteering can dramatically slash mortality rates. Another researcher, Doug Oman and his colleagues did a study involving 2,025 older residents of California and found that those who volunteered had a 44 percent reduction in mortality-and those who volunteered for two or more organizations had an astonishing 63 percent lower mortality rate than non-volunteers. If you are an older adult, I have one recommendation: volunteer!

IC: *You've talked about loyalty and marriage. We live in a world where people are likely to say, "I want to be happy, and if it means breaking up this marriage, the kids will understand that I needed to be happy."*

POST: Love without loyalty is a joke. Imagine if someone said, "I love you, but only for 30 seconds." It wouldn't quite ring true. Loyalty is a significant expression of any kind of love worthy of the word. When we enter into marriage it's very important that we have loyalty in mind. The literature is very clear that marriages tend to last longer if they begin in friendship so when people who've been friends, who have common interests, who have loyalty on the basis of friendship marry, those relationships tend to endure more so than relationships based on a physical arousal, if you will, a kind of romantic Eros. That's not always the case, but as a generalization, it is true. The literature is very clear that Eros itself is inadequate for a long and successful marriage. All the early romantics like Stendahl and others understood this. This is the so-called Don Juan phenomenon that Kierkegaard described. It only lasts so long and then one becomes-shall we say?-a more realistic about the qualities of the other.

A study we supported by Vincent Jeffries, the sociologist at California State University, found that commitment to the relationship is an important factor for older couples who've had lasting marriages. He studied more than 50 couples who had been married for more than 25 years. He found that the couples who were happier and more in love after all these years were the ones who had a commitment to the relationship. So, in that sense, loyalty in marriage is not just loyalty to a particular spouse but it's loyalty to the sense that people have of the dignity of human beings generally considered. I don't claim that all marriages should last forever, but with regard to divorce, yeah, the idea that somehow people benefit from quick and easy divorce, both partners and children, is just not the case. What it creates is a lot of panicky, anxious emotion both in adults and in their children as they look for some kind of emotional stability in life that's not available to them. So the so-called low threshold of divorce based on what is called low conflict is not beneficial for anybody else. But when you have high-conflict situations, it's pretty clear that separation or divorce can be beneficial for spouses and children. Nobody debates that in certain circumstances-profound abuse or neglect-divorce can't be justified. But what's happened in our society is that people have extended that kind of careful justification to apply to pretty much any kind of marital relationship and that creates instability. The impact is not good. A hundred years ago or eighty years ago, people went to their psychiatrist because they were sexually inhibited. Now they go to their psychiatrist because they can't find any stable relationships in the world. They are troubled deeply and disturbed because there is no temporal glue in love, there is no connective tissue between past and present and future. There is no security, nothing can be assumed. Love without loyalty is not worthy of the word.

http://incharacter.org/features/do-good-things-happen-to-good-people-2/

Stem cell therapy 'damage' seen in kidney disease case

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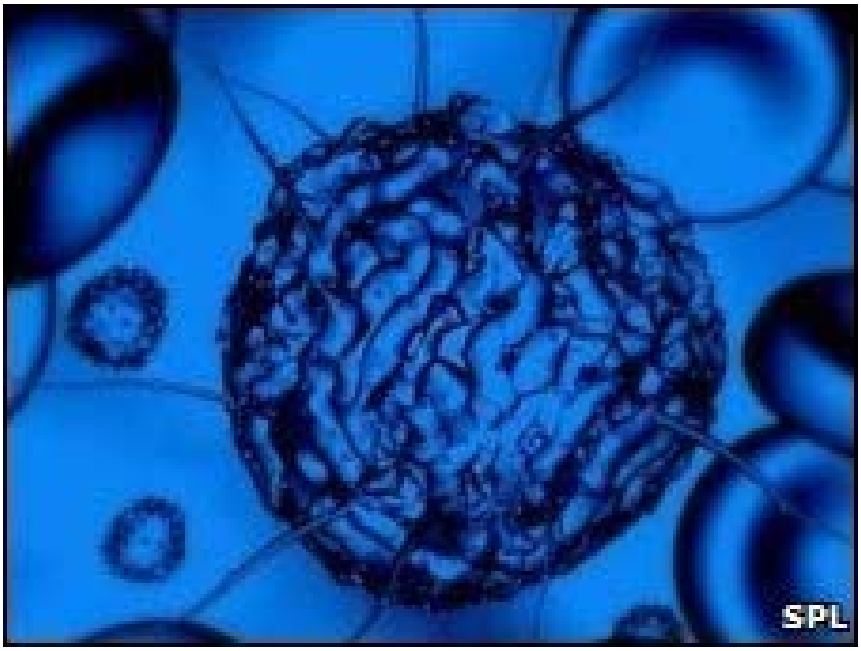

There are hopes that stem cell therapy can be used to tackle many diseases

A new complication has been seen in a patient with kidney disease who received stem cell therapy, scientists have warned.

Stem cells were injected into the kidney, but the patient suffered tissue damage and died from an infection.

The Canadian and Thai researchers said the findings published in the Journal of the American Society of Nephrology showed caution was needed.

Experts said there was a gap between research and treatment.

Many scientists hope stem cell therapy can be used to treat a wide range of diseases.

It has been shown that it is possible to reprogram adult stem cells, taken from bone marrow, to become a range of specific cell types - including kidney cells.

We believe that this is either formed directly by the stem cells that were injected or that the stem cells caused these masses to form

Dr Duangpen Thirabanjasak, Chulalongkorn University

And animal studies have indicated that injecting stem cells directly into organs, including the kidney, is safe.

The patient in this case had been treated by a private clinic.

Researchers from Chulalongkorn University in Bangkok, Thailand, and Paul Scott Thorner, from the University of Toronto, were involved in removing and analysing the kidney.

They found that the patient had not benefited at all from the treatment, but had actually developed tissue damage called angiomyeloproliferative lesions at the injection sites. These were found to be clusters of blood vessels and bone marrow cells.

Enthusiasm 'premature'

Dr Duangpen Thirabanjasak, from Chulalongkorn University, who led the research, said: "This type of lesion has never been described before in patients, and we believe that this is either formed directly by the stem cells that were injected or that the stem cells caused these masses to form."

And she warned that, because they had not been seen before, no-one knew how the lesions might have developed over time.

The authors conclude that their findings should serve as a warning to clinical investigators that the development of blood vessel and bone marrow masses may be a possible complication of stem cell therapy.

And they said more work was needed to identify why the masses formed, and how this could be avoided.

Writing in the journal, Andras Nagy, of Toronto's Mount Sinai Hospital, and Susan Quaggin, of the University of Toronto, said caution was needed over stem cell therapies - especially if they were being offered by unregulated private clinics.

They added: "Premature enthusiasm and protocols that are not fully vetted are dangerous and result in negative publicity for the field of stem cell research, and more importantly, may result in disastrous outcomes with no benefit to the patient.

"Although there is promise, a large gap still exists between scientific knowledge and clinical translation for safe and effective stem cell-based therapies.

http://news.bbc.co.uk/2/hi/health/10339138.stm

Astronomers Study Kuiper Belt Object During Stellar Occultation

This artist's concept of a Kuiper Belt object found by the Hubble telescope is only 3,200 feet across and a whopping 4.2 billion miles away. (Credit: NASA)

ScienceDaily (June 18, 2010) — Until now, astronomers have used telescopes to find Kuiper Belt objects (KBOs), moon-sized bodies, and obtain their spectra to determine what types of ices are on their surface. They have also used thermal-imaging techniques to get a rough idea of the size of KBOs, but other details have been difficult to glean.

While astronomers think there are about 70,000 KBOs that are larger than 100 kilometers in diameter, the objects' relatively small size and location make it hard to study them in detail. One method that has been has been proposed for studying KBOs is to observe one as it passes briefly in front of a bright star; such events, known as stellar occultations, have yielded useful information about other planets in the solar system. By monitoring the changes in starlight that occur during an occultation, astronomers can determine the object's size and temperature, whether it has any companion objects and if it has an atmosphere.

The trick is to know enough about the orbit of a KBO to be able to predict its path and observe it as it passes in front of a star. This was done successfully for the first time last October when a team of 18 astronomy groups led by James Elliot, a professor of planetary astronomy in MIT's Department of Earth, Atmospheric and Planetary Sciences, observed an occultation by an object named "KBO 55636."

As Elliot and his colleagues report in a paper published to be published June 17 in *Nature*, the occultation provided enough data to determine the KBO's size and albedo, or how strongly it reflects light. The surface of 55636 turns out to be as reflective as snow and ice, which surprised the researchers because ancient objects in space usually have weathered, dull surfaces. The high albedo suggests that the KBO's surface is made of reflective water-ice particles, and that would support a theory about how the KBO formed. Many researchers believe there was a collision that occurred one billion years ago between a dwarf planet in the Kuiper Belt known as Haumea and another object that caused Haumea's icy mantle to break into a dozen or so smaller bodies, including 55636.

More importantly, the research demonstrates that astronomers can predict occultations accurately enough to contribute to a new NASA mission known as the Stratospheric Observatory For Infrared Astronomy (SOFIA) that completed its first in-flight observations in May. A Boeing 747SP aircraft that has a large telescope

mounted onto its rear fuselage, SOFIA can record infrared measurements of celestial objects that are not possible from the ground. Elliot hopes his research will help guide future flights of SOFIA to observe stellar occultations in detail.

Elliot, who has been studying 55636's orbit for five years, thought it would most likely pass in front of an unnamed star on Oct. 9, 2009. But the KBO's small size made it difficult to predict exactly where the object would travel, and so, to be on the safe side, he and his colleagues assembled a network of 18 observation stations along a 5,900-kilometer stretch of the Earth's surface that corresponded to the KBO's predicted shadow path. Such a strategy "covered our uncertainty about where the path would go, both to the north and to the south," Elliot explains. "It was our way of hedging our bets."

While some of the stations couldn't observe because of weather, and others simply didn't detect the occultation, two stations in Hawaii captured data on the changes in starlight that occurred during the roughly 10-second occultation. After measuring the exact amount of time that the star was blocked from view, as well as the velocity with which the shadow of 55636 moved across Earth, the researchers calculated that the KBO has a radius of about 143 kilometers. Knowing this, they could then calculate the object's albedo.

The highly reflective surface of 55636 is perplexing because the surfaces of celestial bodies in the outer solar system are supposed to darken over time as a result of dust accumulation and exposure to solar radiation.

Although other highly reflective bodies in the solar system, such as the dwarf planet Pluto and Saturn's moon Enceladus, have their surfaces continuously renewed with fresh ice from the condensation of atmospheric gases or by volcanic activity that spews water instead of lava, 55636 is too small for these mechanisms to be at work, says Elliot. He has no plans to investigate the cause of the high albedo but will continue to collect data about the orbits and positions of the largest KBOs in order to predict future occultations with enough accuracy that he doesn't have to rely on a vast network of observers.

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Massachusetts Institute of Technology**. The original article was written by Morgan Bettex, MIT News Office.

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http://www.sciencedaily.com/releases/2010/06/100616133323.htm

Malaria Threat Is as Old as Humanity, New Research Shows

Anopheles gambiae mosquitoes -- the principal vector of malaria in Africa. (Credit: CDC/Mary F. Adams, MA, MS)

ScienceDaily (June 18, 2010) — New research by scientists funded by the Biotechnology and Biological Sciences Research Council (BBSRC) shows that malaria is tens of thousands of years older than previously thought. An international team, led by researchers at Imperial College London, have found that the potentially deadly tropical disease evolved alongside anatomically modern humans and moved with our ancestors as they migrated out of Africa around 60-80,000 years ago.

The research is published in the journal *Current Biology*.

The findings and the techniques in the study could be important in informing current control strategies aimed at reducing the prevalence of malaria. There are an estimated 230 million cases each year, causing between 1 and 3 million deaths, and around 1.4bn people are considered to be at risk of infection.

Dr Francois Balloux from the Medical Research Council (MRC) Centre for Outbreak Analysis and Modelling at Imperial College London was lead researcher on the project. He said: "Most recent work to understand how malaria has spread across the tropics has worked on the premise that the disease arose alongside the development of agriculture around 10,000 years ago. Our research shows that the malaria parasite has evolved

and spread alongside humans and is at least as old as the event of the human expansion out of Africa 60-80,000 years ago."

The international team worked on the largest collection of malaria parasites ever assembled. By characterising them by DNA sequencing they were able to track the progress of malaria across the tropics and to calculate the age of the parasite. The scientists discovered clear correlation of decreasing genetic diversity with distance from sub-Saharan Africa. This accurately mirrored the same data for humans suggesting strong evidence of co-evolution and migration.

Dr Balloux said: "The genetic sequencing of the malaria parasite shows a geographic spread pattern with striking similarities to studies on humans. This points to a shared geographic origin, age and route of spread around the world. This understanding is important because despite the prevalence and deadly impact of malaria little research has previously been done to understand the genetic variation of the parasite. The genetic diversity of malaria parasites is central to their threat as it helps them to overcome the immune system and to develop drug resistance, making this research vital in informing new and more effective control strategies."

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Biotechnology and Biological Sciences Research Council**.

Journal Reference:

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Climate Change Threatens Food Supply of 60 Million People in Asia

taken while facing south on the Tibetan plateau near Tingri, close to the Mount Everest base camp, at an elevation of 4380m above sea level, this photo illustrates the 'water tower' function of the Himalayas. (Credit: A. Hamer)

ScienceDaily (June 18, 2010) — According to an article by three Utrecht University researchers published in the journal *Science* on 11 June, climate change will drastically reduce the discharge of snow and ice meltwater in a region of the Himalayas, threatening the food security of more than 60 million people in Asia in the coming decades. The Indus and Brahmaputra basins are expected to be the most adversely affected, while in the Yellow River basin the availability of irrigation water will actually increase.

More than one billion people depend on the meltwater supplied by the Indus, Ganges, Brahmaputra, Yangtze and Yellow River. The snow and ice reserves situated upstream are important in sustaining the availability of water downstream. Researchers from Utrecht University and FutureWater have calculated the reduction in glacier and snow coverage and forecasted the future river discharge and made predictions about food security in the basins of these five major rivers.

How important is meltwater?

"The role of meltwater in the Indus basin is much more significant than that in other river basins in Asia," according to Walter Immerzeel, hydrologist at Utrecht University and FutureWater. "The downstream

sections of the Indus are dry, are home to one of the largest irrigation networks in the world and are completely dependent on meltwater."

Food production

Climate change will ultimately result in declining discharge levels of the major Asian rivers, impacting the volume of irrigation water available. "Our model calculations show that the Brahmaputra and Indus are the most vulnerable. According to our estimates, this will threaten the food security of the approximately 60 million inhabitants of these areas by the year 2050," explains Immerzeel. "However, the opposite is also possible. In the Yellow River basin, an increase in wintertime rainfall is expected, resulting in increased availability of water early in the growing season."

Uncertainty about glaciers

The size and discharge of Himalayan glaciers are experiencing significant decline due to climate change. "However, observed glacial decline varies greatly from region to region, and there is a high degree of uncertainty regarding the speed of decline," says Marc Bierkens, hydrology professor at Utrecht University. "However, the trends identified in the river discharge forecast do not take this uncertainty into account." The researchers based their results on a combination of hydrologic models, climate forecasts from five different climate scenarios, and satellite images depicting snow and ice, rainfall, and changes in the Earth's gravitational field.

Story Source:

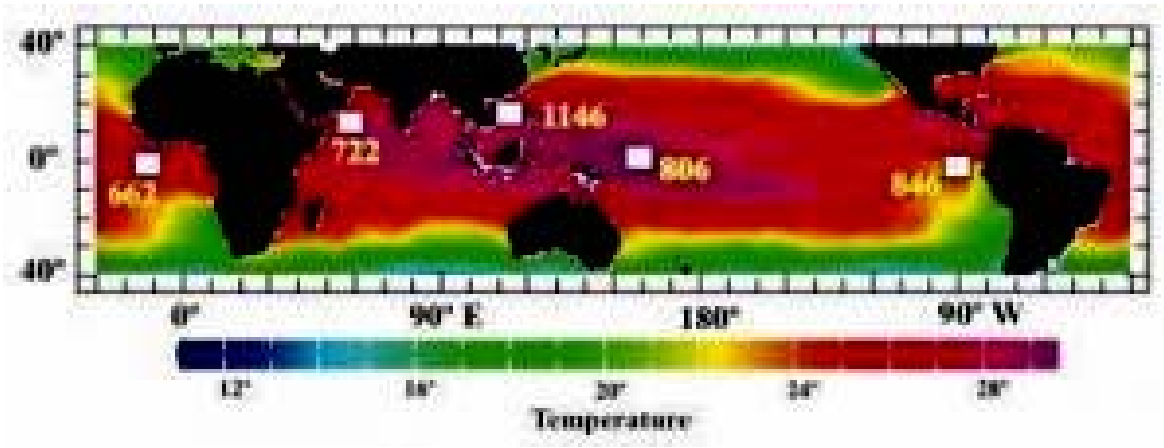
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Utrecht University**.

Journal Reference:

1. Immerzeel et al. **Climate Change Will Affect the Asian Water Towers**. *Science*, 2010; 328 (5984): 1382 DOI: 10.1126/science.1183188

http://www.sciencedaily.com/releases/2010/06/100616090225.htm

Carbon Dioxide Is the Missing Link to Past Global Climate Changes



Sedimentary cores taken from the ocean floor in four locations show that climate patterns in the tropics have mirrored Ice Age cycles for the last 2.7 million years and that carbon dioxide has played the leading role in determining global climate patterns. Cores from site 806 were used as controls. (Credit: Timothy Herbert, Brown University)

ScienceDaily (June 17, 2010) — Increasingly, the Earth's climate appears to be more connected than anyone would have imagined. El Nino, the weather pattern that originates in a patch of the equatorial Pacific, can spawn heat waves and droughts as far away as Africa.

Now, a research team led by Brown University has established that the climate in the tropics over at least the last 2.7 million years changed in lockstep with the cyclical spread and retreat of ice sheets thousands of miles away in the Northern Hemisphere. The findings appear to cement the link between the recent Ice Ages and temperature changes in tropical oceans. Based on that new link, the scientists conclude that carbon dioxide has played the lead role in dictating global climate patterns, beginning with the Ice Ages and continuing today.

"We think we have the simplest explanation for the link between the Ice Ages and the tropics over that time and the apparent role of carbon dioxide in the intensification of Ice Ages and corresponding changes in the tropics," said Timothy Herbert, professor of geological sciences at Brown and the lead author of the paper in *Science.*

"It certainly supports the idea of global sensitivity of climate to carbon dioxide as the first order of control on global temperature patterns," Herbert added, "but we don't know why. The answer lies in the ocean, we're pretty sure."

The research team, including scientists from Luther College in Iowa, Lafayette College in Pennsylvania, and the University of Hong Kong, analyzed cores taken from the seabed at four locations in the tropical oceans: the Arabian Sea, the South China Sea, the eastern Pacific and the equatorial Atlantic Ocean.

They decided to zero in on tropical ocean surface temperatures because these vast bodies, which make up roughly half of the world's oceans, in large measure orchestrate the amount of water in the atmosphere and

thus rainfall patterns worldwide, as well as the concentration of water vapor, the most prevalent greenhouse gas.

Looking at the chemical remains of tiny marine organisms that lived in the sunlit zone of the ocean, the scientists were able to extract the surface temperature for the oceans for the last 3.5 million years, well before the beginning of the Ice Ages. Beginning about 2.7 million years ago, the geologists found that tropical ocean surface temperatures dropped by 1 to 3 degrees Celsius (1.8 to 5.4 degrees Fahrenheit) during each Ice Age, when ice sheets spread in the Northern Hemisphere and significantly cooled oceans in the northern latitudes. Even more compelling, the tropics also changed when Ice Age cycles switched from roughly 41,000-year to 100,000-year intervals.

"The tropics are reproducing this pattern both in the cooling that accompanies the glaciation in the Northern Hemisphere and the timing of those changes," Herbert said. "The biggest surprise to us was how similar the patterns looked all across the tropics since about 2.7 million years ago. We didn't expect such similarity."Climate scientists have a record of carbon dioxide levels for the last 800,000 years -- spanning the last seven Ice Ages -- from ice cores taken in Antarctica. They have deduced that carbon dioxide levels in the atmosphere fell by about 30 percent during each cycle, and that most of that carbon dioxide was absorbed by high-latitude oceans such as the North Atlantic and the Southern Ocean. According to the new findings, this pattern began 2.7 million years ago, and the amount of atmospheric carbon dioxide absorbed by the oceans has intensified with each successive Ice Age. Geologists know the Ice Ages have gotten progressively colder -- leading to larger ice sheets -- because they have found debris on the seabed of the North Atlantic and North Pacific left by icebergs that broke from the land-bound sheets.

"It seems likely that changes in carbon dioxide were the most important reason why tropical temperatures changed, along with the water vapor feedback," Herbert said.Herbert acknowledges that the team's findings leave important questions. One is why carbon dioxide began to play a major role when the Ice Ages began 2.7 million years ago. Also left unanswered is why carbon dioxide appears to have magnified the intensity of successive Ice Ages from the beginning of the cycles to the present. The researchers do not understand why the timing of the Ice Age cycles shifted from roughly 41,000-year to 100,000-year intervals.

Contributing authors are Laura Cleaveland Peterson at Luther College, Kira Lawrence at Lafayette College and Zhonghui Liu at the University of Hong Kong. The U.S. National Science Foundation and the Evolving Earth Foundation funded the research. The cores came from the Ocean Drilling Program, sponsored by the NSF, and the Integrated Ocean Drilling Program.

Story Source:

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

Journal Reference:

1. timothy D. Herbert, Laura Cleaveland Peterson, Kira T. Lawrence, Zhonghui Liu. **Tropical Ocean Temperatures Over the Past 3.5 Million Years**. *Science*, June 18, 2010; Vol. 328. no. 5985, pp. 1530 - 1534 DOI: 10.1126/science.1185435

http://www.sciencedaily.com/releases/2010/06/100617143936.htm

110-Foot Concrete Bridge Withstands 8.0 Earthquake Simulation

The 200-ton, four-span bridge was built over several months atop the 14-foot square shake tables at the world-renowned University of Nevada, Reno large-structures lab. The innovative bridge was hit with nine increasingly more powerful earthquakes over several days, and survived, giving researchers reams of data collected from sensors through 350 channels. (Credit: Photo by Mike Wolterbeek, University of Nevada, Reno)

ScienceDaily (June 17, 2010) — After a succession of eight separate earthquake simulations, a 110-foot long, 200-ton concrete bridge model at the University of Nevada, Reno withstood a powerful jolting, three times the acceleration of the disastrous 1994 magnitude 6.9 Northridge, Calif. earthquake, and survived in good condition.

"This is very satisfying to see how well the design and components worked," Saiid Saiidi, principal investigator for the project and University of Nevada civil engineering professor said after the final test on this bridge Tuesday afternoon. "We estimated bridge failure at 8 inches of deflection, which is a lot, but we had 10 inches of deflection in the support columns and the bridge remained standing and usable, even with considerable internal stresses."

The bridge model is shaken with bidirectional forces to realistically simulate an earthquake. The researchers mimic the Northridge earthquake using recorded data of the actual earthquake. Computer programs direct the movements of the three large hydraulically-controlled shake tables in the University's world-renowned, large-scale structures laboratory.

"We know the bridge would have survived that quake in good condition and still be usable," Saiidi said.

The University of Nevada research team is experimenting with and testing a number of materials and innovations to potentially revolutionize seismic design of future bridges to help protect lives, prevent damage and avoid bridge closure even when there is a strong earthquake.

"We anticipate these designs and components would be used in future bridge and overpass construction," Saiidi said.

The 11-foot-high, four-span concrete bridge model was the third experiment in a series of these tests using innovative composite materials and construction to give superior seismic performance for bridges and highway overpasses.

"What is extraordinary about the construction techniques tested with this bridge is the use of glass and carbon fibers to support the bridge, precast columns, segmental columns and special steel pipe-pin connections in a high seismic setting," Saiidi said.

The test was attended by about 50 engineers and industry representatives, including Caltrans chief of earthquake engineering and several senior bridge engineers from Caltrans and NDOT. About 100 viewers from around the country observed the test live via the Web.

The experiment is funded by a $2 million grant from the National Science Foundation. It is part of a larger multi-university project within the George E. Brown Jr. Network for Earthquake Engineering Simulation (NEES) research program. The Large-Scale Structures Laboratory is a member of NEES, established by the National Science Foundation in 2004. As a NEES Equipment Site, the laboratory is equipped with four, large-scale, high-performance shake tables; the only laboratory in the world of its kind.

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **University of Nevada, Reno**, via EurekAlert!, a service of AAAS.

http://www.sciencedaily.com/releases/2010/06/100616171649.htm

Brain Comes Hard-Wired With Working Navigational Neurons, Rat Study Suggests

Rosamund Langston is from the Norwegian University of Science and Technology's Kavli Institute of Systems Neuroscience and Center for the Biology of Memory, and is now at the Center for Neuroscience, Division of Medical Sciences, Ninewells Hospital and Medical School in Dundee, Scotland. Langston's work with baby rats shows that the brain comes hard wired with an innate sense of direction. (Credit: Kavli Institute for Systems Neuroscience and Centre for the Biology of Memory)

ScienceDaily (June 17, 2010) — Are we born with an innate sense of direction, or is it learned? Research from the Norwegian University of Science and Technology's Kavli Institute for Systems Neuroscience suggests that the brain comes hard-wired with working navigational neurons. While these neurons -- head direction cells, place cells and grid cells -- mature over time, they appear to function in rodents as soon as they make their first exploratory steps outside the nest.

Results of the research are published in the journal *Science*.

Researchers Rosamund Langston and colleagues wanted to know how the brain mapped place and space when an animal navigates for the first time ever. The research team implanted miniature sensors in rat pups before their eyes had opened (and thus before they were mobile). That enabled the researchers to record neural activity when the rat pups left the nest for the first time to explore a new environment.

The researchers were not only able to see that the rats had working navigational neurons right from the beginning, but they were also able to see the order in which the cells matured.

The first to mature were head direction cells. These neurons are exactly what they sound like -- they tell the animal which direction it is heading, and are thought to enable an internal inertia-based navigation system, like a compass. "These cells were almost adult-like right from the beginning," Langston says.

The next cells to mature were the place cells, which are found in the hippocampus. These cells represent a specific place in the environment, and in addition provide contextual information -- perhaps even a memory -- that might be associated with the place. Last to mature were grid cells, which provide the brain with a geometric coordinate system that enables the animal to figure out exactly where it is in space and how far it has travelled. Grid cells essentially anchor the other cell types to the outside world so that the animal can reliably reproduce the mental map that was made last time it was there.

Baby rats open their eyes and begin exploring by about 15 days after birth. At this point, researchers could already see head direction cells fully developed, and the rudiments of the other two cell types in place. By the time they were 30 days old, or on the threshold of rat adolescence, virtually all of the different navigational cell types had matured.

Langston says the findings are a partial answer to the age-old question of whether or not you are born with the innate ability to find your way around. Her answer? "It really seems that this is hard-wired," she says, "You do have a basic foundation that is there as soon as you can explore -- there are strong building blocks for a system that you can use to navigate. " Langston says experience could also play a role, which makes this topic an important theme for further research.

The researchers found no difference in navigational skills between male and female rat pups, which implies that both sexes have the same building blocks with which to construct representations of space. Perhaps the age-old question of whether males or females have a better sense of direction could be a case of how we choose to build our map, rather than the materials we start with.

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Norwegian University of Science and Technology**, via EurekAlert!, a service of AAAS.

Journal Reference:

1. Rosamund F. Langston, James A. Ainge, Jonathan J. Couey, Cathrin B. Canto, Tale L. Bjerknes, Menno P. Witter, Edvard I. Moser, and May-Britt Moser. **Space and direction are already represented in specific neurons when rat pups navigate a location for the first time**. *Science*, 2010; 328 (5985): 1576-1580 DOI: 10.1126/science.1188210

http://www.sciencedaily.com/releases/2010/06/100617143928.htm

Astronomers Focus on Revealing Hidden Mysteries of the Universe

Pan-STARRS telescope 1: The Pan-STARRS sky survey telescope in Hawaii. (Credit: Photo by Rob Ratowski)

ScienceDaily (June 17, 2010) — Secrets of the Universe are to be revealed as a new telescope equipped with the world's most powerful digital camera begins its observations of the night sky.

The Pan-STARRS sky survey telescope -- known as PS1 -- will enable scientists to better understand the mysteries of dark matter and dark energy, the material that is thought to account for much of the mass of the universe but has never been proven to exist.

Astronomers from the Universities of Durham, Edinburgh and Queen's University Belfast together with researchers from around the world are using the telescope to scan the skies from dusk to dawn each night.

PS1's 1400 megapixel camera is the world's largest -- with about 150 times as many pixels as the average camera. It is able to gather detailed images of almost three-quarters of the night sky from its base in Hawaii. The project will enable scientists to assess wide areas of sky at a level of detail that was previously impossible.

Scientists believe the device, which was built by the University of Hawaii, will provide vital clues into the nature of dark energy and dark matter. They hope to use images of galaxies to validate Einstein's theory of general relativity, which predicts that light can bend around an object in space -- such as dark matter -- because it is pulled towards the object by gravity.

The telescope, which took more than a decade to develop, will also pinpoint new supernovae -- stellar explosions -- as well as near-earth asteroids. It is also able to track fast-moving objects and exploding stars across nearly the whole sky.

Powerful computers will process the data from the telescope, which is expected to generate enough information over the three-year project to fill the equivalent of several thousand PCs.

Professor Carlos Frenk of Durham University, the UK's member on the Pan-STARRS board, said: "PS1 will generate the largest ever multi-colour survey of the cosmos. Alongside supercomputer simulations of the universe, these data will help us understand the life cycles of galaxies and, if we are very lucky, the nature of the mysterious dark matter and dark energy that control the evolution of our cosmos."

Professor Stephen Smartt of Queen's University Belfast and Chair of the Pan-STARRS Science Council, said: "The huge camera lets us map about one-sixth of the sky every month, in five different colours. We compare every image with one taken previously and try to track everything that either moves or flashes. Already we have discovered hundreds of supernovae, some of them the most luminous explosions known."

Professor Alan Heavens of the University of Edinburgh said: "Pan-STARRS has immense potential for mapping the distribution of matter in the Universe, even the unseen dark matter. Our goal is to do this over the majority of the sky for the first time -- but there are still big challenges ahead for us."

Development of Pan-STARRS -- Panoramic Survey Telescope and Rapid Response System -- has been funded by the US Air Force. Also involved in the project are the University of Hawaii, the Pan-STARRS Project Office, the Max-Planck Society, John Hopkins University, Baltimore, the Harvard-Smithsonian Centre for Astrophysics, the Las Cumbres Observatory Global Telescope Network, the National Central University of Taiwan and the Ogden Trust.

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Durham University**, via AlphaGalileo.

http://www.sciencedaily.com/releases/2010/06/100617075159.htm

Certain Proteins Extend Life Span in Worms by 30 Percent

A roundworm. (Credit: iStockphoto/Nancy Nehring)

ScienceDaily (June 17, 2010) — Researchers at the Stanford University School of Medicine have identified a new group of proteins involved in determining the life span of laboratory roundworms. Blocking the expression of one member of the group can extend the worm's life span by up to 30 percent. Because the proteins work in the worms' reproductive systems, the research represents yet another intriguing link between longevity and fertility.

In particular, the researchers showed that the proteins are involved in epigenetics -- a phenomenon in which chemical modifications to DNA and the proteins around it affect how it is packaged and expressed in a cell. Although an organism can't change the DNA sequence of the genes it has inherited, epigenetic changes allow it to silence or tweak their expression in response to environmental or other external cues.

"We've shown here that an epigenetic change can affect the life span of an organism," said Anne Brunet, PhD, assistant professor of genetics, "but only within the context of an intact reproductive system." Brunet is the senior author of the study, which will be published online June 16 in *Nature*.

Roundworms, also known as *Caenorhabditis elegans*, are a popular laboratory animal. They are easy to care for, and their approximately four-week life span makes them good models for longevity studies. For technical reasons, though, most longevity researchers have conducted their experiments on sterile worms.

Brunet and graduate student Eric Greer wanted to explore the effect of epigenetic changes on longevity. But they wondered if using fertile worms might be more appropriate for their studies. After all, other studies of the worms have suggested that fertility is at least indirectly linked to longevity.

Greer, who is the lead author of the study, used a technique called RNA interference in fertile worms to methodically block the expression -- one by one -- of genes known to affect a cell's epigenetic status. He identified a number of genes that, when inhibited, caused the worms to live up to 30 percent longer than normal.

The gene with the most pronounced effect, Ash-2, makes a protein that functions as a methyltransferase -- meaning it works together with other proteins to add a chemical tag called a methyl group to a component of a cell's DNA packaging machinery, which is known as a histone. The presence or absence of this tag affects whether the DNA remains wound up tightly like thread on a spool, or unfurls to allow its genes to be expressed.

Inhibiting Ash-2 activity reduces the number of methyl tags on the histone, which keeps the DNA inaccessible and somehow extends the animal's life by as much as 30 percent. Conversely, the researchers found, blocking the expression of a protein called Rbr-2 taxed with removing the tag -- a demethylase -- shortened the worm's life span by about 15 to 25 percent. Worms in which the expression of both proteins were blocked had slightly shortened lives.

Clearly the levels of methylation on that particular spot on the histone are important to longevity. But why? And how are they calibrated?

The researchers found that Ash-2 is highly expressed in the germline, or reproductive cells, as well as in newly formed eggs. These cells also had high levels of the methyl tag. When Greer blocked the expression of Ash-2 in worms that lacked normal reproductive cells, he found that this no longer extended worm life span, suggesting that an intact germline is necessary for Ash-2 to regulate longevity.

Further investigation showed that Ash-2 activity affects the expression of several genes specific to germline cells, including a group previously shown to affect adult life span. Blocking Ash-2 expression only in germline cells, but not in the rest of the worm's body, still extended its life span, as did expressing excess amounts of the tag-removal protein Rbr-2 in the germline. Finally, another series of experiments showed that the presence of mature eggs is required for Ash-2 knockdown to have an effect.

"We still don't know exactly how this works mechanistically," said Brunet, "but we've shown that the presence of the germline is absolutely essential for this longevity extension to happen."

In the future the researchers plan to monitor the methylation status of the histone during the animal's life span. Because epigenetic changes are reversible, it's likely they'll see a natural ebb and flow as the worm ages. They'd also like to examine the effect of environmental situations known to affect longevity, such as calorie restriction, on the tagged histone.

"Aging is a very plastic process," said Brunet, who cautioned that it's possible that Ash-2 also works elsewhere in the worm. "This tagging doesn't affect reproduction directly, but it somehow talks to the rest of the body to affect the whole organism." Perhaps, they speculate, the genes activated by the loss of Ash-2 work together with other factors produced by mature eggs to lengthen the animal's life.

"It makes a sort of sense that the reproductive system would be involved in life span, since that is really the only 'immortal' part of an organism," said Brunet. "In that context, the body is just the mortal envelope."

In addition to Greer and Brunet, other Stanford researchers involved in the study include assistant professor Or Gozani, PhD; postdoctoral scholars Travis Maures, PhD, Erin Green, PhD, and Geraldine Maro, PhD; graduate students Dena Leeman, Shuo Han and Max Banko; and undergraduate student Anna Hauswirth. The research was supported by the National Institutes of Health, the Human Frontier Science Program and a Searle Scholar Award.

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Stanford University Medical Center**. The original article was written by Krista Conger.

Journal Reference:

1. Eric L. Greer, Travis J. Maures, Anna G. Hauswirth, Erin M. Green, Dena S. Leeman, Géraldine S. Maro, Shuo Han, Max R. Banko, Or Gozani & Anne Brunet. **Members of the H3K4 trimethylation complex regulate lifespan in a germline-dependent manner in C. elegans**. *Nature*, June 16, 2010 DOI: 10.1038/nature09195

http://www.sciencedaily.com/releases/2010/06/100616133319.htm

Hints from Taiwan That Free-Range Eggs May Be Less Healthy Than Regular Eggs

New research suggests that free-range eggs may be less healthy than regular eggs. (Credit: iStockphoto/Chris Hepburn)

ScienceDaily (June 17, 2010) — Contrary to popular belief, paying a premium price for free-range eggs may not be healthier than eating regular eggs, a new study reports. Scientists found that free-range eggs in Taiwan contain at least five times higher levels of certain pollutants than regular eggs.

Their findings appear in ACS' bi-weekly *Journal of Agricultural and Food Chemistry*.

In the new study, Pao-Chi Liao and colleagues note that free-range chickens are those that have continuous access to fresh air, sunshine, and exercise, in contrast to chickens that are confined to cages. Demand for eggs from free-range chickens has increased steadily due to their supposed better nutrition qualities, including higher levels of certain healthy fats. But scientists suspect that free-range chickens may risk getting higher levels of exposure to environmental pollutants, particularly PCDDs and PCDFs, potentially toxic substances that are produced as by-products of burning waste. Also known as dioxins, these substances may cause a wide range of health problems in humans, including reproductive and developmental problems and cancer.

The scientists collected six free-range eggs and 12 regular eggs from farms and markets in Taiwan and analyzed the eggs for their content of dioxins. Taiwan, they note, is a heavily populated, industrialized island with many of the municipal incinerators that release PCDDs and PCDFs. They found that the free-range eggs contained 5.7 times higher levels of PCDDs and PCDFs than the regular eggs. The scientists suggest that the findings raise concern about the safety of eating free-range chicken eggs.

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **American Chemical Society**, via EurekAlert!, a service of AAAS.

Journal Reference:

1. Jing-Fang Hsu, Chun Chen, Pao-Chi Liao. **Elevated PCDD/F Levels and Distinctive PCDD/F Congener Profiles in Free Range Eggs**. *Journal of Agricultural and Food Chemistry*, 2010; : 100603133421072 DOI: 10.1021/jf100456b

http://www.sciencedaily.com/releases/2010/06/100616122124.htm

Dinosaur-Chewing Mammals Leave Behind Oldest Known Tooth Marks

A close-up of the tooth marks gouged in the rib bone of a large dinosaur by a mammal that lived 75 million years ago. (Credit: Photo by Nicholas Longrich/Yale University)

ScienceDaily (June 17, 2010) — Paleontologists have discovered the oldest mammalian tooth marks yet on the bones of ancient animals, including several large dinosaurs.

They report their findings in a paper published online June 16 in the journal *Paleontology*.

Nicholas Longrich of Yale University and Michael J. Ryan of the Cleveland Museum of Natural History came across several of the bones while studying the collections of the University of Alberta Laboratory for Vertebrate Palaeontology and the Royal Tyrrell Museum of Palaeontology. They also found additional bones displaying tooth marks during fieldwork in Alberta, Canada. The bones are all from the Late Cretaceous epoch and date back about 75 million years.

The pair discovered tooth marks on a femur bone from a *Champsosaurus*, an aquatic reptile that grew up to five feet long; the rib of a dinosaur, most likely a hadrosaurid or ceratopsid; the femur of another large dinosaur that was likely an ornithischian; and a lower jaw bone from a small marsupial.

The researchers believe the marks were made by mammals because they were created by opposing pairs of teeth -- a trait seen only in mammals from that time. They think they were most likely made by multituberculates, an extinct order of archaic mammals that resemble rodents and had paired upper and lower incisors. Several of the bones display multiple, overlapping bites made along the curve of the bone, revealing a pattern similar to the way people eat corn on the cob.

The animals that made the marks were about the size of a squirrel and were most likely gnawing on the bare bones for minerals rather than for meat, said Longrich. "The bones were kind of a nutritional supplement for these animals."

There are likely many other instances of mammalian tooth marks on other bones that have yet to be identified, including older examples, said Longrich. "The marks stood out for me because I remember seeing the gnaw marks on the antlers of a deer my father brought home when I was young," he said. "So when I saw it in the fossils, it was something I paid attention to."

But he points out that the Late Cretaceous creatures that chewed on these bones were not nearly as adept at gnawing as today's rodents, which developed that ability long after dinosaurs went extinct.

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Yale University**.

Journal Reference:

1. Nicholas R. Longrich, Michael J. Ryan. **Mammalian tooth marks on the bones of dinosaurs and other Late Cretaceous vertebrates**. *Paleontology*, 2010; DOI: 10.1111/j.1475-4983.2010.00957.x

http://www.sciencedaily.com/releases/2010/06/100616161207.htm

Towards Nanowire Solar Cells With a 65-Percent Efficiency

Solar cells. (Credit: Image courtesy of TU/)

ScienceDaily (June 17, 2010) — Eindhoven University of Technology (TU/) researchers want to develop solar cells with an efficiency of over 65 percent by means of nanotechnology. In Southern Europe and North Africa these new solar cells can generate a substantial portion of the European demand for electricity. The Dutch government reserves EUR 1.2 million for the research.

The current thin-film solar cells (type III/V) have an efficiency that lies around 40 percent, but they are very expensive and can only be applied as solar panels on satellites. By using mirror systems that focus one thousand times they can now also be deployed on earth in a cost-effective manner. The TU/ researchers expect that in ten years their nano-structured solar cells can attain an efficiency of more than 65 percent. Jos Haverkort: "If the Netherlands wants to timely participate in a commercial exploitation of nanowire solar cells, there is a great urgency to get on board now." The research is conducted together with Philips MiPlaza.

They think that nanotechnology, in combination with the use of concentrated sunlight through mirror systems, has the potential to lead to the world's most efficient solar cell system with a cost price lower than 50 cent per Watt peak. In comparison: for the present generation of solar cells that cost price is 1.50 euro per Watt peak.

Stacking Nanowires make it possible to stack a number of subcells (junctions). In this process each subcell converts one color of sunlight optimally to electricity. The highest yield reported until now in a nanowire solar cell is 8.4 percent. Haverkort: "We expect that a protective shell around the nanowires is the critical step towards attaining the same efficiency with nanowire solar cells as with thin-film cells." Haverkort thinks that at 5 to 10 junctions he will arrive at an efficiency of 65 percent.

Scarcity of raw materials In addition, the researchers expect considerable savings can be made on production costs, because nanowires grow on a cheap silicon substrate and also grow faster, which results in a lower cost of ownership of the growth equipment. What is more, the combination of the mirror systems with nanotechnology will imply an acceptable use of the scarce and hence expensive metals gallium and indium.

An agency of the Ministry of Economic Affairs, will grant the EUR 1.2 million to researchers dr. Jos Haverkort, dr. Erik Bakkers en dr. ir. Geert Verbong for their research into nanowire solar cells. It is their expectation that, when combined with mirror systems, these solar cells can generate a sizeable portion of the European electricity demand in Southern Europe and North Africa.

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Eindhoven University of Technology**.

http://www.sciencedaily.com/releases/2010/06/100616122320.htm

Volcanic Emissions Used to Study Earth's Atmospheric Past

Eruption of Eyjafjallajökull Volcano, Iceland. Image taken on May 17, 2010 (Credit: NASA/Earth Observatory)

ScienceDaily (June 17, 2010) — On March 20, Iceland's Eyjafjallajokull volcano woke from its nearly 200-year slumber to change the way the world viewed volcanoes forever. Bringing almost all transatlantic air travel to a halt for the first time in modern history, this volcano reminded humanity of the powers these forces of nature contain -- and of our relative inability to understand them. Associate Professor Huiming Bao of LSU's Department of Geology & Geophysics has published research in the journal *Nature* about massive volcanic eruptions and their atmospheric consequences in the past in North America.

"Past volcanic eruptions have had significant impacts on the environment," said Bao. "We humans have witnessed the various impacts of volcanic eruptions like the 1991 Mount Pinatubo and the more recent Icelandic one. The physical aspect of the impacts such as explosion or ash plumes is often short-lived, but the chemical consequence of its emitted massive gases can have a long-lasting effect on global climate."

The paper represents research into the Earth's climactic past. Using computer models and geological data, Bao and his colleagues, Shocai Yu of the EPA and Daniel Tong of the National Oceanic and Atmospheric Administration, or NOAA, were able to simulate the sulfur gas oxidation chemistry and atmospheric condition of the northern high plains region of North America long before human activities began significantly impact the air quality. Yu and Tong contributed to the modeling aspect of the study. They used a state-of-the-art atmospheric sulfur chemistry and transport model to simulate the atmospheric conditions necessary for the observed sulfate isotope data preserved in rock records.

Bao and his colleagues discovered that many of the volcanic ash beds are rich in sulfate, the product of atmospheric oxidation of sulfur gases. Most importantly, these sulfates have distinct stale isotope signatures that can tell how they were formed in the atmosphere, particularly which oxidation pathways they went through. In order to explain their geological data, they did an extensive modeling test and found that it is imperative to have an initial alkaline cloudwater pH condition, which rarely exists in modern days.

According to Bao, the most important volcanic gas -- as far as atmospheric implications go -- is sulfur dioxide, or SO_2. This gas is oxidized in the atmosphere, where it is turned into sulfate aerosol, which plays a

very sensitive role in the rate and impact of climate change. When the sulfate aerosol is dense or long-lasting and the depositional condition is right, the sulfate aerosol can be preserved in rock records.

"These sulfate aerosol deposition events were so intense that the sulfate on the ground or small ponds reached saturation and gypsum mineral formed," Bao said. He pointed out that the closest analog event is perhaps the 1783 Laki eruptions of Iceland and the subsequent "dry fogs" in continental Europe. "That event devastated Iceland's cattle population. People with lung problems suffered the worst. In North America, the next year's winter was the longest and one of the coldest on record. The Mississippi River froze at New Orleans. The French Revolution in 1789 may have been triggered by the poverty and famine caused by the eruption."

These explosive eruptions are much more intense and sulfur rich than any human has ever experienced or recorded. But that doesn't mean that eruptions of such magnitude can't happen today.

"It is important to note that the volcanic eruptions we experienced in the past thousands of years are nothing compared to some of the eruptions occurred in the past 40 million years in western North America, either in the level of power or the amount of SO_2 spewed," said Bao. "What we reported in our *Nature* paper is that there were many massive volcanic SO_2 emissions and dense sulfate aerosol events in the northern High Plains of North America in the past. We show that in the past the sulfate aerosol formed in a very different way than today, indicating a difference in the past atmospheric condition or something peculiar with these explosive eruptions in the west."

Story Source:

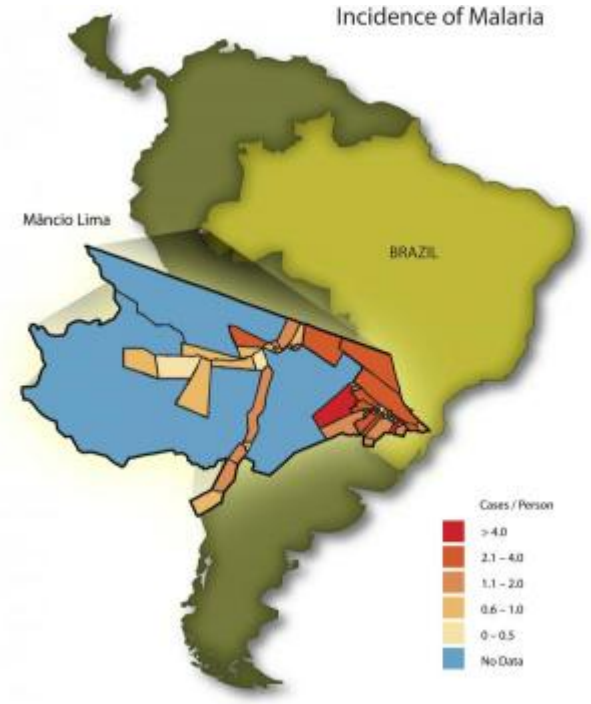
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Louisiana State University**.

Journal Reference:

1. Huiming Bao, Shaocai Yu & Daniel Q. Tong. **Massive Volcanic SO2 Oxidation and Sulfate Aerosol Deposition in Cenozoic North America**. *Nature*, June 16, 2010 DOI: 10.1038/nature09100

http://www.sciencedaily.com/releases/2010/06/100616141657.htm

Incidence of Malaria Jumps When Amazon Forests Are Cut, Study Finds



A new study by researchers Jonathan Patz and Sarah Olson from the University of Wisconsin--Madison Center for Sustainability and the Global Environment documents the incidence of malaria in relation to land use in 54 Brazilian health districts deep in the Amazon. The study shows that a 4 percent increase in deforestation can spark a 48 percent jump in the incidence of malaria by creating favored habitat for the mosquito that is the primary carrier of the disease in the region. (Credit: Map by Barry Carlsen)

ScienceDaily (June 17, 2010) — Establishing a firm link between environmental change and human disease has always been an iffy proposition.

Now, however, a team of scientists from the University of Wisconsin-Madison, writing in the current (June 16, 2010) online issue of the CDC journal *Emerging Infectious Diseases*, presents the most enumerated case to date linking increased incidence of malaria to land-use practices in the Amazon.

The report, which combines detailed information on the incidence of malaria in 54 Brazilian health districts and high-resolution satellite imagery of the extent of logging in the Amazon forest, shows that clearing tropical forest landscapes boosts the incidence of malaria by nearly 50 percent.

"It appears that deforestation is one of the initial ecological factors that can trigger a malaria epidemic," says Sarah Olson, the lead author of the new report and a postdoctoral fellow at the Nelson Institute, Center for Sustainability and the Global Environment.

The clearing of tropical forests, say Olson and senior author Jonathan Patz of the University of Wisconsin School of Medicine and Public Health, creates conditions that favor malaria's primary carrier in the Amazon, the mosquito Anopheles darlingi, which transmits the malaria parasite if it draws its blood meals from infected humans.

"The deforested landscape, with more open spaces and partially sunlit pools of water, appears to provide ideal habitat for this mosquito," Olson says, noting that Anopheles darlingi has been shown to displace other types of mosquitoes that prefer forest and that are far less prone to transmit malaria.

"This study of human malaria cases complements our previous work that focused more on the abundance of the malaria-carrying mosquito," Patz adds. "In those studies from the Peruvian Amazon, we showed a correlation between this mosquito's larvae and aquatic breeding sites in disturbed habitats following land clearance."

The new Wisconsin study focused on 54 Brazilian health districts in a corner of the Brazilian Amazon near Peru and where detailed health and population data were collected in 2006 by Brazilian researchers. Combined with high-resolution satellite data of changes in land cover, the health data reveals the large human-health impact of relatively small changes to the forest landscape.

"A 4 percent change in forest cover was associated with a 48 percent increase in malaria incidence in these 54 health districts," notes Olson. "The health data used in the study is of the highest quality and spatial resolution. Unlike previous studies, our data allowed us to zoom in on areas where people are being exposed to malaria and to exclude areas where they are not being exposed."

The health districts reflected in the Wisconsin study are typical of many of the thousands of such districts spread across Brazil and its Amazon region. Since 2001, the Brazilian Ministry of Health has similarly monitored and treated malaria in more than 7,000 districts. Deforestation in the districts, says Olson, is occurring as it typically does in Amazonia, and occurs mostly near rivers, the backbone of the region's transportation system, and spreads outward.

The new work, argues Patz, an authority on environmental change and human health, shows how deforestation and land clearing contribute to malaria's dynamic at the frontier of settlement. "In 2006, the county that encompasses these health districts was in the top five of all Brazilian counties with malaria," Patz says. "Even after we adjusted for human populations, access to healthcare and other factors, malaria hotspots paralleled locations with the most destruction of rainforests."

The message from the study, say Olson and Patz, is that tropical forest conservation may benefit human health more than we realized.

"Land-management practices show promise as useful interventions to reduce malaria risk factors," says Olson.

Patz and Olson believe the new work provides a template that could be used to spatially track environmental risk factors and the incidence of malaria, which infected an estimated 500,000 Brazilians annually across the Amazon basin from 1997 to 2006. "The technology is there. The health data is there. Health officers with cell phones could gather data for the whole Amazon region," Olson says.

The National Aeronautics and Space Administration funded the new study.

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New Tools for Helping Heart Patients

By GINA KOLATA

On a recent Monday, Helen Elzo got a call from her doctor's office. A device implanted in her heart was not functioning. She needed to go to the hospital and have it replaced.

She was aghast — her heart is damaged and, at any time, can start quivering instead of beating. If the device, a defibrillator, was unable to shock her heart back to normal, her life was in danger.

In the old days, Mrs.Elzo, 73, who lives outside Tulsa, Okla., could have gone for months before the problem was discovered at a routine office visit.

But she has a new defibrillator that communicates directly with her doctor, sending signals about its functions and setting off alarms if things go wrong.

On the horizon is an even smarter heart device, one that detects deterioration in various heart functions and tells the patient how to adjust medications.

They are part of a new wave of smart implantable devices that is transforming the care of people with heart disease and creating a bonanza for researchers. The hope is that the devices, now being tested in clinical trials, will save lives, reduce medical expenses and nudge heart patients toward managing their symptoms much the way people with diabetes manage theirs. Patients, who often are frail or live far from their doctors, can be spared frequent office visits. Doctors can learn immediately if devices are malfunctioning or if patients' hearts are starting to fail.

"It's like having an office visit every day and a complete physical every week," said Dr. Leslie Saxon, a cardiologist at the University of Southern California.

The big leap forward came a few years ago when device companies figured out how to make transmitters that send data over a broader range, 20 or 30 feet. That meant that, with her device, Mrs. Elzo did not have to wait till her doctor could put a receiver directly on her chest. Instead, she simply went near a small box, which is attached to a phone jack near her bed. Once a week, she also measures her weight and blood pressure — key indicators of heart failure — and that information is automatically transmitted to her doctor. If there are problems, the machine alerts her doctor.

"Now, every single day the device is being queried," said her doctor, James Coman of the Heart Rhythm Institute in Tulsa. "It's just a phenomenal tool."

There is a downside, though: "Information overload is a very serious problem" for the doctors, said Dr. Lynne Warner Stevenson, director of the Heart Failure Program at Brigham and Women's Hospital in Boston and a professor at Harvard Medical School, who counts herself as a proponent of smart devices. More information, she warned, is not always beneficial.

The devices transmit useful data along with data whose significance is not clear, like variations in heart rate. Large swings in heart rate can indicate risk, but it is not clear what to do about them.

Even more confusing are changes in thoracic impedance, a measurement of resistance to electric current through the lung. Impedance changes can predict future heart crises, but more often have no clinical explanation. Yet when doctors get data on impedance changes, they often feel uneasy and call patients to see how they are, making patients uneasy in turn, Dr. Stevenson said.

Dr. Stevenson likened such information to the game of "Jeopardy!" — doctors are given answers in search of a question. It's a challenge even for the nation's 1,000 heart failure specialists. But it can be even harder for primary care doctors, who have less expertise in heart failure yet care for most of the six million patients in the country with the condition.

Dr. Richard Page, president of the Heart Rhythm Society, said doctors wonder if they can be held liable if they do not look at all the data. Still, he said, the new technology "is potentially transformative."

For researchers the information deluge leads to a different problem: how to analyze the data. A large clinical trial of a cardiac device used to involve 1,000, maybe 2,000 patients. Now, Boston Scientific, a maker of one of the smart heart devices, is following 400,000 patients.

"No one has ever done research like this before," said Dr. Saxon, who leads an independent team of academic scientists overseeing Boston Scientific research. The company has no editorial control over the papers the scientists write, Dr. Saxon said.

Boston Scientific gets data from patients' defibrillators. It also gets information on deaths from Medicare.

The data are stripped of patient identifiers and analyzed, a task requiring the company to become more like a Google or a Microsoft, handling enormous amounts of information. There are, for example, more than four

million recordings of weights and blood pressures and over 60,000 instances when the defibrillators went off, shocking a patient's heart.

So far, Dr. Saxon's group has reported on the first 90,000 patients. Half of them had not been enrolled for remote monitoring and served as a control group.

Patients whose doctors looked at the data survived 5 to 15 percent longer than patients in earlier clinical trials of the devices, Dr. Saxon reported. And, in a paper under review, the group reports that their three-year survival was significantly greater than that of patients in the study whose doctors did not see the data.

Other researchers will be analyzing economic data. The devices can cost as much as $30,000. Do patients with defibrillators make up for some of that expense with fewer hospitalizations or doctor visits?

A study using a similar device, made by Medtronic, suggests that is the case. The Medtronic study, directed by Dr. George Crossley, president of St Thomas Heart at Baptist Hospital in Nashville, involved 2,000 patients randomly assigned to receive a defibrillator that transmitted data or a device that did not transmit. Those with the nontransmitting device were seen in their doctor's offices every few months, the standard of care.

Patients whose devices transmitted spent less time, on average, in the hospital when they were admitted — 3.3 days compared with 4 days — and their hospital costs were $1,600 less per admission.

"The plausible reason, we think, is that we got to these people much sooner in the course of their illness," Dr. Crossley said. "We think we did not let the people in the remote sensing group get into heart failure."

Still, the information overload problem looms. One solution, being tested by St. Jude Medical, a medical device company in St. Paul, is to let patients deal with important data.

The idea, said Dr. Neal Eigler, a senior vice president at St. Jude, is to get heart patients to adjust their medications regularly based on readings of their heart's functioning, just as patients with diabetes adjust their insulin based on blood glucose readings.

Patients hold a small device over their chest twice a day, and if they experience symptoms like shortness of breath. It transmits readings of blood pressure in the left atrium — the upper left chamber of the heart. If pressure in that chamber gets too high, the lungs can fill with fluid.

Doctors preprogram the hand-held device to provide instructions to patients in response to their left atrial pressure measurements, telling them, for example, to take a different dose of a medication, restrict fluid intake, increase their activity level or call the clinic.

If successful, the smart device could have a big effect. One million patients a year are hospitalized for heart failure. Ninety percent of the time it is because fluid has accumulated in their lungs.

Dr. Stevenson, who has no connection with St. Jude, is intrigued. Patients can see what is happening to their own bodies and act accordingly. They have to strictly limit salt in their diet, for example, and seeing their left atrial pressure might be motivating.

"A patient might say, 'Maybe my pressure is higher because that pizza I had for dinner last night had a lot of salt,' " Dr. Stevenson said.

As a more positive incentive, the device can also instruct patients to decrease their medications if they are doing well.

St. Jude recently completed a small study of 40 patients and is starting a large clinical trial. In the pilot study, the device reduced the frequency of high atrial pressure readings by two-thirds and the number of hospitalizations by 80 percent over five months.

Meanwhile, patients whose doctors can deal with the data stream from smart devices say they are getting peace of mind.

They include people like Danielle Denlein, who, to her total shock, developed a serious heart problem.On October 20, 2008, at 1:50 p.m., Ms. Denlein was driving to a drug store to buy formula for her 5-day-old baby girl. Suddenly, she felt a pain in her chest. She thought it was heartburn. Then it began radiating down her arm.

"I just knew — I don't know how I knew, but I knew — I was having a heart attack," she said.

Although she was only 35, her main coronary artery had ripped open, a rare complication associated with pregnancy.

Ms. Denlein now relies on her smart defibrillator to save her from her injured heart, and to alert her doctor, Dr. Saxon, to problems if they occur.

"It's life changing," Ms. Denlein said. "It gives me such a feeling of comfort."

Mrs. Elzo feels the same way.

Had her device not alerted her doctor that it needed to be replaced, she said, "I shudder to think what would have happened."

http://www.nytimes.com/2010/06/22/health/22heart.html?nl=health&emc=healthupdateema2

Tuberculosis: Mining Plays Bigger Role in TB in Africa Than Had Been Realized, Study Finds

By DONALD G. McNEIL Jr.

Dust-choked mine shafts, crowded working conditions and stifling hostels where up to 16 miners share a room — all conspire to make mining a more important contributor to tuberculosis in Africa than had been realized, a new study finds.

Rates of the illness have doubled in Africa over the past two decades, and have tripled in South Africa, which even in 1996 had the highest TB rates in the world. Until now it has been assumed that the increases were driven by Africa's high rates of infection with the AIDS virus, which weakens the immune system, helping latent TB become active.

But researchers from Brown and Oxford Universities, the London School of Hygiene and Tropical Medicine, and the University of California, San Francisco, compared 44 African countries and found that even some with low rates of H.I.V. infection rates had high TB rates. When a country's mines shut down, tuberculosis often fell. The study appeared in The American Journal of Public Health.

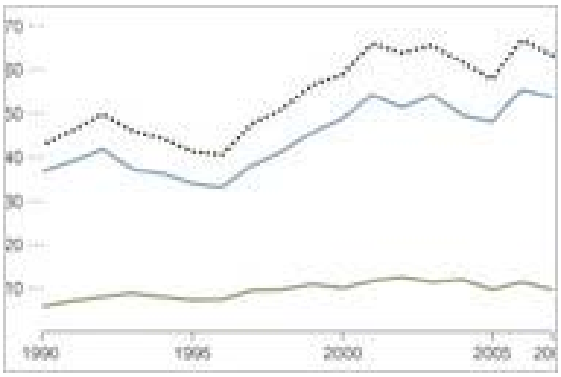
The paper notes that many miners are migrant laborers who may go home only once or twice a year. Not only can they infect their wives and children, the authors found, but they stop seeing the mine clinic doctors who are familiar with tuberculosis and may interrupt taking their antibiotics, increasing the chances that they will develop a drug-resistant strain.

Gold seems to be the most dangerous product to mine, because workers in those deep, hot shafts breathe in more rock dust.

http://www.nytimes.com/2010/06/22/health/22glob.html?ref=research

Weight-Lifting Injuries on the Rise

By NICHOLAS BAKALAR



More and more people are lifting weights these days — and sometimes dropping them where they shouldn't.

A new study finds that from 1990 to 2007, nearly a million Americans wound up in emergency rooms with weight-training injuries, and that annual injuries increased more than 48 percent in that period.

About 82 percent of the 970,000 people injured were men, according to the study, which appeared in the April issue of The American Journal of Sports Medicine. (The researchers used data from a national injury surveillance database.) But the annual number of injuries in women increased faster — by 63 percent, compared with 46 percent among men — perhaps because weight training is growing more popular with women.

Women were more likely to injure their feet and legs, while men's injuries were more common in the trunk and hands; men had more sprains and strains, and women had more fractures.

People were most often injured by dropping weights on themselves, crushing a body part between weights or hitting themselves with the equipment. Overexertion, muscle pulls and loss of balance accounted for about 14 percent of emergency room visits. More than 90 percent of the injuries occurred while using free weights rather than weight machines.

Under 2 percent of the injuries resulted in hospitalization, but a few were fatal: the researchers estimate that 114 deaths nationwide were related to weight training over the 18-year period.

Estimates of the number of people who use weights vary, but according to the National Sporting Goods Association, a trade group, 34.5 million people participated in weight training in 2009.

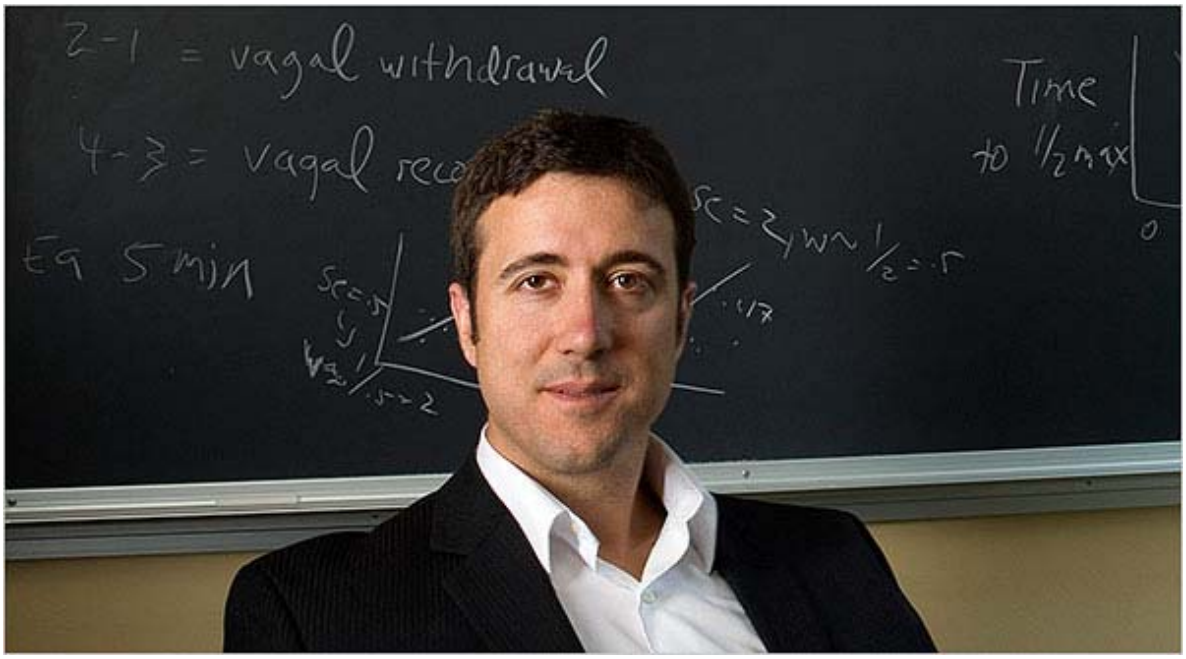
"We want people to continue to use weight training as part of their physical routine," said a co-author of the study, Christy L. Collins, a senior research associate at Nationwide Children's Hospital in Columbus, Ohio. But, she added, they "should receive proper instruction and use proper techniques for their lifts."

"As researchers," she went on, "we want to learn more about these injuries so that we can develop targeted preventive measures."

http://www.nytimes.com/2010/06/22/health/22stat.html?ref=research

Seeking to Illuminate the Mysterious Placebo Effect

By ERIK VANCE



The phrase “mind-body connection” has many connotations. For some, it’s shorthand for New Age quackery. For others, it’s a source of hope and a way to reconcile their spiritual life with modern science.

For Tor D. Wager, it’s just another day at the office.

Dr. Wager (pronounced WAY-gur) is a professor of psychology at the University of Colorado. His specialty is neuroscience and brain imaging, but his passion is the placebo effect — a phenomenon that has undergone a resurgence in recent years and is now being studied by researchers in many corners of science.

Much of this attention is a result of the kind of brain imaging Dr. Wager does, and he is a leading figure in the new generation of placebo researchers.

Which may make his background seem unlikely. Dr. Wager, 35, was raised in Christian Science, a religion mostly known for its aversion to medical treatment. His family was not strict about it, however; he recalls an incident from his Colorado childhood that could have served as a harbinger for his career.

As a baby, he says, he came down with a rash, and after much prayer his mother took him to a doctor, fearing scarlet fever. “The doctor said, ‘Here’s a cream, rub it on there,’ and it went away,” Dr. Wager said.

So did his mother’s distress. Her pulse probably slowed, he says now, and her breathing relaxed — just the effect a placebo may have on a terrified patient.

Increasingly, placebo effects are being viewed as real and tangible, if mysterious. In various surveys, 45 percent to 85 percent of American and European practitioners say they have used placebos in clinical practice, and 96 percent of academic physicians in the United States say they think placebos have therapeutic effects.

Even so, many scientists mistrust them.

“When I started grad school I felt like it was kind of taboo to study the placebo,” Dr. Wager said. The research at the time was spotty at best, “and then there were whole sections of society that were ready to jump on that and say, ‘Oh, look how powerful the mind is!’ ”

But placebo research has gained respectability in recent years, thanks largely to the work of Dr. Fabrizio Benedetti, an Italian neuroscientist widely seen as the patriarch of the field. Dr. Benedetti argues that there is not a single placebo effect, but many.

One common effect involves the assumption that a particular pill is responsible for easing pain or discomfort that is actually subsiding naturally. Another is classic Pavlovian conditioning, in which a patient is so accustomed to feeling better after a shot that it works no matter what is in it. Another is the relief a patient like Dr. Wager’s mother feels when a doctor offers a concrete solution.

As a graduate student at the University of Michigan, Dr. Wager used imaging to watch emotions in the brain. It was fascinating work, he says, but emotions are hard to define with precision and he wanted to do something that could help patients.

So he decided to look at placebos in a clinical setting. In 2001 he joined forces with Dr. Robert M. Rose, a University of Texas scientist who had done pioneering studies of stress in Vietnam War veterans, and a group of respected researchers called the Network on Mind-Body Interactions.

Within a few years, Dr. Wager’s name was at the top of a groundbreaking study in the journal Science that used functional magnetic resonance imaging — a specialized scan that measures changes in blood flow — to link specific brain activation to people experiencing a placebo effect (in this case rubbing unmedicated cream on a burn). Since then, he has written roughly a dozen scientific papers on placebo effects, including a 2007 study linking pain-related effects to parts of the brain that process opium or heroin (which may help explain why many placebos are temporary). “Tor is a person who has to convince himself of something,” Dr. Rose said. “He doesn’t buy it because someone else does it. He is a skeptic. But once he buys it, boy, is he dogged.”

When Dr. Wager isn’t writing about placebos, he is defending the tools he uses to study them. Many critics are skeptical of functional M.R.I., and Dr. Wager says that at first he was, too.

To deal with that skepticism, he said, one can either “a) say, ‘Ah, this is all sort of bogus, let’s do something else,’ or b) try to work and develop things that make it a lot more believable.”

At the recent conference of the Organization for Human Brain Mapping, Dr. Wager gave a presentation about placebos to a full house of scientists. But his laboratory at the University of Colorado also shared arcane new statistics for reading brain scans. Such attention to detail, he said, is the only way to convince skeptics.

Until recently, the government and the drug industry have been hesitant to finance studies of placebo effects.

"Companies who are developing new treatments like to think that actually their new treatment works well enough to do better than just the power of positive thinking," said Dr. Helen S. Mayberg, a neurologist at Emory University known for her work with functional M.R.I. in patients with depression. (She quickly added that placebo effects were very different from positive thinking.)

Drug trials sometimes start with everyone getting a placebo; those who recover are then weeded out. While perhaps strengthening the results, this does not help researchers understand why people in the first group got better.

That persistent question — why some people are more responsive to placebos than others — has long frustrated scientists. "There's decades of research that has more or less failed," Dr. Wager said. "New methods are going to let us get a lot more out of it."

Solving the mystery would potentially unlock whole new areas for therapy. Dr. Wager recently attended a meeting sponsored by the National Institutes of Health about enlisting multiple institutions in an effort to understand placebos. Several drug companies were present; some have begun their own research into the mystery.

Dr. Wager (who receives financing from the N.I.H., the National Science Foundation and the Michael J. Fox Foundation) says drug companies were cautious about bringing too much attention to placebos, but recognized a potential for better therapies.

But for him it is a deeper question, tied to his childhood religion and the way he sees the world.

"What is the placebo effect?" he asked. "It's not some weird magical thing that just kind of happened out of the blue.

"I think it's connected to systems that generate emotional responses," he continued. "It's a window into ways in which psychological factors can affect brain and body factors that are related to health."

http://www.nytimes.com/2010/06/22/health/22prof.html?ref=research

Sharing Liberally

Cognitive Surplus: Creativity and Generosity in a Connected Age
Clay Shirky
The Penguin Press, $25.95 (Hardcover)

Evgeny Morozov

Internet enthusiasts come in two flavors: utopians and populists. The rhetoric of both camps is revolutionary, but the revolutions are different.

Utopians believe that the Internet provides promising new solutions to our most intractable problems. With enough tweets, all global bugs—war, poverty, illiteracy, fascism—can be quashed.

Populists promise no such lofty goals. They see the profound social confusion sown by the Internet as a historic opportunity to snatch power from elites and their institutions and redistribute it more evenly among netizens, the ordinary citizens who have been empowered by the Internet. Like the participatory democrats of earlier eras, the populists want a more direct democracy, and they think that most social institutions, from the traditional media to political organizations, are unnecessary ballast.

Of the two camps, the populists—whose ranks include social innovators (Jimmy Wales of Wikipedia and Craig Newmark of Craig's List), professors of journalism (NYU's Jay Rosen and CUNY's Jeff Jarvis), and social-diva-cum-publisher Arianna Huffington—are in much better shape. Although the cyber-utopian project is not dead—consider the irrational exuberance over Iran's "Twitter revolution"—the traces of evidence it relies upon don't support a coherent or convincing theory.

The resurgent cyber-populists, in contrast, have a theory and a plan. For them, the Internet is what a hand-made grenade was to 19th-century Russian anarchists. They want to rewire completely our social relations in order to maximize the role that the individual plays in this new—to use their buzzword—"eco-system."

Clay Shirky, an adjunct professor at NYU's Tisch School of the Arts, is a towering figure in this camp, with considerable credibility among business executives, technologists, and media critics. Having cut his teeth at several dotcoms, Shirky emerged as a leading popular theorist of Web 2.0 and used his blog as his main publishing platform. His 2008 bestseller, *Here Comes Everybody: The Power of Organizing without Organization*, was Web 2.0's equivalent of Thomas Friedman's *The World is Flat.* Building on insights from institutional economics and public-choice theory, Shirky argued that the Internet obviated the need for hierarchical structures and the sluggish organizations that perpetuated them: it was now possible to do things on the cheap—and, most importantly, on your own.

The success of *Here Comes Everybody* owed much to its propitious timing: public anxiety over the cultural barbarity of Wikipedia, YouTube, and MySpace was beginning to subside, while buzzwords like "crowdsourcing" and "the long tail" were becoming integrated into our everyday language. Thanks to his immense charisma (in his pre-Internet life Shirky was a theater director), his Gladwellian eye for the anecdotal, and, ironically, the growing institutional demand for his unabashedly anti-institutional Web 2.0 wizardry, Shirky found himself advising the World Bank, the U.S. State Department, and, in a bizarre turn, the Libyan government.

Cognitive Surplus: Creativity and Generosity In a Connected Age, Shirky's new book, grew out of a fifteen-minute lecture that became an Internet sensation. It's not hard to see why: Shirky is a rarity in today's Internet punditry, where bad Twitter jokes increasingly pass for original insights. When Shirky talks, he gives the impression that he not only writes books, but actually reads them.

From gin to the Internet

The main argument of *Cognitive Surplus* rests on a striking analogy. Just as gin helped the British to smooth out the brutal consequences of the Industrial Revolution, the Internet is helping us to deal more constructively with the abundance of free time generated by modern economies.

Shirky argues that free time became a problem after the end of WWII, as Western economies grew more automated and more prosperous. Heavy consumption of television provided an initial solution. Gin, that "critical lubricant that eased our transition from one kind of society to another," gave way to the sitcom.

More recently TV viewing has given way to the Internet. Shirky argues that much of today's online culture—including videos of toilet-flushing cats and Wikipedia editors wasting 19,000 (!) words on an argument about whether the neologism "malamanteau" belongs on the site—is much better than television. Better because, while sitcoms give us couch potatoes, the Internet nudges us toward creative work.

That said, *Cognitive Surplus* is not a celebration of digital creativity along the lines of Richard Sennett's *The Craftsman* or Lawrence Lessig's "remix culture." Shirky instead focuses on the sharing aspect of online creation: we are, he asserts, by nature social, so the Internet, unlike television, lets us be who we really are. "No one would create a lolcat to keep for themselves," Shirky argues, referring to the bête noire of Internet-bashers, the humorous photos of cats spiced up with funny and provocative captions. "Cognitive surplus" is what results when we multiply our constantly expanding free time by the tremendous power of the Internet to enable us do more with less, and to do it together with others.

According to Clay Shirky, 'the real gap is between doing nothing and doing something, and someone making lolcats has bridged that gap.'

Arguments about infinite digital opportunities for doing good have been a commonplace of cyber-utopians since the mid-1990s. But Shirky is a populist, not a utopian. His only benchmark of success is the relative standing of "us" against dominant institutions and, in particular, against the mind-numbing, brain-damaging, creativity-suppressing beast that is the traditional media.

For Shirky, doing anything online beats the passivity nurtured by the traditional media. The argument is beautiful in its simplicity: "the real gap is between doing nothing and doing something, and someone making lolcats has bridged that gap," for "the stupidest possible creative act is still a creative act."

To drive that point home, he proposes a thought experiment: while Americans spend 200 billion hours a year watching television, the whole of humanity spent something like 100 million hours to create Wikipedia (or, at least, its 2008 version). Thus, even a tiny change in our TV watching habits can lead to significant social gains. Not every Internet project would become a Wikipedia—lolcats are still currency of the day—but Shirky urges us to keep trying. Short-selling the Internet may prevent us stumbling upon a technology as revolutionary as the printing press.

Unencumbered by facts

Shirky's strong suit is not hard data, but clever anecdotes. He draws on a vast array of provocative and memorable stories—from anime communities in Japan to skaters in Santa Monica, garbage-collectors in Pakistan, and car-poolers in Canada—that help to bolster his thesis. But the anecdotes don't make up for the lack of rigor. In a book that claims to document broad social shifts across different media eco-systems, revolutionary changes are presumed to be self-evident, linear, and transparent.

This is not the first time that Shirky has made very liberal use of his evidence. In *Here Comes Everybody*, he discussed how young Belarusians used blogs to organize anti-government flash mobs. When I pointed out that the campaign was short-lived and had died out at the very moment that the country's secret police—which calls itself KGB even twenty years after the fall of the Soviet Union—started reading the same blogs, Shirky conceded that his book was "about social media rather than politics" and that it offered only "an imbalanced account of the arms race between citizens and their governments." Unfortunately, Shirky's confessions came too late: his flash-mob myth is now part of the populist lore.

In *Cognititive Surplus*, Shirky is comparably inventive. This time, the tech-savvy teenage protesters of South Korea make a prominent appearance. The South Korean example is worth discussing in detail because it highlights how easy it is to draw misleading conclusions from anecdotes.

For more than a month between May and June 2008, the streets of Seoul brimmed with tens of thousands of angry people, unhappy that newly elected president Lee Myung-Bak had lifted a five-year ban on imports of American beef. Many South Koreans felt that the ban, originally imposed because of fears of mad cow disease, had been rescinded too hastily, giving public safety a back seat to the exigencies of foreign policy.

So they took to Seoul's parks and public squares and mounted candlelight vigils and sang "No to mad cow!" By late June, their efforts paid off: the president was forced to apologize on national television, reshuffle his cabinet, and add a few extra restrictions to the trade agreement.

Shirky zeroes in on the high-school students—most of them girls—who spearheaded the protests. He is particularly impressed to report that they learned about the ban through postings on an Internet forum dedicated to their favorite boy band. "Massed together, frightened and angry that Lee's government had agreed to what seemed a national humiliation and a threat to public health, the girls decided to do something about it," Shirky writes, pointing out that the band's Web site "provided a place and a reason for Korea's youth to gather together by the hundreds of thousands."

For Shirky, this suggests nothing less than a revolution in revolution-making: "When teenage girls can help organize events that unnerve national governments, without needing professional organization or organizers to get the ball rolling, we are in new territory." He uses the story to illustrate the limitations of the South Korean media in fostering such revolutionary pursuits: a similar protest would have been unimaginable in the sitcom age.

Shirky says he is writing about Western democracies, but they are unrecognizable in his book, for they appear to have been sterilized completely of social conflict.

The media, he contends, were passive, as was their audience: “a large number of mostly uncoordinated amateur media consumers.” Meanwhile anything posted on the band’s site “was as widely and publicly available as any article in a Korean newspaper, and more available than much of what was on TV.” The girls “weren’t silent consumers but noisy producers themselves, able to both respond to and redistribute those messages at will”; as a result, “connected South Korean citizens, even thirteen-year-olds, radicalized one another” and were able to shake a government “used to a high degree of freedom from public oversight.”

But before the tale of candle-holding South Korean high schoolers forcing ministers to resign joins the Belarus myth, it might pay to look a little more carefully at what happened.

Discontent with Lee had been brewing before he lifted the ban, especially among students. One of his most controversial ideas involved a radical change to the country’s education system, which would have made English the language of instruction in most high schools. The candlelight protests also were not a novelty: the country went through a similar phase in 2002, when two girls were killed by a vehicle belonging to U.S. forces stationed in the country. Protests are common in South Korea, with about 11,000 annually.

Perhaps because of his scorn for the professional media, Shirky misses what may have been the real cause of the protests: a television report, provocatively titled “Is American Beef Really Safe from Mad Cow Disease?” that aired on *PD Notebook*, a current affairs program on the popular channel MBC. According to that program, a woman in Virginia recently had died from mad cow disease, the South Korean government had surrendered its sovereignty, South Koreans were genetically predisposed to the disease, and the disease could spread through the powdered soup base in instant noodles.

Shirky never mentions the TV show, nor does he say anything about the role of Korean celebrities in mobilizing the masses (a well-known actress claimed she would rather drink acid than eat American beef). Videos of the MBC broadcast did go viral online, and this “rebroadcast” played a role in getting people onto the streets. Still, rather than a triumph of the digital public sphere, the story of the high school protesters ultimately is an example of old-media alarmism spread with a little help from new-media friends.

The problem isn’t just that Shirky overlooks some facts. His central narrative—people vs. corrupt and irresponsible government—blinds him to the ambiguous implications of that mix of free time and Internet access that he celebrates as “cognitive surplus.” Yes, South Korea is prosperous and wired. But it still harbors numerous social ills that information technology may aggravate.

Shirky ignores South Korea’s epidemic of Internet addiction, from which 2 million residents (4 percent of the population) reportedly suffer. (Remember the South Korean couple that let their three-month-old starve to death while they reared their virtual child?) Nor does he mention the growth of xenophobic cyber-vigilante groups that troll social-networking sites in search of evidence that foreigners who come to teach English in the country behave immorally. And Shirky is similarly oblivious to the patriotic netizens who organize cyber-attacks on Japanese Web sites over matters as petty as figure skating. More substantial issues between the two countries—like the future of the disputed Liancourt Rocks islands—result in even greater online vitriol.

If your only metric of social progress concerns who has access to what tools and at what costs, such “negative externalities” do not matter. But if you are not already a committed populist, such risks may give you pause.

What Dwight Macdonald said of the work of Marshall McLuhan, that earlier media sage, aptly describes Shirky’s as well: “A single page is impressive, two are stimulating, five raise serious doubts, ten confirm them.” Macdonald also gave us an excellent diagnosis of this method:

McLuhan is a fast man with a fact. Not that he is careless or untruthful, simply that he's a system-builder and so interested in data only as building stones; if a corner has to be lopped off, a roughness smoothed to fit, he won't hesitate to do it.

When it comes to system-building and corner-smoothing, Shirky is an ultra-McLuhanite.

Populism without politics

A cyber-utopian polemic—a passionate call for the younger generation to ditch consumerist culture and pour its creative energies into fighting all the evil that exists in the world, one tweet at a time—could have made a worthy contribution. But Shirky's populism urges us simply to stop worrying, love the Web, and focus on liberating ourselves from the oppression of the traditional media.

"However pathetic you may think it is to sit in your basement pretending to be an elf," Shirky writes of those poor souls who waste too much time on computer games like World of Warcraft, "I can tell you from personal experience: it's worse to sit in your basement trying to decide whether Ginger or Mary Ann [from *Gilligan's Island*] is cuter." We have fundamentally misunderstood media, he argues, and what it should offer us. "Media is actually like a triathlon. . . . People like to consume, but they also like to produce and to share. We've always enjoyed all three of those activities, but until recently, broadcast media rewarded only one of them."

The Internet rewards all three. Furthermore, now that we know what really matters, we should disregard the people shilling—that is, working—for the print, radio, and television industries. Such people are only obstructing progress, and they will continue doing so, for "those deeply committed to old solutions cannot see how society would benefit from an approach incompatible with older models."

Like other books that attack television, *Cognitive Surplus* conveniently glosses over the fact that the BBC, for example, has been churning out superb cultural programming for decades. Forced to choose between the shallow activity fostered by the production and consumption of lolcats and the enlightened passivity fostered by watching BBC Four's in-depth documentaries, many people might reasonably favor the latter. But calling for publicly funded media, and, particularly, arguing that *quality content* matters, would be an Internet populist's suicide.

The broader societal implications of Shirky's argument are clear: universal access to tools for producing and disseminating information is the ultimate public good, even if it crowds out other such goods. To that end Shirky closes the book with a powerful—if abstract—call to arms:

We look everywhere a reader or a viewer or a patient or a citizen has been locked out of creating and sharing . . . and we're asking. *If we carve out a little bit of the cognitive surplus and deploy it here, could we make a good thing happen?* (Emphasis original.)

Maybe. But Shirky's digital populism not only blinds him, McLuhan-style, to inconvenient facts, it blinds him to the immense complexities and competing values inherent in democratic societies. He says he is writing about Western democracies, but they are unrecognizable in his book, for they appear to have been sterilized completely of social conflict.

Shirky presents a world without nationalism, corruption, religion, extremism, terrorism. It is a world without any elections, and thus no need to worry about informed voters. Class, gender, and race make a few appearances, but not as venues of systemic oppression. They are just more testimony to the mainstream media's elitism. Describing the media habits of his young students, Shirky remarks that they "have never known a world with only three television channels, a world where the only choice a viewer had in the early evening was which white man was going to read them the news in English."

But while Shirky seems content to gloss over the deficiencies of democratic politics and declare them transformed, a more sober analyst will realize that the transformation of those politics is far from complete and in fact requires more determined popular engagement. Even in the age of the Internet, the fate of the nation depends on who organizes in the public sphere, who shows up at the voting booth, and how well-informed those people are.

We want to cultivate voters who are less susceptible to propaganda than Shirky's beloved South Korean teenagers. Very little suggests that we are enjoying greater success in this quest than we did in the golden era of network television. The environment of media scarcity produced voters who, on average, were far less partisan and far better informed about politics than are today's voters. Yes, this was an accident—viewers had nothing else to watch at 9 p.m.—but the byproducts were valuable.

As Markus Prior points out in his excellent 2007 book *Post-Broadcast Democracy*, today's environment of information abundance splits the public into a small cohort of news junkies, who know everything there is to know about politics, and a much larger contingent of entertainment fans, who know the names of the latest YouTube celebrities and their favorite lolcats, but not of their home senators. "Although it is comforting to know that [viewers] finally get to watch what they always wanted to watch," Prior writes, "their newfound freedom may hurt both their own interests and the collective good." That is the case of those South Korean Internet users, who helped to spread panic that harmed their country's diplomatic standing.

Shirky, of course, would never talk about viewers' interests: that is not populist-speak. Populists prefer to make normative claims about the need to break up the traditional media without specifying how we should nurture responsible citizenship and promote good public policy in their absence. This just happens, apparently.

But the Internet will not automatically preserve—never mind improve—the health of democratic politics. Yes, a wired future might look good for democracy if some of the social functions currently performed by traditional media are taken up by new Internet projects. But that outcome needs to be demonstrated—perhaps constructively aimed at—rather than assumed. For populists such as Shirky, the need for considered political commitment does not even merit discussion. The triathlon must go on, even if the athletes become brainwashed and bigoted.

To paraphrase an old gospel song, do we really want to get what we wanted—but lose what we had?

http://bostonreview.net/BR35.4/morozov.php

Dysregulation Nation

By JUDITH WARNER

The gulf oil fiasco is just the latest instance in which a lack of regulation — or dysfunctional system of regulation — has led to a major American disaster. After the failure of the levees during Hurricane Katrina, the Wall Street meltdown of 2008, the collapse of the housing market and now the BP spill,we have come to what feels like a moment of reckoning, with some tentative signs that our country's decades-long love affair with deregulation is starting to chill.

The Obama administration has issued hundreds of new rules and standards over the past year, the most prominent initiative, of course, being the financial-oversight bill now making its way through Congress. What remains to be seen, as we move forward into what The Times's Eric Lipton recently called "a new age of regulation," is whether this new spirit of control and reform will carry over into the American psyche. For in the anything-goes atmosphere of our recent past, it wasn't just external controls that went awry; inwardly, people lost constraint and common sense, too. Now there is a case to be made that problems of self-regulation — of appetite, emotion, impulse and cupidity — may well be the defining social pathology of our time.

In the late 1970s, the historian Christopher Lasch famously described America as a culture of narcissism. Today we might well be called a nation of dysregulation. The signs that something is amiss in our inner mechanisms of control and restraint are everywhere. Eating disorders, "in general a disorder of self-regulation," according to Darlene M. Atkins, director of the Eating Disorders Clinic at Children's National Medical Center in Washington, grew epidemic in the past few decades, and in recent years have spread to minority communities, younger girls, older women and boys and men too. Obesity is viewed in many cases by mental-health experts as another form of self-dysregulation:a "pathologically intense drive for food consumption" akin to drug addiction, in the words of Nora D. Volkow, director of the National Institute on Drug Abuse, and Charles P. O'Brien, a professor in the department of psychiatry at the University of Pennsylvania, who have argued for including some forms of obesity as a mental disorder in the coming version of the psychiatric bible, the DSM-V.

In book publishing, addiction memoirs seem to have evolved into the bildungsromans of our time, their broad popularity suggesting that stories of self-destruction through excess can be counted upon to inspire a reliable there-but-for-the-grace-of-God affinity in readers. We read about dopamine fiends sitting enslaved to their screens, their brains hooked on the bursts of pleasure they receive from the ding of each new e-mail message or the arousing flash of a tweet. We see reports of young children so unable to control their behavior that they're being expelled from preschool. And teenagerswho, after years spent gorging on instant gratification

(too-easy presents from eager-to-please parents, the thrill of the fast-changing screen), are restless, demanding, easily bored and said to be suffering from a plague of insatiability.

Mental-health professionals report seeing increasing numbers of kids who are all out of sync: they can't sustain attention, regulate their rage, moderate their pain, tolerate normal types of sensory input. Some of this is biological; a problem of faulty brain wiring. But many of the problems — in both children and adults — according to Peter C. Whybrow, director of the Semel Institute for Neuroscience and Human Behavior at the University of California in Los Angeles, come from living in a culture of excess.

Under normal circumstances, the emotional, reward-seeking, selfish, "myopic" part of our brain is checked and balanced in its desirous cravings by our powers of cognition — our awareness of the consequences, say, of eating too much or spending too much. But after decades of never-before-seen levels of affluence and endless messages promoting instant gratification, Whybrow says, this self-regulatory system has been knocked out of whack. The "orgy of self-indulgence" that spread in our land of no-money-down mortgages, he wrote in his 2005 book, "American Mania: When More Is Not Enough," has disturbed the "ancient mechanisms that sustain our physical and mental balance."

If you put a person in an environment that worships wealth and favors conspicuous consumption, add gross income inequalities that breed envy and competition, mix in stagnant wages, a high cost of living and too-easy credit, you get overspending, high personal debt and a "treadmill-like existence," as Whybrow calls it: compulsive getting and spending.

Recently there have been pointed efforts to use government regulation to prod people toward self-regulating, based on the belief that if you present consumers with more and better information on the risks and consequences of their actions (better labeling of food; clearer information on mortgage documents), they will, in turn, make better choices. A provision in the new health care reform law requiring fast-food chains to post calorie counts is one such effort. New credit-card legislation requiring that monthly statements make clear the long-term cost to cardholders of making only minimum payments is another. Both seem likely to have at least some success; a Stanford University study earlier this year found that Starbucks customers in New York City who routinely bought highly fattening foods had lowered their typical calorie consumption by 26 percent after local labeling requirements went into effect in 2008, and a survey that was released in May found 25 percent of people saying that being confronted with the long-term cost of making only minimum credit-card payments had inspired them to pay down their debt more quickly.

These initiatives, however, focus on choices that are rather simple. The larger structural problems that create our widespread envy, greed, overconsumption and debt — gross income inequality, for starters — will be much more difficult, politically, to address.

The "yawning void, an insatiable hunger, an emptiness waiting to be filled," that Lasch identified as animating the typical narcissist of the 1970s has grown only deeper with the passage of time. The Great Recession was supposed to portend a scaling back, a recalibration of our lifestyle, and usher in a new era of making more of less. But the pressures that drive the dysregulated American haven't abated any since the fall of 2008. Wall Street is resurgent, and unemployment is still high. For too many people, the cycle of craving and debt that drives our treadmill existence simply can't be broken.

http://www.nytimes.com/2010/06/20/magazine/20fFOB-WWLN-t.html?partner=rss&emc=rss

Hubble Captures Bubbles and Baby Stars

This broad vista of young stars and gas clouds in our neighbouring galaxy, the Large Magellanic Cloud, was captured by the NASA/ESA Hubble Space Telescope's Advanced Camera for Surveys (ACS). This region is named LHA 120-N 11, informally known as N11, and is one of the most active star formation regions in the nearby Universe. This picture is a mosaic of ACS data from five different positions and covers a region about six arcminutes across. (Credit: NASA, ESA and Jesús Maíz Apellániz (Instituto de Astrofísica de Andalucía, Spain))

ScienceDaily (June 23, 2010) — A spectacular new NASA/ESA Hubble Space Telescope image -- one of the largest ever released of a star-forming region -- highlights N11, part of a complex network of gas clouds and star clusters within our neighbouring galaxy, the Large Magellanic Cloud. This region of energetic star formation is one of the most active in the nearby Universe.

The Large Magellanic Cloud contains many bright bubbles of glowing gas. One of the largest and most spectacular has the name LHA 120-N 11, from its listing in a catalogue compiled by the American astronomer and astronaut Karl Henize in 1956, and is informally known as N11. Close up, the billowing pink clouds of glowing gas make N11 resemble a puffy swirl of fairground candy floss. From further away, its distinctive overall shape led some observers to nickname it the Bean Nebula. The dramatic and colourful features visible in the nebula are the telltale signs of star formation. N11 is a well-studied region that extends over 1000 light-years. It is the second largest star-forming region within the Large Magellanic Cloud and has produced some of the most massive stars known.

It is the process of star formation that gives N11 its distinctive look. Three successive generations of stars, each of which formed further away from the centre of the nebula than the last, have created shells of gas and dust. These shells were blown away from the newborn stars in the turmoil of their energetic birth and early life, creating the ring shapes so prominent in this image.

Beans are not the only terrestrial shapes to be found in this spectacular high resolution image from the NASA/ESA Hubble Space Telescope. In the upper left is the red bloom of nebula LHA 120-N 11A. Its rose-like petals of gas and dust are illuminated from within, thanks to the radiation from the massive hot stars at its centre. N11A is relatively compact and dense and is the site of the most recent burst of star development in the region.

Other star clusters abound in N11, including NGC 1761 at the bottom of the image, which is a group of massive hot young stars busily pouring intense ultraviolet radiation out into space. Although it is much smaller than our own galaxy, the Large Magellanic Cloud is a very vigorous region of star formation. Studying these stellar nurseries helps astronomers understand a lot more about how stars are born and their ultimate development and lifespan.

Both the Large Magellanic Cloud and its small companion, the Small Magellanic Cloud, are easily seen with the unaided eye and have always been familiar to people living in the southern hemisphere. The credit for bringing these galaxies to the attention of Europeans is usually given to Portuguese explorer Fernando de Magellan and his crew, who viewed it on their 1519 sea voyage. However, the Persian astronomer Abd Al-Rahman Al Sufi and the Italian explorer Amerigo Vespucci recorded the Large Magellanic Cloud in 964 and 1503 respectively.

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **European Space Agency**.

http://www.sciencedaily.com/releases/2010/06/100622074722.htm

Filtering Donor Blood Reduces Heart, Lung Complications

ScienceDaily (June 22, 2010) — Researchers at the University of Rochester Medical Center (URMC) have discovered yet another reason to filter the foreign white cells from donor blood: the resulting blood product is associated with dramatically fewer cardiopulmonary complications for patients who received a transfusion.

The study is published online in the journal, *Transfusion*. It is the latest in a large body of work led by Neil Blumberg, M.D., who for 25 years has been investigating the benefits of filtering or washing blood to create safer, simpler approaches to transfusion therapy.

The observational study was conducted during the seven years before and after 2000, when the URMC introduced universal leukoreduction, a process that filters the white cells from blood to be used for transfusions. Researchers looked at the number of reports of transfusion reactions during the 14-year period, and divided them by the total number of blood components transfused (778, 559).

Rates of acute, transfusion-related lung injury dropped 83 percent in the years after filtering took place, and transfusion-associated circulatory overload declined 49 percent, when compared to the rates prior to the year 2000. Both conditions are rare, but are among the most common causes of death following a transfusion.

"These data are very exciting because we described two unexpected and unexplained associations between adverse reactions and leukoreduction, "Blumberg said. "However, our observations do not prove cause and effect, and therefore require further investigation before we can say with certainty that leukoreduction is responsible for so many fewer cardiopulmonary complications."

The Centers for Disease Control and Prevention is introducing a new blood surveillance system to track severe transfusion reactions, Blumberg said, which should provide more detailed information to support or refute the URMC study.

About five million people a year in the United States receive transfusions to replenish blood lost during surgery, serious injury or illness. While transfusions can be life-saving, they also lead to health complications.

In previous studies, Blumberg's team has shown that the odds of post-surgical infection and death are greatly reduced by leukoreduction. White cells from donor blood can attack the immune system of the blood recipient; removing them diminishes the chances of an inflammatory response or infection, according to Blumberg's research.

Transfusion-related lung injury is believed to happen when antibodies or other molecules from the donor's white blood cells or plasma react in an adverse way with the recipient's white blood cells. Circulatory overload is presumed to occur when the volume of blood given in a transfusion is too much for the recipient's cardiovascular system. Researchers hypothesized that leukoreduction, which removes the white cells, would reduce those complications.

In 1998 Strong Memorial Hospital, a 739-bed facility owned by the URMC, became one of the first hospitals in the nation to use leukoreduced blood during heart surgeries. Two years later Strong extended its leukoreduction practices to all patients. Work done at URMC also has supported keeping transfusions to an absolute minimum. Blumberg's evidence-based stance on the judicious use of transfusions and safer

techniques has contributed greatly to the national and international dialogue on reducing in-hospital infections rates and controlling costs.

No extramural funding supported this study, although two researchers receive partial salary support from National Institutes of Health grants. Data retrieval and analysis were conducted as part of a larger quality assurance initiative.

Co-authors are: Joanna M. Heal, Kelly F. Gettings, Richard P. Phipps, Debra Masel, Majed A. Refaai, Scott A. Kirkley, and L. Benjamin Fialkow, from the Transfusion Medicine Unit and Department of Pathology and Laboratory Medicine, at the University of Rochester Medical Center. Phipps is also a professor of Environmental Medicine.

Story Source:

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

Journal Reference:

1. Neil Blumberg, Joanna M. Heal, Kelly F. Gettings, Richard P. Phipps, Debra Masel, Majed A. Refaai, Scott A. Kirkley, L. Benjamin Fialkow. **An association between decreased cardiopulmonary complications (transfusion-related acute lung injury and transfusion-associated circulatory overload) and implementation of universal leukoreduction of blood transfusions (p)**. *Transfusion*, Jun 18 2010 DOI: 10.1111/j.1537-2995.2010.02748.x

http://www.sciencedaily.com/releases/2010/06/100622142605.htm

Coffee May Protect Against Head and Neck Cancers

Results of a recent study add to the brewing evidence that drinking coffee protects against cancer, this time against head and neck cancer. (Credit: iStockphoto)

ScienceDaily (June 22, 2010) — Data on the effects of coffee on cancer risk have been mixed. However, results of a recent study add to the brewing evidence that drinking coffee protects against cancer, this time against head and neck cancer.

Full study results are published online first in *Cancer Epidemiology, Biomarkers & Prevention*, a journal of the American Association for Cancer Research.Using information from a pooled-analysis of nine studies collected by the International Head and Neck Cancer Epidemiology (INHANCE) consortium, participants who were regular coffee drinkers, that is, those who drank an estimated four or more cups a day, compared with those who were non-drinkers, had a 39 percent decreased risk of oral cavity and pharynx cancers combined.

Data on decaffeinated coffee was too sparse for detailed analysis, but indicated no increased risk. Tea intake was not associated with head and neck cancer risk.

The association is more reliable among those who are frequent, regular coffee drinkers, consuming more than four cups of coffee a day.

"Since coffee is so widely used and there is a relatively high incidence and low survival rate of these forms of cancers, our results have important public health implications that need to be further addressed," said lead researcher Mia Hashibe, Ph.D., assistant professor in the department of family and preventive medicine at the University of Utah, Salt Lake City, and a Huntsman Cancer Institute investigator.

"What makes our results so unique is that we had a very large sample size, and since we combined data across many studies, we had more statistical power to detect associations between cancer and coffee," she said.

At the AACR Frontiers in Cancer Prevention Research Conference last December, researchers from Harvard presented data that showed a strong inverse association between coffee consumption and the risk of lethal and advanced prostate cancers -- men who drank the most coffee had a 60 percent lower risk of aggressive prostate cancer than men who did not drink any coffee.

More recently, results of another study published in the January issue of *Cancer Epidemiology, Biomarkers & Prevention* showed a decreased risk of gliomas, or brain tumors, associated with coffee. This association was found among those who drank five or more cups of coffee or tea a day, according the researchers from the Imperial College, London.

Cancer Epidemiology, Biomarkers & Prevention editorial board member Johanna W. Lampe, Ph.D., R.D., believes this current analysis by Hashibe and colleagues provides strong, additional evidence for an association between caffeinated coffee drinking and cancer risk.

"The fact that this was seen for oral and pharyngeal cancers, but not laryngeal cancers, provides some evidence as to a possible specificity of effect," said Lampe, who is a full member and associate division director in the division of public health sciences at Fred Hutchinson Cancer Research Center, Seattle., Wash.

"These findings provide further impetus to pursue research to understand the role of coffee in head and neck cancer prevention," she added. Lampe is not associated with this study.

Additional research is warranted to characterize the importance of timing and duration of exposure and possible mechanisms of action, according to Hashibe.

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **American Association for Cancer Research**.

Journal Reference:

1. Carlotta Galeone, Alessandra Tavani, Claudio Pelucchi, Federica Turati, Deborah M. Winn, Fabio Levi, Guo-Pei Yu, Hal Morgenstern, Karl Kelsey, Luigino Dal Maso, Mark P. Purdue, Michael Mcclean, Renato Talamini, Richard B. Hayes, Silvia Franceschi, Stimson Schantz, Zuo-Feng Zhang, Gilles Ferro, Shu-Chun Chuang, Paolo Boffetta, Carlo La Vecchia, and Mia Hashibe. **Coffee and Tea Intake and Risk of Head and Neck Cancer: Pooled Analysis in the International Head and Neck Cancer Epidemiology Consortium**. *Cancer Epidemiol Biomarkers Prev*, June 22, 2010; 1055-9965.EPI-10-0191; DOI: 10.1158/1055-9965.EPI-10-0191

http://www.sciencedaily.com/releases/2010/06/100622142551.htm

Quantum Gas in Free Fall: Bose-Einstein Condensate at Zero Gravity

Experiment with a dramatic fall: The capsule is pulled up to the starting position in the drop tower, where the physicists generate a Bose-Einstein condensate by remote control and observe how it behaves at zero gravity -- a step towards extremely-sensitive measuring devices for gravitation. (Credit: Image: ZARMS / University of Bremen)

ScienceDaily (June 22, 2010) — A sensitive measuring device must not be dropped -- because this usually destroys the precision of the instrument. A team of researchers including scientists from the Max Planck Institute of Quantum Optics has done exactly this, however. And the researchers want to use this experience to make the measuring instrument even more sensitive. The team, headed by physicists from the University of Hanover, dropped a piece of apparatus, in which they generated a weightless Bose-Einstein condensate (BEC), to the bottom of a drop tower at the University of Bremen.

The particles in a BEC lose their individuality and can be considered to be a 'super-particle'. The researchers want to use such an ultra-cold quantum gas at zero gravity to construct a very sensitive measuring device for the Earth's gravitational field -- in order to find deposits of minerals, and also to settle fundamental issues in physics.

The research appears in the journal *Science*.

In a vacuum, a feather falls as quickly as a lead ball -- something that is already presented to students as being irrefutable. "However, the equivalence principle is only a postulate that needs to be tested," says Ernst Maria Rasel, professor at the University of Hanover. According to the equivalence principle, the heavy mass with which bodies attract each other corresponds to the inertial mass, which resists an accelerating force. This means that in a vacuum all bodies hit the ground with the same speed. Physicists want to use a measuring

device that measures gravity extremely accurately to investigate whether this hypothesis can really become a physical law. Ernst Maria Rasel's team has now taken an initial step in this direction.

The researchers generated a Bose-Einstein condensate (BEC) in zero gravity and observed, for more than a second, how the atomic cloud behaves in free fall. To this end, they installed an atom chip developed by researchers working with Theodor W. Hänsch, Director at the Max Planck Institute of Quantum Optics, and solenoids, lasers, a camera and the necessary energy supply into a cylindrical capsule, which is about as high and wide as a door. After they had moved a cloud of several million rubidium atoms onto the atom chip, they dropped the complete apparatus 146 metres into the depths. A tower at the Center of Applied Space Technology and Microgravity of the University of Bremen specializes in such scientific cases.

As the capsule was falling to the ground for four seconds in the drop tower, the researchers generated the BEC on the atom chip, initially by remote control: strong magnetic fields and lasers hold the particles on the chip and cool them. At a few millionths of a degree above absolute zero, the temperature at minus 273.16 degrees Celsius, the particles have lost almost all of their energy and assume a new physical state: all atoms are now in the quantum mechanical ground state so that they can no longer be distinguished as individual particles in the quantum gas.

An atom chip -- the fast path to ultra-cold quantum gas

"They behave completely coherently, practically like a heap of atoms that assumes the properties of a single huge atom," says Tilo Steinmetz, who was involved in the experiment as a researcher from the Max Planck Institute of Quantum Optics. Since the laws of quantum mechanics say that every particle can also be considered to be a wave, it is possible to describe what is happening in a different way: A wave packet of matter forms in which the atoms no longer stay at fixed locations -- they are delocalized. This grouping is maintained until an energetic push, however small, mixes it up.

"We generate a BEC in less than a second on our atom chip. With conventional laboratory apparatus, this takes up to one minute," says Tilo Steinmetz. In addition, an experiment on an atom chip requires significantly less electrical power. "It is thus ideal for use in a drop tower capsule, where energy supply and cooling present a logistical challenge," says Steinmetz.

Ten times more time for a measurement

As soon as the atoms on the chip had merged into the super-particle, the researchers carefully loosened the hold of the trap and released the BEC. The camera in the capsule now enabled them to observe how the condensate spread. This movement reacts extremely sensitively to external fields -- to differences in Earth's gravitational field, for example. These differences exist because the gravitation at a certain point on Earth depends on the local density of the Earth's crust. The longer the Bose-Einstein condensate expands, i.e. the longer it floats in zero gravity, the clearer these differences make themselves felt as it expands. With the experiment in the drop tower alone, the researchers extended the time available for a measurement by more than tenfold when compared to a laboratory experiment. This could help in the future to drastically improve the accuracy of measurement data.

The differences can be measured in an atom interferometer: A quantum gas, that is the wave-packet of matter, is split into two parts and moves in the gravitational field along different paths through space-time. Gravitation behaves like an optical medium, whose refractive index refracts the waves. As soon as the two parts reunite, there is interference, as is also generated when waves on a water surface run into each other.

The interference pattern depends on how differently the two matter waves expand. If matter waves of different composition are compared, a test of the equivalence principle with matter waves is performed. The physicists in Ernst Maria Rasel's group now want to construct such an atom interferometer for the capsule of the Bremen drop tower.

"Ultimately, we would like to perform such experiments in space," says Ernst Maria Rasel. The equivalence principle could also be tested there. To this end, the researchers must drop clouds of different atoms to Earth for as long as possible. They could then find out whether all bodies really fall with the same speed. And the longer the atom clouds remain in zero gravity -- that is, the further they fall -- the more chance there is of clarifying this.

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Max-Planck-Gesellschaft**.

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1. P. Nussenzveig, J. C. A. Barata. **A Drop of Quantum Matter**. *Science*, 2010; 328 (5985): 1491 DOI: 10.1126/science.1191666

http://www.sciencedaily.com/releases/2010/06/100622112700.htm

Enzyme Trio for Biosynthesis of Hydrocarbon Fuels

Harry Beller (foreground) and Ee-Been Goh of the Joint BioEnergy Institute have identified a trio of bacterial enzymes that can help convert plant sugars into hydrocarbon compounds for the production of green transportation fuels. (Credit: Photo by Roy Kaltschmidt, Berkeley Lab Public Affairs)

ScienceDaily (June 21, 2010) — If concerns for global climate change and ever-increasing costs weren't enough, the disastrous Gulf oil spill makes an even more compelling case for the development of transportation fuels that are renewable, can be produced in a sustainable fashion, and do not put the environment at risk. Liquid fuels derived from plant biomass have the potential to be used as direct replacements for gasoline, diesel and jet fuels if cost-effective means of commercial production can be found.

Researchers with the U.S. Department of Energy (DOE)'s Joint BioEnergy Institute (JBEI) have identified a trio of bacterial enzymes that can catalyze key steps in the conversion of plant sugars into hydrocarbon compounds for the production of green transportation fuels.

Harry Beller, an environmental microbiologist who directs the Biofuels Pathways department for JBEI's Fuels Synthesis Division, led a study in which a three-gene cluster from the bacterium *Micrococcus luteus* was introduced into the bacterium *Escherichia coli*. The enzymes produced by this trio of genes enabled the *E. coli* to synthesize from glucose long-chain alkene hydrocarbons. These long-chain alkenes can then be reduced in size -- a process called "cracking" -- to obtain shorter hydrocarbons that are compatible with today's engines and favored for the production of advanced lignocellulosic biofuels.

"In order to engineer microorganisms to make biofuels efficiently, we need to know the applicable gene sequences and specific metabolic steps involved in the biosynthesis pathway," Beller says. "We have now identified three genes encoding enzymes that are essential for the bacterial synthesis of alkenes. With this information we were able to convert an *E. coli* strain that normally cannot make long-chain alkenes into an alkene producer."

Working with Beller on this study were Ee-Been Goh and Jay Keasling. The three were the co-authors of a paper that appeared earlier this year in the journal Applied and Environmental Microbiology.

It has long been known that certain types of bacteria are able to synthesize aliphatic hydrocarbons, which makes them promising sources of the enzymes needed to convert lignocellulose into advanced biofuels. However, until recently, little was known about the bacterial biosynthesis of non-isoprenoid hydrocarbons beyond a hypothesis that fatty acids are precursors. JBEI researchers in the Fuels Synthesis Division, which is headed by co-author Keasling, are using the tools of synthetic biology, and mathematical models of metabolism and gene regulation to engineer new microbes that can quickly and efficiently produce advanced

biofuel molecules. *E.coli* is one of the model organisms being used in this effort because it is a well-studied microbe that is exceptionally amenable to genetic manipulation.

"We chose to work with *M. luteus* because a close bacterial relative was well-documented to synthesize alkenes and because a draft genome sequence of *M. luteus* was available," Beller says. "The first thing we did was to confirm that *M. luteus* also produces alkenes."

Beller and his colleagues worked from a hypothesis that known enzymes capable of catalyzing both decarboxylation and condensation should be good models for the kind of enzymes that might catalyze alkene synthesis from fatty acids. Using condensing enzymes as models, the scientists identified several candidate genes in *M. luteus*, including Mlut_13230. When expressed in *E. coli* together with the two adjacent genes -- Mlut_13240 and 13250 -- this trio of enzymes catalyzed the synthesis of alkenes from glucose. Observations were made both *in vivo* and *in vitro*.

"This group of enzymes can be used to make aliphatic hydrocarbons in an appropriate microbial host but the resulting alkenes are too long to be used directly as liquid fuels," Beller says. "However, these long-chain alkenes can be cracked -- a technique routinely used in oil refineries -- to create hydrocarbons of an appropriate length for diesel fuel."

The next step Beller says is to learn more about how these three enzymes work, particularly Mlut_13230 (also called OleA), which catalyzes the key step in the alkene biosynthesis pathway -- the condensation of fatty acids.

"We're also studying other pathways that can produce aliphatic hydrocarbons of an appropriate length for diesel fuels without the need for cracking," Beller says. "Nature has devised a number of biocatalysts to produce hydrocarbons, and our goal is to learn more about them for the production of green transportation fuels."

JBEI is one of three Bioenergy Research Centers funded by the U.S. Department of Energy to advance the development of the next generation of biofuels. Headquartered in Emeryville, California, JBEI is a scientific partnership led by Lawrence Berkeley National Laboratory (Berkeley Lab) and including the Sandia National Laboratories, the University of California (UC) campuses of Berkeley and Davis, the Carnegie Institution for Science (located on the campus of Stanford University), and the Lawrence Livermore National Laboratory.

Story Source:

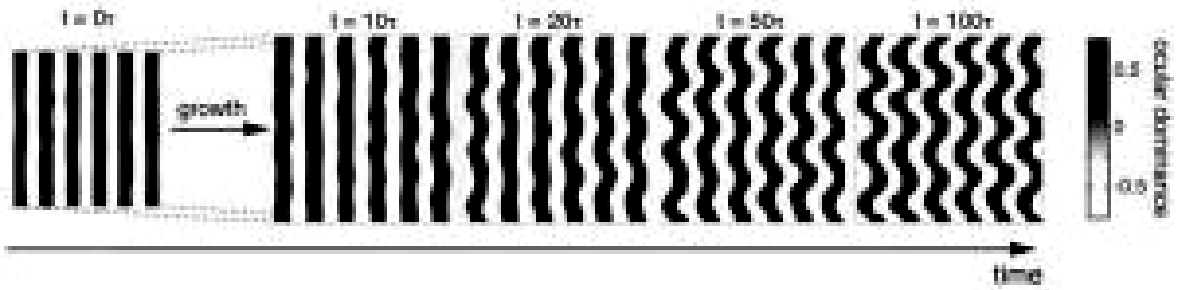
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **DOE/Lawrence Berkeley National Laboratory**.

Journal Reference:

1. Beller et al. **Genes Involved in Long-Chain Alkene Biosynthesis in Micrococcus luteus**. *Applied and Environmental Microbiology*, 2010; 76 (4): 1212 DOI: 10.1128/AEM.02312-09

http://www.sciencedaily.com/releases/2010/06/100621174001.htm

How the Brain Changes During Growth



Computer simulation of the development of ocular dominance columns in a simple model with cortical growth. Black areas correspond to a preference for the left eye, white areas a preference for the right eye. The pattern is initially striped and slowly dissolves after the growth into a zigzag pattern. A similar rearrangement is also shown by experimental studies on the visual cortex of the cat. (Credit: Wolfgang Keil)

ScienceDaily (June 22, 2010) — Science has long puzzled over why a baby's brain is particularly flexible and why it easily changes. Is it because babies have to learn a lot? A group of researchers from the Bernstein Network Computational Neuroscience, the Max Planck Institute for Dynamics and Self-Organization in Göttingen, the Schiller University in Jena and Princeton University (USA) have now put forward a new explanation: Maybe it is because the brain still has to grow.

The research appears in the *Proceedings of the National Academy of Sciences*.

Using a combination of experiments, mathematical models and computer simulations they showed that neuronal connections in the visual cortex of cats are restructured during the growth phase and that this restructuring can be explained by self-organisational processes. The study was headed by Matthias Kaschube, former researcher at the Max Planck Institute for Dynamics and Self-Organization and now at Princeton University (USA).

The brain is continuously changing. Neuronal structures are not hard-wired, but are modified with every learning step and every experience. Certain areas of the brain of a newborn baby are particularly flexible, however. In animal experiments, the development of the visual cortex can be strongly influenced in the first months of life, for example, by different visual stimuli.

Nerve cells in the visual cortex of fully-grown animals divide up the processing of information from the eyes: Some "see" only the left eye, others only the right. Cells of right or left specialisation each lie close to one another in small groups, called columns. The researchers showed that during growth, these structures are not simply inflated -- columns do not become larger but their number increases. Neither do new columns form from new nerve cells. The number of nerve cells remains almost unchanged, a large part of the growth of the visual cortex can be attributed to an increase in the number of non-neuronal cells. These changes can be explained by the fact that existing cells change their preference for the right or the left eye. In addition, another of the researchers' observations also points to such a restructuring: The arrangement of the columns changes. While the pattern initially looks stripy, these stripes dissolve in time and the pattern becomes more irregular.

"This is an enormous achievement by the brain -- undertaking such a restructuring while continuing to function," says Wolfgang Keil, scientist at the Max Planck Institute for Dynamics and Self-Organization Göttingen and first author of the study. "There is no engineer behind this conducting the planning, the process must generate itself." The researchers used mathematical models and computer simulations to investigate how the brain could proceed to achieve this restructuring. On the one hand, the brain tries to keep the neighbourhood relations in the visual cortex as uniform as possible. On the other, the development of the visual cortex is determined by the visual process itself -- cells which have once been stimulated more strongly by the left or right eye try to maintain this particular calling.

The researchers' model explains the formation of columns by taking both these tendencies into account. The scientists showed that when the tissue grows and the size of the columns is kept constant, the columns in the computer model change exactly as they had observed in their experimental studies on the visual cortex of the cat: The stripes dissolve into a zigzag pattern and thus become more irregular. In this way, the researchers provide a mathematical basis which realistically describes how the visual cortex could restructure during the growth phase.

Story Source:

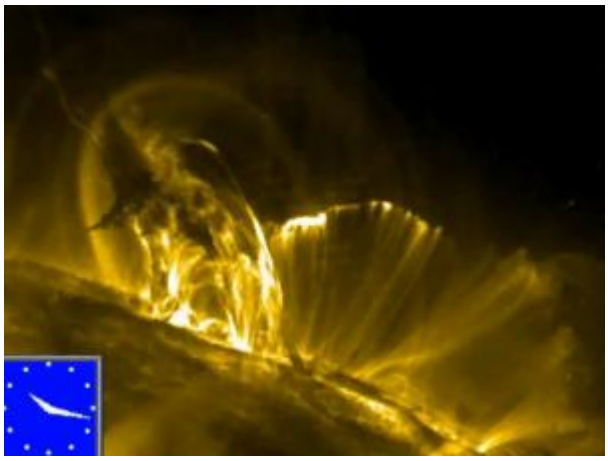
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Max-Planck-Gesellschaft**.

Journal Reference:

1. Wolfgang Keil, Karl-Friedrich Schmidt, Siegrid Löwel and Matthias Kaschube. **Reorganization of columnar architecture in the growing visual cortex**. *PNAS*, June 21, 2010 DOI: 10.1073/pnas.0913020107

http://www.sciencedaily.com/releases/2010/06/100622124706.htm

Scientists Discover Heavenly Solar Music



Still image from a video from the Transitional Region and Coronal Explorer (TRACE), showing eruptions from the solar corona. (Credit: TRACE)

ScienceDaily (June 22, 2010) — Musical sounds created by longitudinal vibrations within the Sun's atmosphere, have been recorded and accurately studied for the first time by experts at the University of Sheffield, shedding light on the Sun's magnetic atmosphere.

Using state-of-the-art mathematical theory combined with satellite observations, a team of solar physicists from the University have captured the music on tape and revealed the harmonious sounds are caused by the movement of giant magnetic loops in the solar corona -- the outermost, mysterious, and least understood layer of the Sun's atmosphere. Most importantly, the team studied how this sound is decaying, giving an unprecedented insight into the physics of the solar corona.

High-resolution images taken by a number of satellites show that the solar corona is filled with large banana-shaped magnetic structures known as coronal loops. It is thought that these giant magnetic loops, some of them over a few 100,000 km long, play a fundamental role in governing the physics of the corona and are responsible for huge atmospheric explosions that occur in the atmosphere, known as solar flares.

These giant coronal loops have also been observed to undergo periodic (oscillatory) motion, which can be thought of as someone plucking a guitar string (transversal oscillations) or blowing the wind-pipe instrument (longitudinal oscillations). With the length and thickness of the string fixed, the pitch of the note is determined by the tension of the string and the tone is made up of the harmonics of the modes of oscillation.

In this sense, the solar atmosphere is constantly pervaded by the music of the coronal loops. The coronal music also provides scientists with a unique and unprecedented tool to study the magnetic solar atmosphere, as the motion of these loops is determined by their local surroundings. This technique is known as solar magneto-seismology and is very similar to the seismology methods used by geologists studying earthquakes.

Studying this magnetic solar atmosphere will help the team, which is headed-up by Professor Robertus von Fáy-Siebenbürgen and includes postgraduate student Richard Morton and postdoctoral research associate Dr Youra Taroyan, all from the Dept of Applied Mathematics, make further breakthroughs into understanding

one of the key and central unresolved problems of modern astrophysics, i.e. the heating of solar and tellar coronal plasmas, and reveal the underlying physical processes: Are there millions of localised magnetic explosions releasing the energy necessary to maintain the corona at millions of degrees or is the physics related to the numerous waves propagating from the internal regions of the Sun toward its outer regions, reaching even space around the Earth's atmosphere.

The discovery was presented by the University experts to an audience of MPs both from the House of Commons and the House of Lords at the House of Commons Marquee, as well as and senior scientists representing prestigious institutions such as the Royal Society, after being selected by the Parliamentary and Scientific Committee.

The next step for the team will be to develop cutting edge numerical modelling that will be able to give further insight into the sub-resolution properties of coronal loops, i.e. on spatial scales that are not even observable with the latest high-resolution satellites available to scientist.

This is the second solar related breakthrough made by experts at the University. The way in which the solar corona is heated to temperatures of over a million degrees had, until recently, remained a long-standing puzzle of solar and space physics, as this region of the sun is even further away from the centre of energy production than the underlying solar surface. However Professor von Fáy-Siebenbürgen and his team last month solved this enigma and revealed that Transition Region Quakes -- described by the experts as 'mega-tsunamis' -- power the lower base of the solar corona.

The news comes as the University of Sheffield launches a unique venture entitled Project Sunshine, led by the Faculty of Science. The Project aims to unite scientists across the traditional boundaries in both the pure and applied sciences to harness the power of the sun and tackle the biggest challenge facing the world today: meeting the increasing food and energy needs of the world´s population in the context of an uncertain climate and global environment change. It is hoped that Project Sunshine will change the way scientists think and work and become the inspiration for a new generation of scientists focused on solving the world´s problems.

Professor Robertus von Fáy-Siebenbürgen from the University of Sheffield's Department of Applied Mathematics and Head of SP2RC, said: "The results of our latest coronal research, presented in the Parliament at Westminster, allow us to gain a fundamentally new insight into the fascinating but at the same time very mysterious solar atmosphere. I'm most proud to have such talented young scientists within my research group and department. The invitation by SET for Britain and our collaborative research efforts clearly demonstrate our international leadership position in the field of solar physics."

A video of the solar music is available on YouTube at the following URL:
http://www.youtube.com/watch?v=ZbIffp40U8w

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **University of Sheffield**.

http://www.sciencedaily.com/releases/2010/06/100621101420.htm

Competition Puts the Brakes on Body Evolution in Island Lizards

The Greater Antilles are home to more than 100 Anolis species in a wide range of shapes and sizes. The Anolis fowleri, pictured here, is a rare anole from the Dominican Republic. (Credit: Photo by Luke Mahler)

ScienceDaily (June 22, 2010) — Millions of years before humans began battling it out over beachfront property, a similar phenomenon was unfolding in a diverse group of island lizards.

Often mistaken for chameleons or geckos, Anolis lizards fight fiercely for resources, responding to rivals by doing push-ups and puffing out their throat pouches. But anoles also compete in ways that shape their bodies over evolutionary time, says a new study in the journal *Evolution*.

Anolis lizards colonized the Caribbean from South America some 40 million years ago and quickly evolved a wide range of shapes and sizes. "When anoles first arrived in the islands there were no other lizards quite like them, so there was abundant opportunity to diversify," said author Luke Mahler of Harvard University.

Free from rivals in their new island homes, Anolis lizards evolved differences in leg length, body size, and other characteristics as they adapted to different habitats. Today, the islands of Cuba, Hispaniola, Jamaica and Puerto Rico -- collectively known as the Greater Antilles -- are home to more than 100 Anolis species, ranging from lanky lizards that perch in bushes, to stocky, long-legged lizards that live on tree trunks, to foot-long 'giants' that roam the upper branches of trees.

"Each body type is specialized for using different parts of a tree or bush," said Mahler.

Alongside researchers from the University of Rochester, Harvard University, and the National Evolutionary Synthesis Center, Mahler wanted to understand how and when this wide range of shapes and sizes came to be.

To do that, the team used DNA and body measurements from species living today to reconstruct how they evolved in the past. In addition to measuring the head, limbs, and tail of over a thousand museum specimens representing nearly every Anolis species in the Greater Antilles -- including several Cuban species that were previously inaccessible to North American scientists -- they also used the Anolis family tree to infer what species lived on which islands, and when.

By doing so, they discovered that the widest variety of anole shapes and sizes arose among the evolutionary early-birds. Then as the number of anole species on each island increased, the range of new body types began to fizzle.

Late-comers in lizard evolution underwent finer and finer tinkering as time went on. As species proliferated on each island, their descendants were forced to partition the remaining real estate in increasingly subtle ways, said co-author Liam Revell of the National Evolutionary Synthesis Center in Durham, NC.

"Over time there were fewer distinct niches available on each island," said Revell. "Ancient evolutionary changes in body proportions were large, but more recent evolutionary changes have been more subtle."

The researchers saw the same trend on each island. "The islands are like Petri dishes where species diversification unfolded in similar ways," said Mahler. "The more species there were, the more they put the brakes on body evolution."

The study sheds new light on how biodiversity comes to be. "We're not just looking at species number, we're also looking at how the shape of life changes over time," said Mahler.

The team's findings are published in the journal *Evolution.*

Richard Glor of the University of Rochester and Jonathan Losos of Harvard University were also authors on this study.

Story Source:

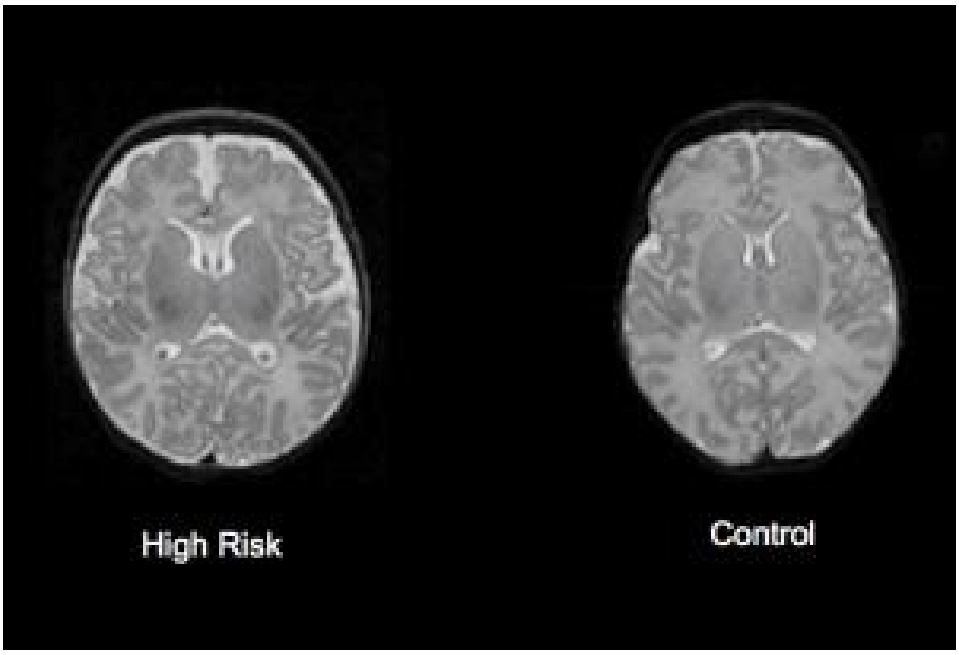
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **National Evolutionary Synthesis Center (NESCent)**, via EurekAlert!, a service of AAAS.

Journal Reference:

1. D. Luke Mahler, Liam J. Revell, Richard E. Glor, Jonathan B. Losos. **Ecological opportunity and the rate of morphological evolution in the diversification of Greater Antillean anoles**. *Evolution*, 2010; DOI: 10.1111/j.1558-5646.2010.01026.x

http://www.sciencedaily.com/releases/2010/06/100618103556.htm

Brain Signs of Schizophrenia Found in Babies



Infant's brain image on left shows the larger lateral ventricles and a generally larger brain overall. (Credit: Image provided by John Gilmore, MD)

ScienceDaily (June 22, 2010) — Schizophrenia is a debilitating mental disorder affecting one in 100 people worldwide. Most cases aren't detected until a person starts experiencing symptoms like delusions and hallucinations as a teenager or adult. By that time, the disease has often progressed so far that it can be difficult to treat.

In a paper published recently online by the *American Journal of Psychiatry*, researchers at the University of North Carolina at Chapel Hill and Columbia University provide the first evidence that brain abnormalities associated with schizophrenia risk are detectable in babies only a few weeks old.

"It allows us to start thinking about how we can identify kids at risk for schizophrenia very early and whether there things that we can do very early on to lessen the risk," said lead study author John H. Gilmore, MD, professor of psychiatry and director of the UNC Schizophrenia Research Center.

The scientists used ultrasound and MRI to examine brain development in 26 babies born to mothers with schizophrenia. Having a first-degree relative with the disease raises a person's risk of schizophrenia to one in 10. Among boys, the high-risk babies had larger brains and larger lateral ventricles -- fluid-filled spaces in the brain -- than babies of mothers with no psychiatric illness.

"Could it be that enlargement is an early marker of a brain that's going to be different?" Gilmore speculated. Larger brain size in infants is also associated with autism.

The researchers found no difference in brain size among girls in the study. This fits the overall pattern of schizophrenia, which is more common, and often more severe, in males.

The findings do not necessarily mean the boys with larger brains will develop schizophrenia. Relatives of people with schizophrenia sometimes have subtle brain abnormalities but exhibit few or no symptoms.

"This is just the very beginning," said Gilmore. "We're following these children through childhood." The team will continue to measure the children's brains and will also track their language skills, motor skills and memory development. They will also continue to recruit women to the study to increase the sample size.

This research provides the first indication that brain abnormalities associated with schizophrenia can be detected early in life. Improving early detection could allow doctors to develop new approaches to prevent high-risk children from developing the disease. "The research will give us a better sense of when brain development becomes different," said Gilmore. "And that will help us target interventions."

The paper is available now online and will be published in the September issue of the journal. The study was funded by grants from the National Institute of Mental Health and the Foundation of Hope.

In addition to Gilmore, authors of the study were Chaeryon Kang, Dianne D. Evans, Honor M. Wolfe, J. Keith Smith, Weili Lin, Robert M. Hamer, Martin Styner, and Guido Gerig. Author Jeffrey A. Lieberman, chairs the Department of Psychiatry at Columbia University.

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **University of North Carolina School of Medicine**.

Journal Reference:

1. J. H. Gilmore, C. Kang, D. D. Evans, H. M. Wolfe, M. D. Smith, J. A. Lieberman, W. Lin, R. M. Hamer, M. Styner, G. Gerig. **Prenatal and Neonatal Brain Structure and White Matter Maturation in Children at High Risk for Schizophrenia**. *American Journal of Psychiatry*, 2010; DOI: 10.1176/appi.ajp.2010.09101492

http://www.sciencedaily.com/releases/2010/06/100621111240.htm

World's First Plastic Antibodies in Live Organisms: Stop Spread of Bee Venom in Mice

"Plastic antibodies" that UCI scientists used to stop the spread of bee venom in mice could be designed to combat deadlier toxins and pathogens. (Credit: Photo by Hoang Xuan Pham / University Communications)

ScienceDaily (June 22, 2010) — UC Irvine researchers have developed the first "plastic antibodies" successfully employed in live organisms -- stopping the spread of bee venom through the bloodstream of mice.

Tiny polymeric particles -- just 1/50,000th the width of a human hair -- were designed to match and encase melittin, a peptide in bee venom that causes cells to rupture, releasing their contents. Large quantities of melittin can lead to organ failure and death.

The polymer nanoparticles were prepared by "molecular imprinting" a technique similar to plaster casting: UCI chemistry professor Kenneth Shea and project scientist Yu Hoshino linked melittin with small molecules called monomers, solidifying the two into a network of long polymer chains. After the plastic hardened, they removed the melittin, leaving nanoparticles with minuscule melittin-shaped holes.

When injected into mice given high doses of melittin, these precisely imprinted nanoparticles enveloped the matching melittin molecules, "capturing" them before they could disperse and wreak havoc -- greatly reducing deaths among the rodents.

"Never before have synthetic antibodies been shown to effectively function in the bloodstream of living animals," Shea says. "This technique could be utilized to make plastic nanoparticles designed to fight more lethal toxins and pathogens."

Takashi Kodama of Stanford University and Hiroyuki Koide, Takeo Urakami, Hiroaki Kanazawa and Naoto Oku of Japan's University of Shizuoka also contributed to the study, published recently in the *Journal of the American Chemical Society.*

Unlike natural antibodies produced by live organisms and harvested for medical use, synthetic antibodies can be created in laboratories at a lower cost and have a longer shelf life.

"The bloodstream includes a sea of competing molecules -- such as proteins, peptides and cells -- and presents considerable challenges for the design of nanoparticles," Shea says. "The success of this experiment demonstrates that these challenges can be overcome."

Story Source:

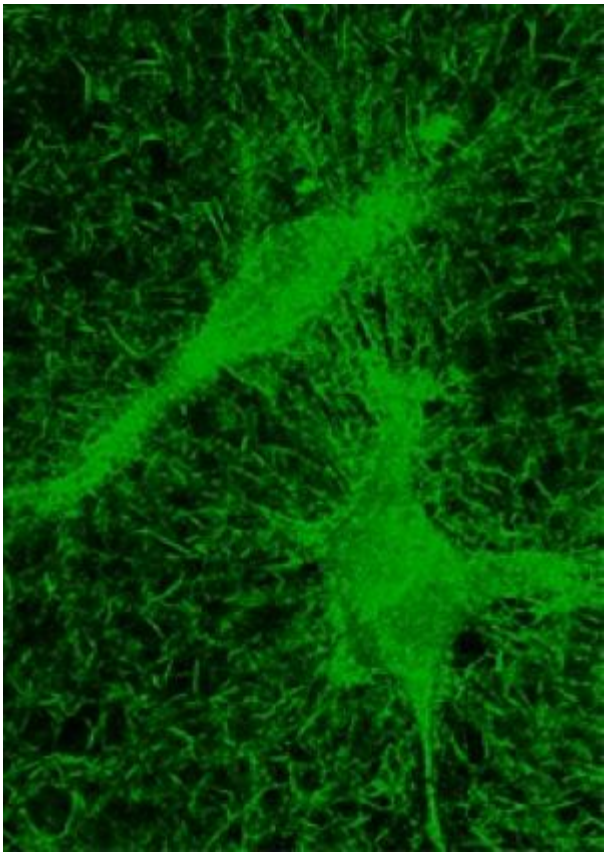
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **University of California - Irvine**.

Journal Reference:

1. Yu Hoshino, Hiroyuki Koide, Takeo Urakami, Hiroaki Kanazawa, Takashi Kodama, Naoto Oku, Kenneth J. Shea. **Recognition, Neutralization, and Clearance of Target Peptides in the Bloodstream of Living Mice by Molecularly Imprinted Polymer Nanoparticles: A Plastic Antibody**. *Journal of the American Chemical Society*, 2010; 132 (19): 6644 DOI: 10.1021/ja102148f

http://www.sciencedaily.com/releases/2010/06/100621141026.htm

Studying Cells in 3-D Could Reveal New Cancer Targets



Reflection confocal micrograph of collagen fibers of a 3D matrix with cancer cells embedded. (Credit: Image by Stephanie Fraley/Wirtz Lab)

ScienceDaily (June 22, 2010) — Showing movies in 3-D has produced a box-office bonanza in recent months. Could viewing cell behavior in three dimensions lead to important advances in cancer research? A new study led by Johns Hopkins University engineers indicates it may happen. Looking at cells in 3-D, the team members concluded, yields more accurate information that could help develop drugs to prevent cancer's spread.

The study, a collaboration with researchers at Washington University in St. Louis, appears in the June issue of *Nature Cell Biology*.

"Finding out how cells move and stick to surfaces is critical to our understanding of cancer and other diseases. But most of what we know about these behaviors has been learned in the 2-D environment of Petri dishes," said Denis Wirtz, director of the Johns Hopkins Engineering in Oncology Center and principal investigator of the study. "Our study demonstrates for the first time that the way cells move inside a three-dimensional environment, such as the human body, is fundamentally different from the behavior we've seen in conventional flat lab dishes. It's both qualitatively and quantitatively different."

One implication of this discovery is that the results produced by a common high-speed method of screening drugs to prevent cell migration on flat substrates are, at best, misleading, said Wirtz, who also is the Theophilus H. Smoot Professor of Chemical and Biomolecular Engineering at Johns Hopkins. This is important because cell movement is related to the spread of cancer, Wirtz said. "Our study identified possible targets to dramatically slow down cell invasion in a three-dimensional matrix."

When cells are grown in two dimensions, Wirtz said, certain proteins help to form long-lived attachments called focal adhesions on surfaces. Under these 2-D conditions, these adhesions can last several seconds to several minutes. The cell also develops a broad, fan-shaped protrusion called a lamella along its leading edges, which helps move it forward. "In 3-D, the shape is completely different," Wirtz said. "It is more spindlelike with two pointed protrusions at opposite ends. Focal adhesions, if they exist at all, are so tiny and so short-lived they cannot be resolved with microscopy."

The study's lead author, Stephanie Fraley, a Johns Hopkins doctoral student in Chemical and Biomolecular Engineering, said that the shape and mode of movement for cells in 2-D are merely an "artifact of their environment," which could produce misleading results when testing the effect of different drugs. "It is much more difficult to do 3-D cell culture than it is to do 2-D cell culture," Fraley said. "Typically, any kind of drug study that you do is conducted in 2D cell cultures before it is carried over into animal models. Sometimes, drug study results don't resemble the outcomes of clinical studies. This may be one of the keys to understanding why things don't always match up."

Fraley's faculty supervisor, Wirtz, suggested that part of the reason for the disconnect could be that even in studies that are called 3-D, the top of the cells are still located above the matrix. "Most of the work has been for cells only partially embedded in a matrix, which we call 2.5-D," he said. "Our paper shows the fundamental difference between 3-D and 2.5-D: Focal adhesions disappear, and the role of focal adhesion proteins in regulating cell motility becomes different."

Wirtz added that "because loss of adhesion and enhanced cell movement are hallmarks of cancer," his team's findings should radically alter the way cells are cultured for drug studies. For example, the team found that in a 3-D environment, cells possessing the protein zyxin would move in a random way, exploring their local environment. But when the gene for zyxin was disabled, the cells traveled in a rapid and persistent, almost one-dimensional pathway far from their place of origin.

Fraley said such cells might even travel back down the same pathways they had already explored. "It turns out that zyxin is misregulated in many cancers," Fraley said. Therefore, she added, an understanding of the function of proteins like zyxin in a 3-D cell culture is critical to understanding how cancer spreads, or metastasizes. "Of course tumor growth is important, but what kills most cancer patients is metastasis," she said.

To study cells in 3-D, the team coated a glass slide with layers of collagen-enriched gel several millimeters thick. Collagen, the most abundant protein in the body, forms a network in the gel of cross-linked fibers similar to the natural extracellular matrix scaffold upon which cells grow in the body. The researchers then mixed cells into the gel before it set. Next, they used an inverted confocal microscope to view from below the cells traveling within the gel matrix. The displacement of tiny beads embedded in the gel was used to show movement of the collagen fibers as the cells extended protrusions in both directions and then pulled inward before releasing one fiber and propelling themselves forward.

Fraley compared the movement of the cells to a person trying to maneuver through an obstacle course crisscrossed with bungee cords. "Cells move by extending one protrusion forward and another backward, contracting inward, and then releasing one of the contacts before releasing the other," she said. Ultimately, the cell moves in the direction of the contact released last.

When a cell moves along on a 2-D surface, the underside of the cell is in constant contact with a surface, where it can form many large and long-lasting focal adhesions. Cells moving in 3-D environments, however, only make brief contacts with the network of collagen fibers surrounding them-contacts too small to see and too short-lived to even measure, the researchers observed.

"We think the same focal adhesion proteins identified in 2-D situations play a role in 3-D motility, but their role in 3-D is completely different and unknown," Wirtz said. "There is more we need to discover."

Fraley said her future research will be focused specifically on the role of mechanosensory proteins like zyxin on motility, as well as how factors such as gel matrix pore size and stiffness affect cell migration in 3-D.

Co-investigators on this research from Washington University in St. Louis were Gregory D. Longmore, a professor of medicine, and his postdoctoral fellow Yunfeng Feng, both of whom are affiliated with the university's BRIGHT Institute. Longmore and Wirtz lead one of three core projects that are the focus of the Johns Hopkins Engineering in Oncology Center, a National Cancer Institute-funded Physical Sciences in Oncology Center. Additional Johns Hopkins authors, all from the Department of Chemical and Biomolecular Engineering, were Alfredo Celedon, a recent doctoral recipient; Ranjini Krishnamurthy, a recent bachelor's degree recipient; and Dong-Hwee Kim, a current doctoral student.

Funding for the research was provided by the National Cancer Institute.

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Johns Hopkins University**. The original article was written by Mary Spiro.

Journal Reference:

1. Stephanie I. Fraley, Yunfeng Feng, Ranjini Krishnamurthy, Dong-Hwee Kim, Alfredo Celedon, Gregory D. Longmore, Denis Wirtz. **A distinctive role for focal adhesion proteins in three-dimensional cell motility**. *Nature Cell Biology*, 2010; 12 (6): 598 DOI: 10.1038/ncb2062

http://www.sciencedaily.com/releases/2010/06/100621173926.htm

Bone Replacement from Laser Melting

A degradable implant closes the fissures in the cranial region. It was designed by Karl Leibinger Medizintechnik company. It was manufactured at Fraunhofer ILT. (Credit: Copyright Fraunhofer ILT)

ScienceDaily (June 22, 2010) — In a medical emergency, a puncture of the cranium is commonly treated with an implant. While replacements made of titanium merely plug holes, a new kind of degradable implant stimulates the body to regenerate itself: It is custom-fit and disappears to the same extent that the bone regrows.

The body can heal minor bone injuries itself -- but with major injuries, it needs help. That's when implants frequently come into use. In contrast to long-term solutions based on titanium, degradable implants are intended to replace the missing pieces of bone only until the fissure closes itself up. That may last months or even years, depending on the size of the defect, the age and health status of the patient. A new implant improves the conditions for the healing process. It emerged from the "Resobone" project of the federal ministry for education and research, and is sized-to-fit for each patient. Unlike the conventional bony substitutes to date, it is not made up as a solid mass, but is porous instead. Precise little channels permeate the implant at intervals of just a few hundred micrometers.

"Its precision fit and perfect porous structure, combined with the new biomaterial, promise a total bone reconstruction that was hitherto impossible to achieve," as Dr. Ralf Smeets of the University Medical Center of Aachen summarizes the findings of the first tolerability studies.

The porous canals create a lattice structure which the adjacent bones can grow into. Its basic structure consists of the synthetic polylactide, or PLA for short. The stored granules from tricalcium phosphate (TCP) ensure rigidity and stimulate the bone's natural healing process. As pastes, granulates and semi-finished products, TCP and PLA already have proven to be degradable implants. The body can catabolize both substances as

rapidly as the natural bones can regrow. But the material can only be applied in places where it will not be subject to severe stress: Thus, the "Resobone" implants will primarily replace missing facial, maxillary and cranial bones. Currently, they are able to close fissures of up to 25 square centimeters in size. Their unique structure is made possible through a manufacturing process that was developed at the Fraunhofer Institute for Laser Technology ILT in Aachen for the development of industrial prototypes -- Selective Laser Melting (SLM): A razor-thin laser beam melts the pulverized material layer-by-layer to structures that may be as delicate as 80 to 100 micrometers.

The patient's computer tomography serves as the template for the precision-fit production of the implants. The work processes -- from CT imaging, to construction of the implant, through to its completion -- are coordinated in such precise sequences that the replacement for a defective zygomatic bone can be produced in just a few hours, while a five-centimeter large section of cranium can be done overnight. In addition to the obvious benefits, there is a considerable gain in time during surgery: "No custom-fit, degradable implants ever existed before now. During the operation, the surgeon had to cut TCP cubes, or the patient's own previously removed bone material, to size and insert it into the fissure," explains Simon Höges, Project Manager at ILT.

In addition, the operations are now fewer in number: Physicians no longer take the bone replacement from the patient's own pelvic bone. Similarly, they can dispense with the countless follow-up operations on children to exchange long-term implants that don't grow as the child matures. "We have achieved our project goal: a closed process chain to produce individual bony implants from degradable materials," explains Höges with satisfaction. Now it is up to the project partners -- which also include implant manufacturers -- who must turn the results into products.

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Fraunhofer-Gesellschaft**.

http://www.sciencedaily.com/releases/2010/06/100616090217.htm

More Than Skin Deep, Tanning Product of Sun's Rays

People who remain pale and never tan can blame their distant ancestors for choosing to live in the northern reaches of the globe and those who easily achieve a deep tan can thank their ancestors for living in the subtropical latitudes, according to Penn State anthropologists. (Credit: iStockphoto/Yuliyan Velchev)

ScienceDaily (June 22, 2010) — People who remain pale and never tan can blame their distant ancestors for choosing to live in the northern reaches of the globe and those who easily achieve a deep tan can thank their ancestors for living in the subtropical latitudes, according to Penn State anthropologists.

"The variation of ultraviolet radiation, especially in the middle and high latitudes is great," said Nina Jablonski, professor of anthropology and chair of Penn State's anthropology department. "Tanning has evolved multiple times around the world as a mechanism to partly protect humans from harmful effects of ultraviolet radiation."

Jablonski, working with George Chaplin, senior research associate in anthropology and an expert in geographic information systems, looked at the way the sun illuminates different parts of the Earth. They looked at levels and angles of incidence of both ultraviolet A and B radiation at various latitudes. Ultraviolet B radiation is much more variable than ultraviolet A as latitude increases due to atmospheric scattering of the light and absorption by oxygen.

Ultraviolet B radiation produces vitamin D in human skin. Ultraviolet radiation can, however, destroy folate. Folate is important for the rapid growth of cells, especially during pregnancy where its deficiency can cause neural tube defects.

"What we now recognize is that some of the medical problems seen in darkly pigmented people may be linked at some level to vitamin D deficiency," said Jablonski. "Things like certain types of cancer in darkly pigmented people and in people who use a lot of sunscreen or always stay inside could be partly related to vitamin D deficiency."

Scientists have understood for years that evolutionary selection of skin pigmentation was caused by the sun. As human ancestors gradually lost their pelts to allow evaporative cooling through sweating, their naked skin was directly exposed to sunlight. In the tropics, where human ancestors evolved and where both ultraviolet radiations are high throughout the year, natural selection created darkly pigmented individuals to protect against the sun.

"Past arguments about the selective value of dark pigmentation focused on the protective effects of melanin against sunburn, skin cancer, and overproduction of vitamin D. These factors can no longer be considered significant selective pressures," the Jablonski and Chaplin report in a recent issue of the *Proceedings of the National Academy of Sciences.*

Sunburn and most skin cancers do not alter an individual's ability to procreate, so they are not selection factors. The human body also has a mechanism to prevent overproduction of vitamin D.

Previously, the researchers concluded that dark skin pigmentation in the tropics protects people from folate destruction by ultraviolet B, but, because levels of ultraviolet B are high year round, the skin can still allow enough in to manufacture vitamin D.

As humans moved out of Africa, they moved into the subtropics and eventually inhabited areas up to the Arctic Circle. Ultraviolet radiation in these areas is neither consistent nor strong. North or south of 46 degrees latitude, which includes all of Canada, Russia, Scandinavia, Western Europe and Mongolia, there is insufficient ultraviolet B through most of the year to produce vitamin D. Populations in these areas evolved to have little skin pigmentation.

In the latitudes between 23 and 46 degrees, an area that encompasses North Africa, South America, the Mediterranean and most of China, ultraviolet B radiation is much more variable. Heavily pigmented skin in the winter would block the development of vitamin D, and lightly pigmented skin during the summer would allow destruction of folate.

"We actually demonstrate that in those middle latitudes where highly fluctuating levels of ultraviolet radiation occur throughout the year, tanning has evolved multiple times as a mechanism to partly protect humans from harmful effect of the sun," said Jablonski.

The tanning process evolved for humans who by and large were naked all the time. As the ultraviolet B radiation began to increase in the early spring, the skin would begin to gradually darken. As the sun became stronger, the tan became deeper. During the winter, as ultraviolet B waned, so did the tan, allowing Vitamin D production and protecting folate.

The researchers note that the ability to tan developed in a wide variety of peoples and while the outcome, tanablity, is the same, the underlying genetic mechanisms are not necessarily identical. They also note that depigmentated skin also developed at least three times through different genetic mechanisms.

Implications for today focus on the fact that depigmented people now live in tropical and subtropical areas where besides getting sunburned they run the risk of losing folate. Highly pigmented people live in higher latitudes where they may become vitamin D deficient, especially if they use sunscreens.

"It is a conspiracy of modernity," said Jablonski. "The rapidity at which we can move long distances and live far away from our ancestral homelands. The fact that we can live and work indoors. All this has happened within the last 500 years and especially within the last 200 years."

Story Source:

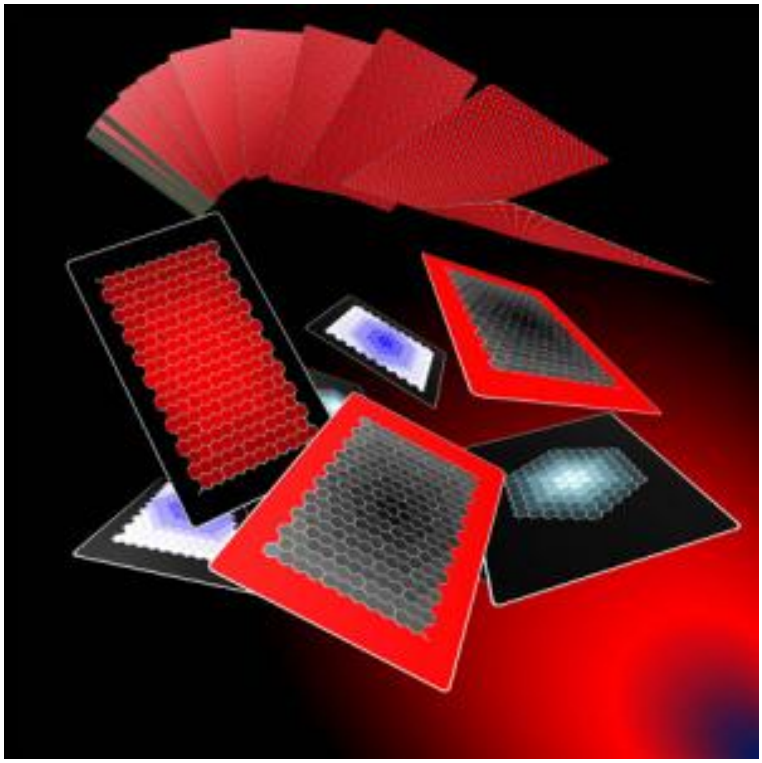
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Penn State**.

Journal Reference:

1. N. G. Jablonski, G. Chaplin. **Colloquium Paper: Human skin pigmentation as an adaptation to UV radiation**. *Proceedings of the National Academy of Sciences*, 2010; 107 (Supplement_2): 8962 DOI: 10.1073/pnas.0914628107

http://www.sciencedaily.com/releases/2010/06/100621125137.htm

New Method for Producing Graphene Paves Way for Mass Production of Nanomaterial



Graphene, as seen in the above renderings, is an atom-thick sheet of carbon arranged in a honeycomb structure. It has unique mechanical and electrical properties and is considered a potential heir to copper and silicon as the fundamental building blocks of nanoelectronics, but is difficult to produce in bulk. A team of Rensselaer researchers has brought science a step closer to realizing this important goal of a simple, efficient way to mass-produce graphene. (Credit: Rensselaer/Kar)

ScienceDaily (June 22, 2010) — Researchers at Rensselaer Polytechnic Institute have developed a simple new method for producing large quantities of the promising nanomaterial graphene. The new technique works at room temperature, needs little processing, and paves the way for cost-effective mass production of graphene.

An atom-thick sheet of carbon arranged in a honeycomb structure, graphene has unique mechanical and electrical properties and is considered a potential heir to copper and silicon as the fundamental building block of nanoelectronics. Since graphene's discovery in 2004, researchers have been searching for an easy method to produce it in bulk quantities.

A team of interdisciplinary researchers, led by Swastik Kar, research assistant professor in the Department of Physics, Applied Physics, and Astronomy at Rensselaer, has brought science a step closer to realizing this important goal. By submerging graphite in a mixture of dilute organic acid, alcohol, and water, and then exposing it to ultrasonic sound, the team discovered that the acid works as a "molecular wedge, " which separates sheets of graphene from the parent graphite. The process results in the creation of large quantities of

undamaged, high-quality graphene dispersed in water. Kar and team then used the graphene to build chemical sensors and ultracapacitors.

"There are other known techniques for fabricating graphene, but our process is advantageous for mass production as it is low cost, performed at room temperature, devoid of any harsh chemicals, and thus is friendly to a number of technologies where temperature and environmental limitations exist," Kar said. "The process does not need any controlled environment chambers, which enhances its simplicity without compromising its scalability. This simplicity enabled us to directly demonstrate high-performance applications related to environmental sensing and energy storage, which have become issues of global importance."

Results of the study, titled "Stable Aqueous Dispersions of Non-Covalently Functionalized Graphene from Graphite and their Multifunctional High-Performance Applications," were published online by the journal *Nano Letters*. The study will also be the cover story of the November print edition of *Nano Letters.*

Graphene eluded scientists for years but was finally made in the laboratory in 2004 with the help of a common office supply -- clear adhesive tape. Graphite, the common material used in most pencils, is made up of countless layers of graphene. Researchers at first simply used the gentle stickiness of tape to pull layers of graphene from a piece of graphite.

Today, graphene fabrication is much more sophisticated. The most commonly used method, however, which involves oxidizing graphite and reducing the oxide at a later stage in the process, results in a degradation of graphene's attractive conductive properties, Kar said. His team took a different route.

The researchers dissolved 1-*pyrenecarboxylic acid* (PCA) in a solution of water and methanol, and then introduced bulk graphite powder. The *pyrene* part of PCA is mostly hydrophobic, and clings to the surface of the also-hydrophobic graphite. The mixture is exposed to ultrasonic sound, which vibrates and agitates the graphite. As the molecular bonds holding together the graphene sheets in graphite start to weaken because of the agitation, the PCA also exploits these weakening bonds and works its way between the layers of graphene that make up the graphite. Ultimately, this coordinated attack results in layers of graphene flaking off of the graphite and into the water. The PCA also helps ensure the graphene does not clump and remains evenly dispersed in the water. Water is benign, and is an ideal vehicle through which graphene can be introduced into new applications and areas of research, Kar said.

"We believe that our method also will be useful for applications of graphene which require an aqueous medium, such as biomolecular experiments with living cells, or investigations involving glucose or protein interactions with graphene," he said.

Using ultrathin membranes fabricated from graphene, the research team developed chemical sensors that can easily identify ethanol from within a mixture of different gases and vapors. Such a sensor could possibly be used as an industrial leakage detector or a breath-alcohol analyzer. The researchers also used the graphene to build an ultra-thin energy-storage device. The double-layer capacitor demonstrated high specific capacitance, power, and energy density, and performed far superior to similar devices fabricated in the past using graphene. Both devices show great promise for further performance enhancements, Kar said.

Co-authors on the *Nano Letters* paper are Rensselaer Post Doctoral Research Associate Xiaohong An; Assistant Professor Kim M. Lewis; Clinical Professor and Center for Integrated Electronics Associate Director Morris Washington; and Professor Saroj Nayak, all of the Department of Physics, Applied Physics,

and Astronomy; Rensselaer doctoral student Trevor Simmons of the Department of Chemistry and Chemical Biology; along with Rakesh Shah, Christopher Wolfe, and Saikat Talapatra of the Department of Physics at Southern Illinois University Carbondale.

The research project was supported by the Interconnect Focus Center New York at Rensselaer, as well as the National Science Foundation (NSF) Division of Electrical, Communications and Cyber Systems.

Story Source:

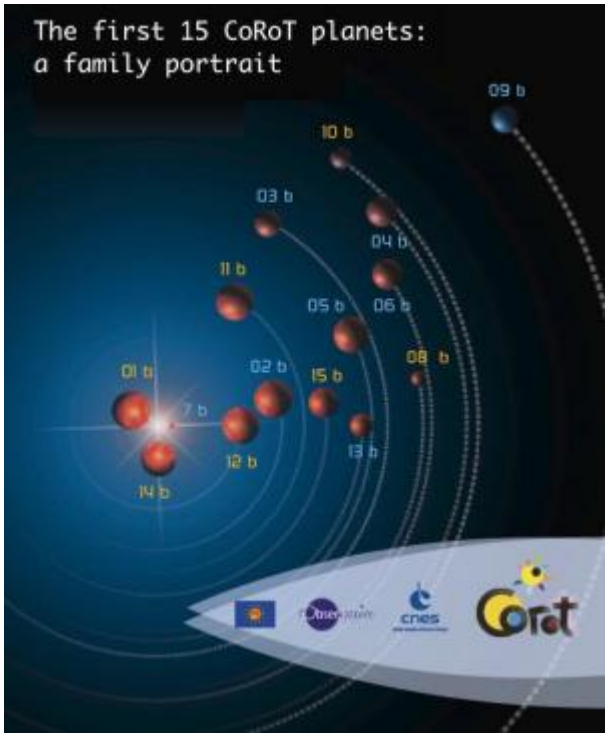
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Rensselaer Polytechnic Institute**.

Journal Reference:

1. Xiaohong An, Trevor Simmons, Rakesh Shah, Christopher Wolfe, Kim M. Lewis, Morris Washington, Saroj K. Nayak, Saikat Talapatra, Swastik Kar. **Stable Aqueous Dispersions of Noncovalently Functionalized Graphene from Graphite and their Multifunctional High-Performance Applications**. *Nano Letters*, 2010: 100617081506041 DOI: 10.1021/nl903557p

http://www.sciencedaily.com/releases/2010/06/100621122132.htm

Six New Planets Discovered



The CoRoT family of planets. (Credit: Courtesy of the CoRoT exoplanet program)

ScienceDaily (June 22, 2010) — An international team, including Oxford University scientists, has discovered six diverse new planets, from 'shrunken-Saturns' to 'bloated hot Jupiters', as well a rare brown dwarf with 60 times the mass of Jupiter.

The CoRoT (Convection, Rotation and Transits) space telescope is operated by the French space agency CNES. It discovers planets outside our solar system -- exoplanets -- when they 'transit', that is pass in front of their stars.

Once CoRoT detects a transit, additional observations are made from the ground, using a number of telescopes all over the world. Although astronomers cannot see the planets directly, they use the space- and ground-based data to measure the sizes, masses, and orbits of these new planets precisely. This is why, among all known exoplanets, those with transits yield the most complete information about planet formation and evolution.

"Each of these planets is interesting in its own right, but what is really fascinating is how diverse they are," said co-investigator Dr. Suzanne Aigrain from Oxford University's Department of Physics. "Planets are intrinsically complex objects, and we have much to learn about them yet."

"Every discovery of an extrasolar planetary system is a new piece in the puzzle of how these systems do form and evolve. The more systems we uncover, the better we can hope to understand the processes at play," said

Magali Deleuil, researcher at the Laboratoire d'Astrophysique de Marseille (LAM) and head of the CoRoT exoplanet program.

The six new planets are:

CoRoT-8b: the smallest in this batch: At about 70% of the size and mass of Saturn, CoRoT-8b is moderately small among the previously known transiting exoplanets. Its internal structure should be similar to that of ice giants, like Uranus and Neptune, in the Solar System. It is the smallest planet discovered by the CoRoT team so far after CoRoT-7b, the first transiting Super-Earth.

CoRoT-10b: the eccentric giant: The orbit of CoRoT-10b is so elongated that the planet passes both very close to and very far away from its star. The amount of radiation it receives from the star varies tenfold in intensity, and scientists estimate that its surface temperature may increase from 250 to 600°C, all in the space of 13 Earth-days (the length of the year on CoRoT-10b).

CoRoT-11b: the planet whose star does the twist: CoRoT-11, the host star of CoRoT-11b, rotates around its axis in 40 hours. For comparison, the Sun's rotation period is 26 days. It is particularly difficult to confirm planets around rapidly rotating stars, so this detection is a significant achievement for the CoRoT team.

CoRoT-12b, 13b and 14b: a trio of giants: These three planets all orbit close to their host star but have very different properties. Although CoRoT-13b is smaller than Jupiter, it is twice as dense. This suggests the presence of a massive rocky core inside the planet. With a radius 50% large than Jupiter's (or 16 times larger than the Earth's), CoRoT-12b belongs to the family of `bloated hot Jupiters', whose anomalously large sizes are due to the intense stellar radiation they receive. On the other hand, CoRoT-14b, which is even closer to its parent star, has a size similar to Jupiter's. It is also massive, 7.5 times the mass of Jupiter, which may explain why it is less puffed up. Such very massive and very hot planets are rare, CoRoT-14b is only the second one discovered so far.

CoRoT-15b: the brown dwarf: CoRoT-15b's mass is about 60 times that of Jupiter. This makes it incredibly dense, about 40 times more so than Jupiter. For that reason, it is classified as a brown dwarf, intermediate in nature between planets and stars. Brown dwarfs are much rarer than planets, which makes this discovery all the more exciting.

Dr. Suzanne Aigrain leads a team of UK researchers at the Universities of Oxford, Exeter and St Andrews who participate in the CoRoT exoplanet program. Their research is supported by the Science and Technology Facilities Research Council.

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **University of Oxford**.

http://www.sciencedaily.com/releases/2010/06/100621133749.htm

Agricultural Scientists Take a Long Look at Livestock and Locoweed

ARS and New Mexico State University researchers are devising new ways to prevent livestock losses to locoweed. (Credit: Photo courtesy of Mary Ellen Harte, Bugwood.org)

ScienceDaily (June 22, 2010) — Keeping livestock away from poisonous locoweed during seasons when it's a forage favorite is one way ranchers can protect their animals and their profits, according to a 20-year collaboration by Agricultural Research Service (ARS) scientists and their university partners.

The ARS researchers teamed up with New Mexico State University (NMSU) scientists to study locoweed poisoning in U.S. livestock and devise ways to minimize or prevent losses. When livestock graze on locoweed, the plant's toxic alkaloids can sicken and sometimes kill the animals, which can cost U.S. producers millions of dollars every year.

The ARS-NMSU collaboration started in 1990 at the request of New Mexico livestock ranchers. Participating ARS scientists at the agency's Poisonous Plant Research Laboratory in Logan, Utah, included Kip Panter, Daniel Cook, Jim Pfister, Mike Ralphs, Dale Gardner, Bryan Stegelmeier, Kevin Welch, and Lynn James, now retired. Their NMSU partners included David Graham, Rebecca Creamer, Shanna Lodge-Ivey, Andres Cibils, Manuel Encinias, Kirk McDaniel, David Thompson and Kevin Gardner.

The research involved identifying fungal species that produce locoweed toxins, assessing toxin level variations, finding biomarkers that could help pinpoint toxicity levels in animals that had consumed locoweed, assessing the effect of locoweed toxins on animal reproduction and livestock grazing preferences, and evaluating herbicide and biological control of the weed.

The ARS-NMSU team assembled a set of grazing management guidelines based on the seasonal availability of locoweed and more benign forage options, such as warm-season grasses. The researchers recommended restricting livestock access to locoweed in spring and fall, when it is relatively more palatable than dormant warm-season grasses. During these critical periods, ranchers could preserve locoweed-free pastures for livestock grazing or else create them with appropriate herbicide treatments. Livestock could resume grazing in locoweed-infested pastures in summer, when green grass is abundant.

The scientists also suggested that supplemental nutrients could be used to tempt livestock away from locoweeds when other forage is low in nutrient quality. In some cases, using conditioned food aversion techniques to train cattle and horses to spurn locoweed might be appropriate.

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **USDA/Agricultural Research Service**. The original article was written by Ann Perry.

http://www.sciencedaily.com/releases/2010/06/100621111242.htm

Europe's next-gen polar weather satellites twin up

Page last updated at 14:48 GMT, Tuesday, 22 June 2010 15:48 UK

By Jonathan Amos
Science correspondent, BBC News

Metop-A was launched in 2006

The next-generation of Europe's polar orbiting weather satellites will fly in a two-spacecraft configuration.

Eumetsat, the organisation that operates Europe's weather observatories, took the decision at its latest council meeting in Rome.

It will allow additional instruments to be flown, producing even more data for numerical weather prediction models.

The Eumetsat Polar System, Second Generation (EPS-2G), will be a multi-billion euro programme.

However, the cost is likely to be comparable with the current system which had a total envelope of about 2.4bn euros.

The two-spacecraft configuration and the possible instrument payloads will be considered in the initial feasibility study.

The present EPS has so far launched just the one platform, Metop-A, which went into space in 2006.

Two reserve satellites, Metop-B and Metop-C, are built and held in storage. They are likely to fly in 2012 and 2016 to give continuity to the programme.

Eruption plume

Metop-A is generally regarded as having been a remarkable step forward in monitoring capability for Europe.

It was the first European weather satellite to circle the Earth via the poles. Eumetsat's familiar Meteosat class of observatories sit in geostationary orbits (GEO) some 36,000km above the equator. From this position, the Meteosats can image half of the Earth's surface every 15 minutes.

Metop, on the other hand, takes high-resolution pictures of the whole planet over a much longer time span, between one and three days.

Its 12-instrument payload (eight of the instruments gather meteorological data) monitors variables such as temperature, humidity, wind velocity, ozone cover and atmospheric chemistry.

Metop-A played a critical role is assessing the progress of the ash plume from Iceland's Eyjafjallajokull eruption in April.

The latest Eumetsat council has also approved the scope of the next-generation of the Meteosat series. This, too, will fly a two-satellite configuration for the first time.

Both of the new programmes will be developed in conjunction with the European Space Agency.

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http://news.bbc.co.uk/1/hi/science_and_environment/10378791.stm

God particle signal is simulated as sound

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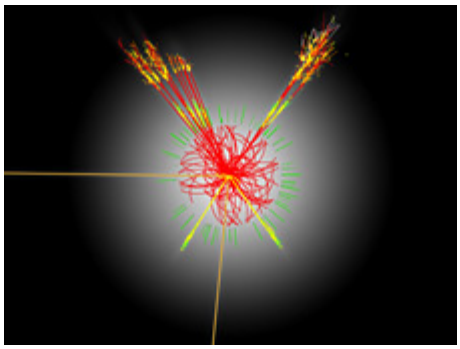
By Pallab Ghosh
Science correspondent, BBC News



The Higgs boson particle is thought to give all others their mass

Scientists have simulated the sounds set to be made by sub-atomic particles such as the Higgs boson when they are produced at the Large Hadron Collider.

Their aim is to develop a means for physicists at Cern to "listen to the data" and pick out the Higgs particle if and when they finally detect it.

Dr Lily Asquith modelled data from the giant Atlas experiment at the LHC.

She worked with sound engineers to convert data expected from collisions at the LHC into sounds.

"If the energy is close to you, you will hear a low pitch and if it's further away you hear a higher pitch," the particle physicist told BBC News.

"If it's lots of energy it will be louder and if it's just a bit of energy it will be quieter."

The £6bn LHC machine on the Swiss-French border is designed to shed light on fundamental questions in physics.

It is housed in a 27km-long circular tunnel, where thousands of magnets steer beams of proton particles around the vast "ring".

At allotted points around the tunnel, the beams cross paths, smashing together near four massive "experiments" that monitor these collisions for interesting events.

Scientists are hoping that new sub-atomic particles will emerge, revealing insights into the nature of the cosmos.

Atlas is one of the experiments at the LHC. An instrument inside Atlas called the calorimeter is used for measuring energy and is made up of seven concentric layers.

Each layer is represented by a note and their pitch is different depending on the amount of energy that is deposited in that layer.

The process of converting scientific data into sounds is called sonification.

Dr Asquith and her team have so far generated a number of simulations based on predictions of what might happen during collisions inside the LHC.

The team is only now feeding in real results from real experiments.

"When you are hearing what the sonifications do you really are hearing the data. It's true to the data, and it's telling you something about the data that you couldn't know in any other way," said Archer Endrich, a software engineer working on the project.

The aim is to give physicists at the LHC another way to analyse their data. The sonification team believes that ears are better suited than eyes to pick out the subtle changes that might indicate the detection of a new particle.

But Richard Dobson - a composer involved with the project - says he is struck at how musical the products of the collisions sound.

"We can hear clear structures in the sound, almost as if they had been composed. They seem to tell a little story all to themselves. They're so dynamic and shifting all the time, it does sound like a lot of the music that you hear in contemporary composition," he explained.

Although the project's aim is to provide particle physicists with a new analysis tool, Archer Endrich believes that it may also enable us to eavesdrop on the harmonious background sound of the Universe.

He said he hoped the particle collisions at Cern would "reveal something new and something important about the nature of the Universe".

And Mr Endrich says that those who have been involved in the project have felt something akin to a religious experience while listening to the sounds.

"You feel closer to the mystery of Nature which I think a lot of scientists do when they get deep into these matters," he said.

"Its so intriguing and there's so much mystery and so much to learn. The deeper you go, the more of a pattern you find and it's fascinating and it's uplifting."

http://news.bbc.co.uk/1/hi/science_and_environment/10385675.stm

The push to make broadband access a civil right

By Rebecca Tuhus-Dubrow | June 20, 2010

If you're one of the millions of Americans who use broadband Internet at home, you probably take for granted how deeply it's woven into your life. It has transformed the way we pay our bills, seek romance, procrastinate, and keep abreast of politics and the lives of friends. The pre-Google era has become a distant, hazy memory.

If anything, many of us often half-wish we could escape the Internet's clutches. The constant connectivity can be a shackle as much as a convenience. Our habits have even triggered a serious debate about whether all that clicking and toggling is warping our brains.

But as the Internet grows more and more important to modern life, some are now asking a different kind of question: Should broadband access be a civil right?

It may seem strange to put the technology that brought us Facebook in the august category where we place voting, or trial by jury. But increasingly, activists, analysts, and government officials are arguing that Internet access has become so essential to participation in society — to finding jobs and housing, to civic engagement, even to health — that it should be seen as a right, a basic prerogative of all citizens. And in cases where people don't have access, whether because they can't afford it or the infrastructure is not in place, the government should have the power — and perhaps the duty — to fix that.

The idea is already gaining traction both overseas and in the United States. In 2009, Finland passed a law requiring telecom companies, as of next month, to make broadband available to all citizens, even in remote areas. UN conferences have featured discussion of an international "Internet Bill of Rights" that would include the right to affordable access; a Pew survey of attendees at the 2007 UN Internet Governance Forum in Rio found that a majority of the respondents supported the idea of such a bill. And the notion is not confined to the progressive spheres of Europe and the UN: In Washington, at least two of the five commissioners at the Federal Communications Commission, Michael Copps and Mignon Clyburn, have said that broadband needs to be seen as a civil right.

As Internet use becomes ever more widespread, advocates say, it becomes an indispensable venue for activities like speech and political participation. More and more government functions are gravitating online; a vast and growing segment of social and cultural life now unfolds on the Web. The Internet, these advocates argue, has not only created a new world, its prevalence has also made it a prerequisite for full membership in the old one.

"Increasingly you can't find a job without it. You can't complete your education, or compete with your peers without it. You can't take advantage of the tools of modern medicine without it," Copps said recently in an interview. "I would hope as we go along...that it does become enshrined as a civil right."

But characterizing Internet access as a civil right raises a number of vexing questions. Who would pay to bring broadband into households without it? By creating a right based on technology, are we making it harder for citizens to make their own, equally valid decisions to opt out of using it? And some analysts, while

supporting the goal of universal service, simply don't believe that a digital network should be elevated to the status of a right.

Even these skeptics, however, generally agree that broadband access is already deeply entwined with existing civil rights. Whether the government must ensure access to the means of taking part, or merely refrain from blocking it, is another question — and one that gets to the heart of what a civil right in America is.

Although supporters don't see broadband as the kind of fundamental right enshrined in the Constitution — the basic human freedoms that protect individuals from government control of their lives — society acknowledges other kinds of rights as well, such as the right not to be excluded from the essential privileges of citizenship. This is the kind of right enforced by the Civil Rights Act of 1964, which guaranteed people equal treatment and equal access to schools and public facilities, regardless of race. The Americans with Disabilities Act of 1990 was similarly crafted to ensure disabled people could fully participate in American society.

Supporters also see a parallel in the 1934 Telecommunications Act, which aimed to make affordable access to telephone and radio services "available, so far as possible, to all the people of the United States." Though it did not declare telephone access a right, the law was updated in 1996 to mandate that providers contribute to a "Universal Service Fund" which helps defray the bills of low-income residents and subsidizes service in low-density areas where prices would be quite high if left to the free market. This charge is often passed on to consumers in the form of an extra fee on phone bills.

Now, the same kind of attention is turning to broadband, widely seen as the most important new infrastructure of the 21st-century. (The emphasis is on broadband, rather than dial-up Internet access, because so much of the online world increasingly requires a higher-speed connection to download data and upload forms.)

"Pick an area of life and it's affected," says Mark Pruner, president of the Native American Broadband Association, an advocacy group that aims to bring broadband to reservations.

Pruner and other advocates can tick off a long list of basic civic functions for which the Internet has become vital. A large percentage of jobs advertise exclusively online and require that applications be submitted electronically. Commerce increasingly takes place online. With every election, Internet access grows more important to political engagement. And the Internet makes it easy to find the text of bills, learn how your representatives vote, and read about the White House's plans and positions.

Even health is affected to a surprising degree. Medical institutions have begun to use the Internet to manage health information and let patients and doctors communicate more closely — an improvement in health care unavailable to people without ready access to the Web. "Telemedicine" — doctors' appointments via the Internet — is expected to be the next wave in health care innovation.

Of course, most of these opportunities remain available through other means — by mail, by phone, in person. The Internet is an immensely valuable vehicle for free speech, but you can still take a bullhorn and air your grievances on the street corner. However, the more central the Internet's advantages become to mainstream society, the more acute the disadvantage of lacking them. As Adam Smith wrote in "The Wealth of Nations," necessity is always relative: Although a linen shirt was not technically a "necessary," it had become one in the context of his society, because a worker would be ashamed to appear in public without one.

A substantial fraction of Americans now lack access to this modern necessity. In October 2009, a Department of Commerce survey found that a little over one-third of households did not use a broadband service. Sometimes this is by choice, but often it's because of cost. In one survey, people told the FCC they paid an average of almost $41 per month for broadband, but that can vary widely; as a rule, broadband is more expensive in rural areas, some of which don't have the relevant infrastructure at all. Usage figures correlate strongly with income, the Department of Commerce found: Households with family incomes above $50,000 overwhelmingly have broadband, but it's far less common for lower-income people. The numbers also differ by race. Only about 45 percent of African-Americans, and an even lower percentage of Hispanics, use broadband at home.

Given how important the online world is to so many aspects of 21st-century life, when many observers look at Americans without broadband, they see a group of people who are slowly being excluded from society. Without it, says Benjamin Lennett, a policy analyst at the Wireless Futures program at the New American Foundation, "You're simply not going to be able to have equal standing in society. You're simply going to be left out."

But there is a case against enshrining broadband access as a civil right. Civil rights and liberties, especially in America, are most often characterized as "negative rights" — that is, freedom from, rather than entitlement to. You are free to be left alone to worship as you please and to say what you like. Voting is a notable exception. But ideologically speaking, the American conception of rights, unlike that in the social democracies of Europe, has always been more sympathetic to negative rights than positive ones.

On a practical level, one obvious problem is that creating any new right of access requires money — either taxpayer money, or, in this case, extra charges levied on current telecommunications customers. Health care offers one analogy. Americans do not, as citizens of some countries do, have a legally enshrined right to health care — in part because the costs of such a right in our health care system could be astronomical. That said, the costs of universal broadband would be far more limited and predictable than those of health care. And the Americans with Disabilities Act is an example of a successful civil rights law that costs money to enforce, but has become broadly accepted.

More philosophically, some people argue that the category of civil rights is almost sacrosanct, defined by basic notions of human liberty and need, and broadband access simply does not rise to that level. Considering that Americans aren't legally entitled to a house or a computer, does it make sense to mandate broadband access at home?

"To declare it as a national goal is a better way to do it than to make it a civil right," says Pruner.

The government has already started trying to remedy the inequality in broadband access. In March, the FCC released a National Broadband Plan, requested by Congress in 2009, to outline ways to ensure universal service. Among its recommendations is to shift up to $15.5 billion over the next 10 years from the Universal Service Fund to support broadband. It also recommends another fund to promote broadband on tribal lands, where it is estimated that fewer than 10 percent of residents currently have the service. There is also an effort underway at the FCC to reclassify broadband as a "common carrier" regulated service rather than an information service. This change would grant the FCC much more authority over broadband providers, partly with the goal of expanding access. Telecom interests, and many members of Congress, strongly oppose the idea.

The New America Foundation, a nonpartisan think tank, has proposed that the government itself should be the provider of last resort in underserved rural areas, much as the Tennessee Valley Authority brought electricity to a wide swath of the country in the 1930s.

If such plans are enacted, the question of "rights" may be partly a matter of semantics — the practical goal of advocates is universal access, however that is achieved. "That is the only way to ensure a level playing field," says Malkia Cyril, executive director of the Center for Media Justice.

But the debate itself, as it plays out, is highlighting something important about the Internet: More than electricity, more than the telephone — probably in an unprecedented way — the online world enables citizens to exercise their other rights, the ones enshrined in the Constitution. There is, increasingly, a virtual America layered on top of the real one, and "citizenship" means having a space in both.

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http://www.boston.com/bostonglobe/ideas/articles/2010/06/20/one_nation_online/

It's true, your boss is a psychopath

Surprising insights from the social sciences

By Kevin Lewis | June 20, 2010

Watching the news some days, you'd think a lot of companies were run by psychopaths. And, according to a recent study, some might well be. One of the authors of the study was hired by companies to evaluate managers — mostly middle-aged, college-educated, white males — for a management development program. It turns out that these managers scored higher on measures of psychopathy than the overall population, and some who had very high scores were candidates for, or held, senior positions. In general, managers with higher scores were seen as better communicators, better strategic thinkers, and more creative. However, they were also seen as having poor management style, not being team players, and delivering poor performance. But, apparently, this didn't prevent some of them from being seen as having leadership potential. The authors conclude that "the very skills that make the psychopath so unpleasant (and sometimes abusive) in society can facilitate a career in business even in the face of negative performance ratings."

Babiak, P. et al., "Corporate Psychopathy: Talking the Walk," Behavioral Sciences & the Law (March/April 2010).

Why women get the tough assignments
In one of the most famous lines from Shakespeare, King Henry V urges his men "once more unto the breach." Nowadays, though, it looks like women are the ones who are urged unto the breach. British researchers analyzed data from the 2005 parliamentary elections and found that, among candidates challenging the incumbent party, women were chosen to run for seats that were seen as more difficult to win. The researchers also conducted an experiment asking people to rate several political candidates, two of whom had essentially the same qualifications, except that one was a man and the other was a woman. When the election was portrayed as hard to win, most people — regardless of gender — preferred the female candidate, while only a quarter preferred the female candidate when the election was portrayed as winnable.

Ryan, M. et al., "Politics and the Glass Cliff: Evidence That Women Are Preferentially Selected to Contest Hard-To-Win Seats," Psychology of Women Quarterly (March 2010).

A touch builds confidence
If you have the Midas touch, everything you touch — figuratively, in most cases — turns to gold. If you're a woman, everyone you touch — literally — goes for the gold. In several experiments, researchers found that both men and women were more willing to take a gamble after being touched briefly on the back of the shoulder by a woman. A regular handshake with a woman did not have the same effect, nor did touching or handshakes by men. However, the effect was attenuated when people were feeling secure (after writing an essay about a secure time in their lives). According to the authors, "a simple pat on the back of the shoulder — by a female — in a way that connotes support may evoke feelings that are similar to the sense of security afforded by a mother's comforting touch in infancy."

Levav, J. & Argo, J., "Physical Contact and Financial Risk Taking," Psychological Science (June 2010).

They aren't playing our song
One of the major grievances of people living outside the United States, especially in the developing world, is that they are at the mercy of American cultural imperialism. To what extent is this actually true? Two

economists at the University of Pennsylvania analyzed music singles charts around the world going back decades. There's little evidence that countries are favoring foreign artists. Moreover, language and geographical barriers are still important, notwithstanding the rise of MTV and the Internet. Each country's share of music in the global market is roughly proportional to the size of its economy. In fact, Sweden, Canada, Finland, the United Kingdom, and New Zealand contribute more to the global music market, relative to the size of their economies, than the United States.

Ferreira, F. & Waldfogel, J., "Pop Internationalism: Has A Half Century of World Music Trade Displaced Local Culture?" National Bureau of Economic Research (May 2010).

Can I have a few minutes to myself?
There's no "I" in team, and, unfortunately, there may not be as many good ideas in a team either. A recent study found that a hybrid individual-team process generates better ideas than a purely team process. Students in an upper-level product design class at the University of Pennsylvania were asked to generate ideas for two different kinds of products. For one kind of product, they brainstormed and selected ideas in teams. For the other kind of product, they worked separately as individuals before coming together into teams. The resulting ideas for both kinds of products were then assessed independently by MBA students and potential customers. The hybrid process generated significantly more and better ideas.

Girotra, K. et al., "Idea Generation and the Quality of the Best Idea," Management Science (April 2010).

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http://www.boston.com/bostonglobe/ideas/articles/2010/06/20/its_true_your_boss_is_a_psychopath/

Monster of rock

'Megalithic' and the power of metaphor

By Jan Freeman | June 20, 2010

If global warming brings sea levels dangerously high, could "a megalithic building project" help Boston ward off the threat? A couple of weeks ago, Ideas writer Drake Bennett described such a proposal for a barrier in Boston Harbor, one that would use "massive sea gates that could swing shut to seal the city off from the most devastating storm surges."

The idea drew responses not just from big-government and global-warming skeptics, but also from language watchers wondering why anything "megalithic" would be used in 21st-century construction. Our dictionaries, after all, define megaliths — literally, huge stones — as the slabs used by the ancient builders of dolmens and menhirs; so far as they tell us, *megalithic* means only "relating to [literal] megaliths."

This time, it clearly doesn't: It means something like "huge, imposing, impressive," but not "made of stone." "It's an interesting metaphorical use," e-mailed reader Bill Ossmann, who recognized that the word, in broadening its meaning, was only doing what comes naturally. But he wondered — as I did — "Is it new or just new to me?"

The answer was at my fingertips: In the past month alone, Google News supplied a soccer player described as "the megalithic Søren Larsen," a reference to "Tchaikovsky's megalithic Symphony No. 4," and a plate of barbecued chicken praised as a "megalithic bundle of breast, thigh, drumstick, and wing."

Further examples of the metaphoric *megalithic* are fairly common back to 1990 or so, and I've snagged one example from 1952, when The Wall Street Journal complained of the "strangling bureaucracy of megalithic government." And at least one dictionary has noticed the innovation: The New Oxford American gives the figurative *megalithic* its own definition, "massive or monolithic."

If only semantic change could always proceed so smoothly. Generally, of course, it does: We swim in a sea of metaphors we no longer notice, *weighing* our options, *chairing* meetings, *kicking* ourselves, feeling *low* and *high* and *driven* and *pressured*. (Did anyone ever object that an option has no weight?) New senses (metaphorical and otherwise) are constantly evolving, and most of them, naturally, suit our needs and set off no alarms.

But since the rise of popular language peeving in the 19th century, we've been increasingly fond of playing *gotcha!* with new words and usages. Of course, to the person with the peeve, this seems entirely reasonable — who wouldn't want to save the world from *incentivize*? The history of usage prescription, however, is a litany of dire warnings about changes that now seem as minor as *megalithic*'s baby step into the figurative domain.

Extend an invitation, for instance. Today's language watchers sometimes grouse about "Please RSVP" and *an invite*, but I've never heard a complaint about *extending an invitation*. A century ago, though, the phrase must have been newly fashionable, for it was roundly thumped by American language mavens. Richard Grant White called it pompous; Robert Palfrey Utter declared it condescending. And Ambrose Bierce attacked it at the root, as an unsound metaphor: If an invitation isn't delivered by hand, he said, it can't be "extended."

As for your *unkempt* appearance: Once upon a time, you would have been chastised for using the word for anything but hair. Its literal sense is "uncombed," but in the 19th century — despite the protests of etymological fundamentalists — *unkempt* was increasingly adopted as a synonym for *disheveled*. (Which would also apply only to hair, if etymology were destiny.)

And as recently as 1926, in "Modern English Usage," H.W. Fowler was trying to beat back the figurative use of *endorse*. The original sense had migrated, by the mid-19th century, from "sign the back of" to our modern sense of "vocally support, approve," and in the 20th century the flourishing young advertising industry heartily endorsed *endorse*. American usagists called it vulgar commercial language, but Fowler decided it was worse than bad taste: It was an "unsustained metaphor." It was OK to endorse an argument or a claim on paper, he conceded, but the verb could not be applied to cornflakes or cars: "To talk of endorsing material things other than papers is a solecism."

These arguments now seem oddly overwrought; their authors might better have simply said — as they sometimes did — "my friends and I don't approve." After all, it is our collective decision that deems a new usage acceptable or not, and reasons, good or bad, don't seem to make much difference.

So welcome to *megalithic*, as it makes its metaphorical way forward. "Massive, imposing, solid" remain part of the package, it seems, but a literal stone is not essential. A megalithic soccer player? If you say so. A megalithic chicken? Allow for some foodie hyperbole and a forbiddingly full plate, and I can see it. A megalithic marshmallow would be harder to swallow, but who knows — someday our metaphorical rocks could be lighter than air. Words have been known to do stranger things.

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http://www.boston.com/bostonglobe/ideas/articles/2010/06/20/monster_of_rock/

Inside the mind of the anonymous online poster

These users comment on everything from today's news to hotel rooms. Many are harmless. But some are ruthless. Who are they exactly, and why do they do what they do?

By Neil Swidey | June 20, 2010

On Monday, May 17, at 2 p.m., a breaking news article headlined "Obama's aunt given OK to stay in United States" hits the home page of Boston.com. In a matter of seconds, the first anonymous online comment appears. A reader with the handle of Peregrinite writes, "of course she can . . . can someone appeal."

Certain topics never fail to generate a flood of impassioned reactions online: immigration, President Obama, federal taxes, "birthers," and race. This story about Obama's Kenyan aunt, who had been exposed as an illegal immigrant living in public housing in Boston and who was now seeking asylum, manages to pull strands from all five of those contentious subjects.

In the next few minutes, several equally innocuous posts follow, including a rare comment in favor of the judge's decision. Then the name-calling begins. At 2:03 p.m., a commenter with the pseudonym of Craptulous calls the aunt, Zeituni Onyango, a "foreign free-loader." Seconds later comes the lament from Redzone 300: "Just another reason to hate are [*sic*] corrupt government."

News websites from across the country struggle to maintain civility in their online comments forums. But given their anonymous nature and anything-goes ethos, these forums can sometimes feel as ungovernable as the tribal lands of Pakistan.

At Boston.com, the website of *The Boston Globe*, a team of moderators – or "mods" – monitor the comments. Actually, with just one or two mods on per shift, and an average of more than 6,000 comments posted every day, on every corner of the site, the mods could never hope to monitor all the simultaneous chatter. Instead, they focus on evaluating the "abuse reports" that commenters file against one another. For Steve Morgan, a veteran editor who coordinates the monitoring, the color of trouble is red. The crimson message at the top of his computer screen keeps a running total of the abuse reports that are awaiting action. Some complaints don't ultimately turn up abuse – coarse language, ad hominem attacks, and the like – but rather just a political stance that the person doing the complaining doesn't care for. So a mod needs to evaluate each complaint and decide either to remove the comment or let it stand.

Over the next two hours, the comments about Obama's aunt keep flying, the abuse reports continue to climb, and the mods scramble to remove the many posts – both conservative and liberal – that they determine have crossed the line. Some comments are enlightening, on both sides of the issue. (Madriver1 offers statistics showing that, of nearly 40,000 asylum requests filed last year, more than one-quarter were granted.) Some are unintentionally funny. (GLOBEREADER83 chastises another commenter for having written "good grammar" instead of "proper grammar," but in both cases misspells it as *grammer*.) And many are not just mean, but make-you-want-to-shower nasty. There are references to Muslim bombers, Somalian pirates, "teabaggers and xenophobes," America becoming "a 3rd world socialist hellhole," and crude comparisons between Aunt Zeituni and James Brown, and between the first family and farm animals.

At 3:41 p.m., when the commentary has degenerated into all-out combat, hummlarry writes, "Obama is Kenyan and he is illegal and president. We have been invaded by non-americans and the liberals are to blame.

I hope that one of the liberals feels the pain by being broken into by a needy illegal and then maybe they will get it. Deport them all."

Not long after that, Boston.com staffers take the drastic and relatively rare step of turning off the comments function on that particular article. (For certain types of stories, such as those involving personal tragedies, the comments section is turned off from the start.) Poof – hundreds of comments about Obama's aunt disappear.

Too many abuse reports had been pouring in; by day's end, the total number would be 1,330 – twice the daily average for the previous month. More than that, the commentary had reached its tipping point. The pros of hosting a robust, freewheeling conversation had become outweighed by the cons of all the venom and nastiness, by people who are allowed to name-call without any obligation to reveal their own names.

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The raging commentary on Obama's aunt is a microcosm of the thorny problem many websites are grappling with right now over what to do with anonymous comments. At many of these sites, executives have begun to ask themselves: How did we get into this thicket, and is there a sensible way out? But a more basic question needs to be answered first: Who are these people who spend so much of their days posting anonymous comments, and what is motivating them?

Newspapers find themselves in a strange position. People wanting to have a letter to the editor printed in the paper have long been required to provide their name, address, and a daytime phone number. Yet on the websites owned by these same newspapers, all it usually takes to be handed a perpetual soapbox is an active e-mail address.

After years of letting anonymity rule online, many media heavyweights, from *The Washington Post* to The Huffington Post, have begun to modify their policies. The goal is to take the playground back from anonymous bullies and give greater weight to those willing to offer, in addition to strong views, their real names.

Others, like *The (Cleveland) Plain Dealer*, are probably wishing they'd taken that step earlier. In March, the paper outed a local judge for allegedly posting comments on Cleveland.com under the handle lawmiss that included critical commentary on cases and individuals appearing before her in court. The judge denied authorship and is now suing the paper and its affiliated companies for $50 million. Her denials might seem a smidge south of persuasive, and *The Plain Dealer* may well have been journalistically suspect had it not gone public with the information once it discovered it. But the judge has a valid point about her expectations of anonymity.

In another suit, a Louisiana public official sued 11 anonymous posters last month for comments on *The Times-Picayune* website that he said were malicious and untruthful. (He didn't sue the website – under federal law, sites are generally not legally responsible for defamatory postings by readers – but rather asked that it disclose the commenters' names. He later dropped the suit.) No matter who you believe in each of these cases, it's a haunted house that anonymity built.

Anonymous commentary is a push and pull between privacy and trust, and the implications extend beyond news sites to include Web reviews for everything from books to technology to hotel rooms. Online postings can sway political opinion and heavily influence whether products or businesses thrive or fail. They can make

or break reputations and livelihoods. On one side, anonymous comments give users the freedom to be completely candid in a public forum. On the other, that freedom can be abused and manipulated to spread lies or mask hidden agendas. With all that in the balance, the thinking goes, shouldn't we know who's saying these things?

Clearly, anonymity is under attack. Even the Chinese government has had enough, announcing last month it would begin a push to end unnamed online comments. And, really, there's not much that officials in Beijing don't already know about who's saying what within their borders.

Still, the nameless nature of the Web is so embedded in the culture that it will be hard to change the rules now. And as newspaper websites struggle to maintain their central role hosting the community conversation and work to increase the time users spend on their sites, scrapping anonymity isn't such a clear-cut call.

I've always loved finding the hidden gems in online comments – the surprising slice of data that makes me question one of my political assumptions, the pithy one-liner that makes me laugh out loud. But those gems seem increasingly rare amid all the yelling and hollow rage and predictable talking points.

If we hope to clean up the online conversation, we need a better understanding of the select group of people doing most of the talking. Studies have shown that participation rates in online social communities tend to follow something called the "90-9-1" rule. About 90 percent of the people are "lurkers," that is, watching but not actively contributing; 9 percent are infrequent contributors; and 1 percent are, to borrow a term from the fast-food industry, the heavy users.

McDonald's and Burger King have teams of researchers who do nothing but try to understand the patterns, desires, and quirks of their heavy users, their best customers. However, yet another unfortunate byproduct of anonymity is that news sites know precious little about their most active commenters.

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Stanley Talabach is a man of routine. He wakes up at 5 every morning and by 6 has made his way down to the dark kitchen of his North Attleborough town house. He consumes a breakfast consisting of a cocktail of Mountain Dew and orange juice, a multivitamin, 25 milligrams of diuretic (for mild hypertension), an adult dose of baby aspirin, folic acid, and a banana.

He then logs on to the desktop computer that functions as the centerpiece of his kitchen table, and goes to three different sites – Boston.com, BostonHerald.com, and MSN.com – to check his horoscope. That the three seldom agree on how a Pisces like him will fare that day has done little to dampen his enthusiasm for the astral arts. If the Boston.com horoscope offers five stars, it puts an extra spring in his step.

Talabach knows housekeeping is not one of his strengths, but as a twice-divorced, semi-retired 66-year-old credit analyst who lives alone, he doesn't feel the need to impress anyone. He assures me the walls and the blinds on the kitchen slider were once white, but I see no evidence of their ever having been anything other than a brownish yellow. "That's thanks to these," he says, holding up a pack of Berkley unfiltered cigarettes. Next to his computer he keeps a blue ashtray that is more like a small urn.

After the horoscopes, Talabach turns to the articles posted on Boston.com and makes his daily transformation, from Stanley to Xenophonic.

Let's clear this up right now: It's not Xeno*phobic*, but Xeno*phonic*, a common mistake, especially by those reading his comments on immigration, one of his favorite topics. Although he is an unenrolled voter, he is a proud conservative, and there are few issues that get him more worked up than illegal immigration. A couple come close: unions, affirmative action, and anything having to do with Ted Kennedy.

"I don't care where you came from to come here ILLEGALLY, GO BACK!" he wrote last month in a comment attached to an article about Governor Deval Patrick blasting Arizona's new immigration law. "Did we all see where some wise guy students in California took down the American flag, hoisted the MEXICAN flag and put the American flag beneath it . . . UPSIDE DOWN? Ahnold should have sent in the National Guard to remove the Mexican Flag and rehoist the American flag."

Although some liberal commenters accuse him of being xenophobic, Talabach says he has no quarrel with outsiders. His father emigrated from Albania, a detail of his biography he often invokes in his posts on immigration, as he did in the closing to his comment about the Mexican flag: "FYI son of an immigrant that came here LEGALLY."

His political views have been shaped unmistakably by his life experience. Knowing that his father followed the rules to come to the States, worked hard every day of his life, and served eight years in the US Army, Talabach is offended when he perceives new immigrants looking for shortcuts. Recalling that he himself made $1.90 an hour at his first job, but he got to take home 85 percent of his pay, Talabach is on guard against any sniff of wasteful spending by a federal and state government that combine to "relieve me of 26, 27, 28 percent of my pay." Feeling he was passed over for promotions during the 1970s and '80s in favor of female and minority candidates he saw as less qualified, he loathes "first" articles, like those touting the first Hispanic Supreme Court justice. "Why do we need to keep score?" he'll thunder.

He posts most of his comments in the morning, before heading to work in Mansfield. Ever since he decided to semi-retire about three years ago, his schedule has been 8:30 a.m. to 12:30 p.m., though he usually shows up at work at 7:10 a.m., taking the extra time to read the paper. He's been at his current job for 11 years and says that for at least nine of them, he never missed a single day of work.

Other than the occasional conversation with his boss, almost all of his political discussions take place in the form of online comments.

When he gets home, he'll look to see how other commenters have responded to his earlier posts. There's a "Recommend" button on the comments page on Boston.com, where people can give their thumbs up to posted comments. This is the metric by which Talabach judges his daily performance. He recalls the time his comment on a column titled "My Lazy American Students" drew hundreds of "Recommends." Leaning back in his chair, with his left arm resting on his thick belly and his right arm jingling change in his pocket, he smiles. "There were more than 600 comments, and at least half of them agreed with me!"

I ask him if he has any hobbies. He points to a large wall hanging behind him. "I made this rug," he says, before adding, "I made those two clocks," and pointing to a pair nearby. "They came in a kit." I ask him if he has a workshop in the house. He shakes his head. "No, I made all of these things when I was living at my old house in Foxborough." Then it dawns on me. He told me earlier that he'd been living in his current place for more than a decade. So much for current hobbies.He has no wife, no children, and a job requiring just 20 hours a week. He doesn't follow sports, doesn't hang out at bars or go on many trips beyond the occasional visit to play the slots at Twin River, and isn't involved in any organizations to speak of. But he is extremely active in his community. It just happens to be one that only exists online.

Despite his strong views, he is generally a responsible member of that community. Every once in a while he'll find one of his comments on Boston.com has been removed because he went too far. (It's a safe bet it involved Teddy K.) Occasionally, he'll commit the common commenter sin of weighing in on an article without having read it, and be called on it when his objection turns out to have been covered in the fifth paragraph.But, overall, he plays by the rules, works hard at this commenter job of his, and, in a way, serves his community. After reading his posts and spending time with him, I believe him when he tells me that, even though he's anonymous online, he would never write anything that he wouldn't say "*mano a mano*." That, incidentally, strikes me as a pretty good standard for separating the stand-up commenters from the cowardly name-callers.

One more thing about this anonymous heavy user named Xenophonic. He's never been all that anonymous. The full name his parents gave him at his christening is the same one his father was given back in Albania: Xenophon Stanley Talabach.

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I reached out to dozens of Boston.com heavy users like Xenophonic. Actually, to protect the privacy of users, I wasn't handed their e-mail addresses. Instead, I gave a list of the commenters with whom I wanted to speak to Boston.com's director of user engagement, Teresa Hanafin, who then e-mailed the commenters directly, telling them they could contact me if they wanted to be interviewed. (I chose to focus on Boston.com users for obvious reasons: It's got the biggest regional reach and it's where I could hope to get the most complete picture of online users.) My list included a wide range of posters: conservatives and liberals, people who comment on articles and people who spend their time on the themed message boards, the reasonable types and the all-caps troublemakers. I made it clear that I wouldn't reveal anyone's identity without their permission.

Those willing to talk included people on the left and the right, males and females, people passionate about sports and people passionate about politics and people passionate about passion (the Love Letters crowd). Somewhat surprisingly, many had no problem with my using their real names in the article, though a few offered some understandable reasons why they didn't want to be identified.

But here are the people I didn't hear back from: the screamers, troublemakers, and trolls (Internet slang for people behind inflammatory posts). Not a single one. The loudest, most aggressive voices grew mum when asked to explain themselves, to engage in an actual discussion. The trolls appear to prize their anonymity more than anyone else.Michael Sol Pollens is not a troll, but he is a heavy user. He explains that he spent three decades as a private detective, focusing mostly on fraud investigations, before suffering a nervous breakdown. He turned in his detective's license and began writing detective fiction. He quickly discovered that posting comments online could be a therapeutic way to kick off his early-morning writing schedule. "I get up at 4, fire up a little incense, fire up some rock music, and go at it," says the 51-year-old.

Pollens posts on Boston.com, NYTimes.com, and elsewhere under the same pen name he uses for his fiction, KurtLarsen. When he worked as a PI, Pollens was careful not to have his photo taken, but he's more relaxed about identity these days. (He recently got his detective's license back.) When I interviewed him in the lilac study of the Malden home he shares with his wife, he had no hesitation about also being videotaped. Curiously, his only request was that he be allowed to wear his shades. He includes a link to his website, KurtLarsen.net, in his posts, and that website includes a reference to his real name.

Pollens, who peppers his sentences with a sometimes exhausting series of literary references, comments most frequently on stories about post-9/11 civil rights infringements and the Arab-Israeli conflict. (He is Jewish but

is a tough critic of the Israeli government's treatment of Palestinians.) At his most productive, he posts up to four comments a day. He is every bit as liberal as Xenophonic is conservative, but the appeal for his participation is similar, and he is equally focused on his "Recommends" standing. "I do enjoy the community nature of this," he says.

That community can morph in fascinating ways. In the comments section on articles about Arab-Israeli relations, Pollens found a poster named Shamu who was preaching from the same pulpit. "I like what you say," Pollens wrote Shamu at one point, inviting Shamu to contact him offline. Shamu did. They've since become friends and have had dinner together several times.

Shamu, it turns out, is a therapist from the North Shore. Out of sensitivity to his clients, he tries to keep his political views private and asked me not to include his real name. He says that months of reading KurtLarsen posts had given him such insight into Pollens that by the time they met, there were few surprises. "I am amazed by how well you can know somebody through the Internet," Shamu says. "When you actually meet, you're just adding a face and body inflections."

Then again, sometimes those impressions formed online can turn out to be off base. Yoshimi25 is one of the most faithful contributors to On the Front Burner, a Red Sox discussion board on Boston.com. On game nights, she'll spend five hours or more on the board – posting comments before, during, and after the game.

Yoshimi25 hasn't lived in the Boston area for nearly two decades. Still, her heart beats for Boston. I met her and her 18-year-old daughter when they returned to the area from Ohio for a recent vacation. Both were wearing Red Sox championship T-shirts.When I ask Yoshimi25 her age, she says, "Forty-three – exactly two months younger than Tim Wakefield." A divorced freelance artist who uses finger quotes when referring to her "social life," Yoshimi25 says, "I don't have many close friends in Ohio." Her friends on Boston.com fill that void. She feels she's gotten to know quite a bit about her fellow heavy users. "I know LloydDobler has two kids, and they must be young, because he talks about putting them to bed at 8 o'clock," she says. "I know jesseyeric is in a local band."

Once when a troll attacked Yoshimi25, hurling ugly anti-Asian slurs at her, her friends on the boards rose to her defense. Most people assume Yoshimi25 is Asian. In fact, she is a blue-eyed Irish-American named Kelly. (She asked me not to use her last name, but agreed to be photographed for this article.) Her Eastern-sounding handle comes from her days practicing martial arts. Yoshimi25 says that because the Front Burner message board is such an intimate group, the regulars on it tend to behave well, even though they're anonymous. "Although I can say anything I want without consequences," she says, "you should behave as though there are consequences."

* * * * * * * * *

That gets to the heart of the problem. The comments sections on many general-interest news sites lack both the carrot and the stick for encouraging responsible behavior. The carrot is the cohesion of a group you don't want to disappoint, like Yoshimi25's Front Burner community. The stick is the shame associated with having your real name publicly attached to embarrassing behavior. Without these two levers, the social contract breaks down.

Steve Yelvington knows this terrain as well as anyone. In the mid-1980s, he began hosting dial-up bulletin boards as a hobby. Most of the people on them used pseudonyms, but because it was a coherent group, the social contract remained strong. In 1994, he was the founding editor of the Star Tribune Online in

Minneapolis (now Startribune.com), which Minnesota's largest newspaper began as a pre-Web platform that required participants to provide not only their real names but also a credit card number. Yet with the arrival of the Web and the proliferation of online forums, anonymity began to take hold, fueled, in particular, by the way the early dominant service provider, America Online, gave each account the option for multiple screen names.

"As the conversational spaces get larger," Yelvington says, "the bonds that tie people together get weaker."

The 57-year-old Yelvington is now a new-media strategist working with Morris Publishing Group, whose holdings include 13 daily papers from Florida to Alaska. His goal is to clean up the playground of online comments while preserving some measure of anonymity, so that, say, a closeted gay student would still feel comfortable posting a comment about the climate at his high school. To strike this balance, Yelvington is pushing Morris sites to insist on collecting (but not publishing) real names and street addresses for everyone who comments, yet allow users to continue to post under pseudonyms. "That gives us a reasonably powerful tool for detecting troublemakers," he says. "Most of the troublemakers tend to lie about their name and address, but they lie poorly."

Still, that approach would have done nothing to prevent the mess that the *The Plain Dealer* found itself in with the judge and lawmiss's comments. To avoid minefields like that, Howard Owens, a former digital executive at Gatehouse Media, insists on real names for anyone posting on TheBatavian.com, the news site he publishes in Batavia, New York.Under Yelvington's plan, Owens says, readers wouldn't know if the JIMY23 posting a comment blasting the mayor is really the guy planning to challenge him in the next election. And if the managers of the news site figure that out, it puts them in an awful bind.

Owens insists that a no-anonymity rule is not just good journalism but good business as well. "My competitor allows anonymous comments," he says. "We don't. We get 10 times what they get. My users are more willing to engage in conversation, because they know who they are arguing with." Almost all the heavy users I spoke with said they would continue to comment even if they had to provide their real name.

While news organizations debate scrapping anonymity, the ground may be shifting beneath them. With all of our identifying information getting sliced, diced, and sold, by everyone from credit card companies to Facebook, is there really such a thing as the anonymous Web anymore? Consider this demonstration from the late '90s by Carnegie Mellon University computer science professor Latanya Sweeney. She took three commonly available data points: sex (male), ZIP code (02138), and date of birth (July 31, 1945). Those seemingly anonymous attributes could have described lots of people, right? Actually, no. She proved they could belong to just one person: former governor William Weld. She tells me that 87 percent of Americans can now be identified with just these three data points.

Maybe the best approach to getting people to behave better online is just reminding them how easy it is to figure out who they really are.

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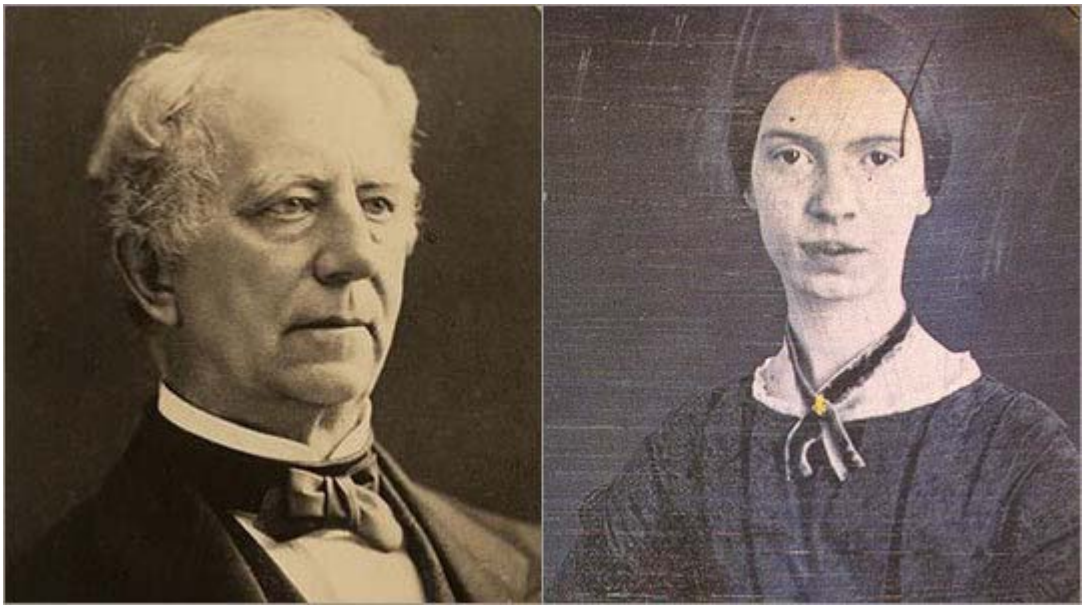
http://www.boston.com/bostonglobe/magazine/articles/2010/06/20/inside_the_mind_of_the_anonymous_online_poster/

Emily's secret love

Following her father's death, poet Emily Dickinson did something unthinkable in his lifetime: She began to romance her father's best friend. This excerpt from a new book reveals a woman so unlike the lovelorn recluse who exists in the popular imagination.

By Lyndall Gordon | June 20, 2010



By the 1870s, the existence of poems by Emily Dickinson had got about, and Miss Emily, then in her 40s, had begun her long career as "the myth." Curiosity grew about the recluse. The poems were secreted away in the Homestead, the Amherst home she shared with her parents and her devoted younger sister, Lavinia, known as Vinnie.

After the death of their father, Edward, in 1874, the sisters stood closer than ever. In business matters, they now leaned on their brother, Austin, who lived next door and took over his father's partnership in a law office. He had already assumed his father's post as treasurer of Amherst College, a position commanding all college decisions.

Another man on whom to rely was Otis Phillips Lord, Edward Dickinson's old friend and a judge on the Massachusetts supreme court. Lord had studied law at Amherst just before Emily was born and during the first 18 months of her life. He had graduated in 1832, and Amherst had conferred on him an honorary doctor of laws in 1869. He was married to Elizabeth Farley, a high-minded descendant of John Leverett, president of Harvard. They were childless and lived near the Witch House in Salem. The Lords used to stay at the Homestead, and after Edward died, "the dear Lords," as Emily wrote, continued to visit. The judge appears to have come on his own for a week in October 1875, when Emily, far from reclusive, spoke of his visit as being "with me."

Since Lord had known Emily all her life, he did not hesitate to inquire after her health in a fatherly way. She was dreaming of her father every night and prone to forget what she was doing during the day, "wondering where he is." This absence of mind may have troubled her sister, since it was with Vinnie that Lord raised his concern: ". . . Knowing . . . how unwilling [she is] to disclose any ailment, I fear that she has been more ill, than she has told me. I hope you will tell me particularly about her." Unsure what her sickness was, he wished Vinnie to report fully, though he respected Emily's reticence.

"Emily never thinks of herself," he remarked to Vinnie in March 1877. He thought her an angel, like his wife, who had rheumatism and other ills. Mrs. Lord died in December 1877, on Emily's 47th birthday.

Over the next few months, Emily turned to the handsome widower – not as a father but as a suitor of sorts. Later, a granddaughter of Dickinson's confidante Elizabeth Holland suggested that Lord's tenderness had "long been latent in his feeling for her." Dickinson expert and Mount Holyoke College professor Christopher Benfey has asserted this possibility more strongly, suggesting in his book A Summer of Hummingbirds that the attraction went back to the summer of 1862, when Lord came to Amherst as commencement speaker.

Eighteen years her senior, his gray hair was shading into white; his expression calm and contained – not a man to exact attention, though his grave and upright bearing subdued others, not only the guilty, as he passed judgment. Lord looked stern "as the Profile of a Tree against a winter sky," Emily ventured to say. He appeared as rigid as Emily's father, but she had a way with elders of this sort, breezing through their barest branches. Her amusing darts disarmed men of law who were accustomed to wither lesser beings; the drafts of her letters to Lord are witty, confident, open, and playfully physical – hardly the way modest women were meant to behave. Gossip had it that Emily's sister-in-law, Susan, had been taken aback to break in on the supposed recluse, the image of white-frocked chastity, in the judge's arms.

Lord's niece Abbie Farley claimed to have heard Susan deplore that embrace. Emily, the niece is reported to have said, had not "any idea of morality." She was bound to take this view, for Miss Farley, aged 35, was the judge's heir. She and her mother, Mrs. Lord's sister, were due to inherit jointly $23,000. Together with another niece on the Farley side (due to inherit $10,000), they kept house for the judge. If he remarried, he would have new claims. "Little hussy," Abbie fumed over a copy of Emily's Poems decades later when questioned about the celebrated poet Abbie had once known. "Loose morals," Abbie remembered. "She was crazy about men. Even tried to get Judge Lord. Insane too."

To Emily herself, Lord's love was "Improbable." It would have been unthinkable in her father's lifetime: his carefully protected daughter permitting such license, and with his old friend. The voice of judgment, "I say unto you" thundering through the startled air at morning prayers, had cleansed impurities from the minds of Edward Dickinson's listeners. As Emily put it humorously, "Fumigation ceased when Father died." Now, four years on, that voice no longer ruled. In her late 40s and early 50s, she found herself free to partake of the forbidden tree.

With Lord, Emily was unafraid to speak up, inviting a glint of humor she called "the Judge Lord brand." A smile broke when she teased him with the solemnities of courtroom language. "Crime," "confess," "punish," "penalty," "incarcerate" were the words she applied to his supposed trial of her as a wanting lover. "I confess that I love him," she has to admit, but cannot pay the "debt" she owes him. Can her "involuntary Bankruptcy" be a crime? Will he "punish" her? "Incarcerate me in yourself – that will punish me," she makes bold to suggest.

Flashing repartee of this sort exploded into intimacy within months of Mrs. Lord's death. That year, 1878, there's immediate talk of consummation. She wasn't shy when she drafted her letters to Lord: "lift me back, wont you, for only there [in your arms] I ask to be. . . ." He was her "lovely Salem"; she, his "Amherst." Weekly letters, directed to arrive on Mondays by the judge's habits of punctuality, bonded Salem and Amherst. Emily's "little devices to live till Monday" – attempts to concentrate on work – gave way to "the thought of you." So she said to herself, if not to Salem, in a penciled scrap that breaks into verse celebrating the nature of love (fleet, indiscreet, wrong, and joyful).

As a single man, it was no longer proper for Lord to stay at the Homestead on his now more frequent trips to Amherst; he and Emily met in the parlor. There, they held each other while the air about them fanned the question of marriage. In August and September of 1880, he practically lived in Amherst. During this time, they may have entered into some kind of private engagement. Softly, her thin hand is offered to him in response to what she calls "your distant hope." He leaves saying it had been a "heavenly hour." How sweet was his candor, she wrote. It was important for her to convey that she would not take advantage of this intimacy; he was not to be used as material for poems. This was strictly a private pleasure.

Was she too frank for her own good? The fear did cross her mind, and it's possible that she edited the surviving drafts or didn't send them. Whether she did or not, her father's friend gave her emotions a "fair home," replacing the vacancy in what she still called "my father's house." And yet he was not like her father. His racy talk, familiar to colleagues on the bench, called out an unfamiliar side to Emily. "I will not wash my arm," she said, "twill take your touch away," and again: "It is strange that I miss you at night so much when I was never with you – but the punctual love invokes you soon as my eyes are shut – and I wake warm with the want sleep had almost filled. . . ."

Wafting through Emily's poems is a woman playing a counter-role: This purified creature has to freeze the life of the "Ethiop within." Abandoned to solitude, she retires from existence, puts on purity in her white dress, assumes "Cobweb attitudes," and hangs her head in ostensible submission. In this poetic role, she enacts the appealing helplessness and self-effacement of 19th-century womanhood, but a cutting voice finds the role absurd: "such was not the posture / Of our immortal mind." All the same, the white legend was to linger: As late as 1976, in the Broadway play The Belle of Amherst, a "shy," "chaste," "frightened" poet charms the audience with her feminine winsomeness. The playwright called it an "enterprise of simple beauty."

The sentiment of this cult invites satire. A 60-foot puppet of the Belle of Amherst, in the signature white dress, pops out in the 1999 movie Being John Malkovich. Demurely, book in hand, this famous "Nobody" decries "Somebodies" who croak about themselves the livelong day. Then, in 2008, "EDickinsonRepliLuxe," a futuristic tale by Joyce Carol Oates, imagines the mass-marketing of a Dickinson robot half the poet's size. This diminutive Belle in her dimity apron is designed to be a harmless pet, a consolation for wives buried in suburban deadness – so unlike the ardent woman who flung out her lassoes.

The question of marriage came up more seriously in November and December 1882, after Emily's mother, also named Emily, had died. Eyeing the poet's thinness, Lord teased her as "Emily Jumbo" (the famous elephant, Jumbo, in Barnum's circus had recently appeared near Amherst). She tossed the joke back.

"Sweetest name, but I know a sweeter – Emily Jumbo Lord. Have I your approval?"

He assumed that she was now freed to live with him. He replied, "I will try not to make it unpleasant."

She was touched that he could invite her into his “dear Home” with “loved timidity.” Her answer, as often when she was moved, almost falls into verse.

“So delicate a diffidence, how beautiful to see! I do not think a Girl extant has so divine a modesty. You even call me to your Breast with apology! Of what must my poor Heart be made?”

Her “No” to marriage was never final. She “lies near” his “longing”; she “touches” it but then wills herself to move away. Emily likely had epilepsy, and it would have been natural to hope that her condition would lessen as she grew older. But she’d had a blackout, perhaps a seizure, in April 1881, brought on by a nearby fire, with a wind blowing the burning shingles. Afterward, she had lain on her pillow for more than a week. At that time, marriage for epileptics was discouraged. She saw herself “by birth a Bachelor.”

In the end she did not tell Lord why she could not “bless” their union, only that not to do so “would be right.” To keep epilepsy the secret it had to be, she must remain at home as long as she lived. But she may have had other considerations as well: The incursions of the spirit are often associated with a particular place, and Emily’s room may have been for her thus hallowed. All that’s certain is that she had to control the tie with Lord. The forgiveness she asks for refusing to consummate their union addresses a divine Spirit rather than a leader of men.

Was Lord vital to Dickinson or was he an aftermath to her soaring? Was this a comfort after her father’s death, the slow fading of her mother, and the premature death of Samuel Bowle – who published some of Emily’s works in the early 1860s – on January 16, 1878, a month after Mrs. Lord died? It’s telling that Lord does not enter her poetry. From that point of view, he was a latecomer, competent, humorous, honorable, and devoted, who offers the woman – not the poet – a new drama. For the first time she experiences a man’s touch and reexperiences it at night in her imagination. Lying in the dark, she thinks of Lord’s need and goes to meet it with a readiness. At 47, 48, 49, and into her 50s, she tried out a prospective husband; his desire held up a mirror to a “want” of her own but she could not forget the red “Fire rocks” of her “volcano” that bound her still to “solitude.” By now, solitude was her habit. In the haunted house of her imagination, a bridegroom would mount her stair at midnight. He’s her poetic “Future”; the consummation she anticipates is posthumous. No ordinary bridegroom could compete with the footfall of the afterlife. All her days she heard it coming.

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Walk in Dickinson’s Footsteps Learn more about the poet by visiting the Emily Dickinson Museum, housed in her family’s homes, the Homestead and the Evergreens, in Amherst. The museum is open Wednesdays through Sundays, March 31 through December 31, from 10 a.m. to 4 p.m., and until 5 p.m. in June, July, and August. For details, call 413-542-8161, or go to emilydickinsonmuseum.org. ■

http://www.boston.com/bostonglobe/magazine/articles/2010/06/20/emilys_secret_love/

There's something about 'Alice'

A century and a half after it was published, we're still obsessed with Lewis Carroll's fantasy

By Don Aucoin, Globe Staff | February 27, 2010

By age 19, Emily Montaglione had read "Alice's Adventures in Wonderland'' more than 70 times. Yet when Montaglione was home from college on winter break last month, she simply had to read "Alice'' twice more.

This would have astonished Lewis Carroll, who was puzzled by the popularity of "Alice'' and its sequel, "Through the Looking-Glass and What Alice Found There.'' According to Jenny Woolf, author of a new biography of Carroll, he once remarked to a friend: 'You know, I can't understand what people see in those books.''

Montaglione has a ready answer for him. "Everybody sees themselves in Alice,'' says the SUNY-Brockport student. "Everybody wants to follow her down that rabbit hole, to escape for a little while, and see what's down that rabbit hole.''

In that, she's got plenty of company. Again and again, filmmakers, authors, artists, songwriters, and the rest of us return to "Alice,'' a Victorian-era children's story that remains a cultural force today, 145 years after it was published. Tim Burton's 3-D movie version opens next Friday.

"It has this central story of a person just like us, an ordinary kid, being thrown into this world that she doesn't understand, and trying to make sense of it,'' says Roger Sutton, editor in chief of Horn Book Magazine, which focuses on children's literature. "And some of it never makes sense. The great thing about 'Alice' is that it acknowledges that not all puzzles can be solved, that some of the nonsense remains.''

To Woolf, whose "The Mystery of Lewis Carroll'' was published this month, Carroll's classic is the Rorschach blot of literature, in which readers see what they want or need to see: a return to lost childhood, an

escape from humdrum reality, a defiant challenge to the arbitrary authority of adults (“You’re nothing but a pack of cards!’’ Alice finally yells at the King, the Queen, and the rest), or a recognition of the fundamental absurdity of life.

“It’s full of very vivid characters, but they only have a few lines, so it’s us who do the work,’’ Woolf says. “We can put our own interpretation on it very easily. You can say it’s a lovely, whimsical story about a little girl’s adventures, or a sinister, dark fantasy. So it’s become the basis for a lot of marvelous creations.’’

Indeed, “Alice’’ has skittered, White Rabbit-like, far beyond the boundaries of literature. Burton’s “Alice in Wonderland,’’ starring Johnny Depp as the Mad Hatter, is the latest of numerous film adaptations of “Alice’’ that began with a silent version in 1903 and includes a 1951 Disney animation. In Burton’s version, also for Disney, a now-19-year-old Alice goes back down the rabbit hole and battles to restore freedom to a Wonderland chafing under tyranny.

Hey, why not? If there is one thing we know about the story of “Alice,’’ it is that it is endlessly malleable.

There is a new app on Facebook called “Which Alice in Wonderland Character Are You?’’ Two stage versions of the story are playing in New York. Salvador Dali did a series of illustrations inspired by the book. “Almost Alice,’’ a soundtrack CD of the Burton film, will also be released next Friday, with Avril Lavigne singing “Alice (Underground)’’ and Franz Ferdinand performing “The Lobster Quadrille.’’

It will join a long line of musical tributes to the book. Gravel-voiced troubadour Tom Waits released an album titled “Alice’’ in 2002. Grace Slick famously counseled listeners to “Go Ask Alice’’ in the trippy 1967 Jefferson Airplane song “White Rabbit.’’

All in all, “Alice’s Adventures in Wonderland’’ (which is often shortened to “Alice in Wonderland’’), is one of the most influential books ever written. In making a girl his chief protagonist, Carroll paved the way for L. Frank Baum’s “The Wonderful Wizard of Oz.’’ Indeed, countless forays into otherworldly fantasy owe a debt to “Alice’’ - among them J.M. Barrie’s “Peter Pan,’’ C.S. Lewis’s “Chronicles of Narnia’’ (where the characters pass through a wardrobe to another world), J.K. Rowling’s “Harry Potter’’ series (train Platform 9 3/4, which Harry takes to get to Hogwarts, is a rabbit hole or looking glass of sorts), the books of Dr. Seuss, the sci-fi film “The Matrix,’’ and Neil Gaiman’s “Coraline.’’ James Joyce’s “Finnegans Wake’’ is studded with allusions to “Alice,’’ as are the novels of Vladimir Nabokov and Douglas Hofstadter’s “Gödel, Escher, Bach.’’

Then there are the likes of Natalie Babbitt, author of “Tuck Everlasting,’’ who says “Alice’’ inspired her to become a writer of children’s books.

“It’s been my favorite book since I was in fourth grade, and I’m a long way from that, my dear,’’ Babbitt says. “In the whole book, there’s only one sensible character, and that’s Alice. The other [main] characters are adults, either human or four-legged, and they’re all ridiculous. When you’re in fourth grade, that’s a very appealing idea, because you’ve already noticed it, that adults are ridiculous. Carroll had an eye that looked right through the outside crust of human nature and exposed it with great glee.’’

Fittingly, for a story that somehow seems to speak to every age, “Alice’’ began with the simple sound of the human voice. The voice belonged to a 30-year-old Oxford mathematician named Charles Lut widge Dodgson, who was soon to become better known to the world as Lewis Carroll.

It was a July afternoon in 1862, and Carroll was in a rowboat with a friend and three young children - one of them named Alice Liddell - on an expedition down the Thames River in London. To keep the children amused, Carroll began to concoct a tale about the adventures of a girl named Alice.

The tale quickly grew (to borrow a phrase) curiouser and curiouser. Carroll later confessed that, in "a desperate attempt to strike out some new line of fairy-lore,'' he sent his main character "straight down a rabbit-hole . . . without the least idea what was to happen afterwards.''

Quite a lot, as it turned out. At Alice Liddell's urging, Carroll put the story down in print, and "Alice's Adventures in Wonderland'' was published in 1865. Now, a century and a half later, it maintains a nearly unrivaled hold on our imagination. In the view of Anita Silvey, author of "100 Best Books for Children,'' one key to the enduring appeal of "Alice'' is that Carroll offered a feast of bizarre invention in the two areas young readers prize most - plot and character - while refraining from the sort of moralizing that they find the biggest turnoff.

"Much of its power has to do with its two levels of meaning,'' Silvey says. "It's a book that works on one level, for simple reading pleasure, and on another level, too. Depending on what prism you look at it through, anyone can take this book and turn it into their philosophy.''

Or play, or song, or cartoon, or painting, or movie. It's now Tim Burton's turn, but he almost certainly won't be the last artist to bend "Alice'' to his particular vision. "Whether they get the movie right, or partially right, the book is always there,'' Silvey says. "And you can always go back to it.''

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http://www.boston.com/ae/books/articles/2010/02/27/the_curious_evolution_of_alices_adventures/

Of Lice and Man: Researchers Sequence Human Body Louse Genome

The human body louse, Pediculus humanus humanus L., has been a witness to, and participant in, millions of years of human history. (Credit: CDC Photo, Courtesy of Frank Collins, Ph.D.)

ScienceDaily (June 22, 2010) — Like an unwelcome houseguest or itinerant squatter, the human body louse shows up when times are bad and always makes them worse. Now a multi-institutional team reports that it has sequenced the body louse genome, an achievement that will yield new insights into louse -- and human -- biology and evolution.

The study, which also sequenced the genome of a microbe that lives inside the body louse, appears in *Proceedings of the National Academy of Sciences.*

Thanks to its tenacity, the tiny, blood-sucking parasite *Pediculus humanus humanus L.* has witnessed, and played a role in, millions of years of human history. The body louse spread epidemic typhus and what is now termed trench fever to Napoleon's retreating army in Russia in 1812, and body lice plagued Lewis and Clark on their adventures in the New World.

The human body louse seems to appear out of nowhere during economic downturns, wars and other crises that cause people to live in unsanitary conditions. It is closely related to the head louse, *Pediculus humanus capitis*, which also feeds on human blood. But the body louse lives in clothing and, unlike the head louse, can spread bacterial diseases.

The body louse genome is the smallest known genome of any insect, said University of Illinois entomology professor Barry Pittendrigh (pronounced PITT-in-dree), who led the drive to fund the project and coordinated the international team of scientists who analyzed the sequence. The size of the body louse genome probably reflects its rather protected habitat and predictable diet, he said.

"The ecology of lice is very, very simple. It either lives in your hair or on your clothing, and it has one type of meal, and that's blood," he said. "So most of the genes that are responsible for sensing or responding to the environment are very much reduced."

The genome analysis found very few genes for light-sensing protein receptors, for example. University of Illinois entomology professor Hugh Robertson was responsible for sorting out the genes contributing to chemical sensing, and discovered that the louse has significantly fewer taste and odorant receptors than other insects.

The body louse also has "the smallest number of detoxification enzymes observed in any insect," the researchers wrote. John Clark, of the University of Massachusetts at Amherst, and Si Hyeock Lee, of Seoul National University, led this part of the analysis. The body louse's pared-down list of detoxifying enzymes makes it an attractive organism for the study of resistance to insecticides or other types of chemical defense, Pittendrigh said. University of Illinois entomology professor and department head May Berenbaum and former graduate student Reed Johnson contributed to this effort.

The body louse is completely dependent on humans for its survival; it will die if separated from its host for very long. It is just as reliant on a microbe that lives inside it: the bacterium *Candidatus* Riesia pediculicola.

In the Riesia genome, the team found genes for the production of an essential nutrient, pantothenate (Vitamin B5), which the louse requires and cannot make on its own. The Riesia genome also is quite small in comparison to its closest "free-living" relatives. So too are the genomes of the bacterial pathogens that the body louse transmits to its human hosts: *Rickettsia prowazekii* (which causes epidemic typhus), *Borrelia recurrentis* (the agent of relapsing fever) and *Bartonella quintana* (which causes trench fever). This, the researchers report, will make the body louse a useful tool for understanding the co-evolution of disease-carrying parasites and their bacterial co-conspirators.

The body louse genome will aid a host of other lines of research, Pittendrigh said.

"Lice have been used to understand human evolution and migration. They've been used to estimate when we started wearing clothing," he said. "The genome should also help us develop better methods of controlling both head and body lice."

"Beyond its importance in the context of human health, the body louse genome is of considerable importance to understanding insect evolution," Berenbaum said. "It is only the second genome sequenced to date of an insect with gradual development -- that is, that does not undergo profound anatomical and ecological change as it matures from egg to adult. Although most of the insect species on the planet undergo complete metamorphosis -- developing from egg to caterpillar to pupa to adult -- in fact gradual metamorphosis is the older developmental program. The body louse genome can provide a baseline for understanding how complete metamorphosis, a key to insect domination of the planet, came to evolve."

The genome sequencing effort involved researchers at 28 institutions in the U.S., Europe, Australia and South Korea. First author Ewen Kirkness coordinated sequencing and gene identification at the J. Craig Venter Institute. Clark; Lee; Spencer Johnson, of Texas A&M University; Jeanne Romero-Severson, of the University of Notre Dame; Greg Dasch, of the Centers for Disease Control and Prevention; and Pittendrigh wrote the original proposal to obtain funding for the genome sequencing effort from the National Institutes of Health and guided the effort. Evgeny Zdobnov and his team conducted the evolutionary analysis.

Story Source:

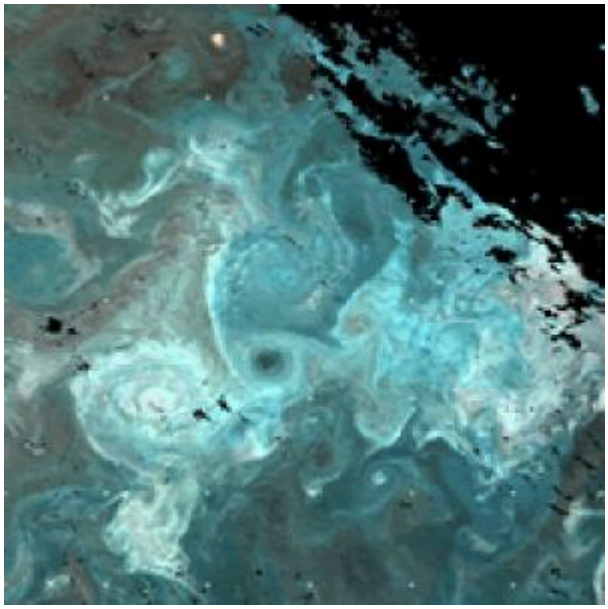
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **University of Illinois at Urbana-Champaign**, via EurekAlert!, a service of AAAS.

Journal Reference:

1. E. F. Kirkness, B. J. Haas, W. Sun, H. R. Braig, M. A. Perotti, J. M. Clark, S. H. Lee, H. M. Robertson, R. C. Kennedy, E. Elhaik, D. Gerlach, E. V. Kriventseva, C. G. Elsik, D. Graur, C. A. Hill, J. A. Veenstra, B. Walenz, J. M. C. Tubio, J. M. C. Ribeiro, J. Rozas, J. S. Johnston, J. T. Reese, A. Popadic, M. Tojo, D. Raoult, D. L. Reed, Y. Tomoyasu, E. Krause, O. Mittapalli, V. M. Margam, H.-M. Li, J. M. Meyer, R. M. Johnson, J. Romero-Severson, J. P. VanZee, D. Alvarez-Ponce, F. G. Vieira, M. Aguade, S. Guirao-Rico, J. M. Anzola, K. S. Yoon, J. P. Strycharz, M. F. Unger, S. Christley, N. F. Lobo, M. J. Seufferheld, N. Wang, G. A. Dasch, C. J. Struchiner, G. Madey, L. I. Hannick, S. Bidwell, V. Joardar, E. Caler, R. Shao, S. C. Barker, S. Cameron, R. V. Bruggner, A. Regier, J. Johnson, L. Viswanathan, T. R. Utterback, G. G. Sutton, D. Lawson, R. M. Waterhouse, J. C. Venter, R. L. Strausberg, M. R. Berenbaum, F. H. Collins, E. M. Zdobnov, B. R. Pittendrigh. **Genome sequences of the human body louse and its primary endosymbiont provide insights into the permanent parasitic lifestyle**. *Proceedings of the National Academy of Sciences*, 2010; DOI: 10.1073/pnas.1003379107

http://www.sciencedaily.com/releases/2010/06/100621151115.htm

Ocean Stirring and Plankton Patchiness Revealed by Computer Simulation



Near-true colour MODIS satellite image showing a coccolithophore (phytoplankton) bloom in the Iceland Basin. Visible are the patches and filamentous structures of the bloom. The view is a bit like what you would see if you were an Astronaut in space and you took away Earth's atmosphere. The image is a composite for the period 5-11 July 2007. The image spans 14-26˚W, 55-62˚N. (Credit: NEODAAS/PML)

ScienceDaily (June 22, 2010) — Computer simulations performed by researchers at the National Oceanography Centre and the University of Glasgow show how oceanic stirring and mixing influence the formation and dynamics of plankton patches in the upper ocean.

Tiny free-floating marine plants called phytoplankton live in vast numbers in the sunlit upper ocean. Through the process of photosynthesis, they build carbon compounds such as sugars starting with just water and carbon dioxide, which is thereby drawn down from the atmosphere.

Phytoplankton also need nutrients such as phosphate and iron, shortage of which can limit their population growth. They are also preyed upon by tiny planktonic animals called zooplankton.

"Interactions between phytoplankton, nutrients, zooplankton and the physical environment lead to complex dynamics, which we seek to understand using computer models," explained Emma Guirey, whose work on the problem was done as part of her PhD studies. "These complex dynamics can produce the patchiness of phytoplankton at the ocean surface that is invariably seen in satellite images and observed at sea during research cruises."

Guirey and her colleagues applied the methods of synchronisation theory -- previously used to explain such phenomena as the co-ordinated flashing of fireflies along whole riverbanks. Initially they studied the balance between localised increases in phytoplankton populations and small-scale mixing, such as that due to breaking waves, in creating patches. Patchiness was found to persist despite the mixing which might be expected to smooth out the patches by blending them together.

The initial studies neglected the effects of stirring, or 'advection' by large scale ocean currents such as the Gulf Stream and Kuroshio, but this is included in the most recent computer simulations. This stirring stretches the patches out into long filaments. However, the patches still resist dispersal.

"What is exciting is that the inclusion of large-scale advection, far from disrupting plankton patchiness, actually creates the kind of filamentary structure that we often observe in real-life plankton populations. Application of synchronisation theory has given us a new perspective on the production of this complex patchiness," said Guirey.

The research was supported by the Natural Environmental Research Council and the Engineering and Physical Sciences Research Council.

The researchers are Emma Guirey, Adrian Martinand Meric Srokosz (NOC), and Martin Bees (University of Glasgow).

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **National Oceanography Centre, Southampton (UK)**.

Journal Reference:

1. Emma Guirey, Martin Bees, Adrian Martin, Meric Srokosz. **Persistence of cluster synchronization under the influence of advection**. *Physical Review E*, 2010; 81 (5): 051902 DOI: 10.1103/PhysRevE.81.051902

http://www.sciencedaily.com/releases/2010/06/100621101422.htm

New Air Conditioning System Has Potential to Slash Energy Usage by Up to 90 Percent

NREL senior engineer Eric Kozubal examines a prototype air flow channel of the DEVap air conditioner, which he co-invented. DEVap, which stands for desiccant-enhanced evaporative air conditioner, is a novel concept that uses membrane technology to combine the efficiency of evaporative cooling and the drying potential of liquid desiccant salt solutions. The graph superimposed on the photo shows shows how hot humid air, in red, changes to cool dry air, in blue, as the air passes through the DEVap core. (Credit: Pat Corkery)

ScienceDaily (June 22, 2010) — Ah, the cool, refreshing feel of air conditioning on a sweltering summer day.

Ugh, the discomfort when those energy bills in July, August and September come due -- $200, $400, $600 or more.

Feel miserable, or dig deep into your wallet -- not much of a choice for the 250 million Americans who live in climates where heat, humidity or both are a Catch-22 for three to 12 months a year.

A soothing solution may be on its way, thanks to a melding of technologies in filters, coolers and drying agents.

The U.S. Department of Energy's National Renewable Energy Laboratory has invented a new air conditioning process with the potential of using 50 percent to 90 percent less energy than today's top-of-the-line units. It uses membranes, evaporative cooling and liquid desiccants in a way that has never been done before in the centuries-old science of removing heat from the air.

"The idea is to revolutionize cooling, while removing millions of metric tons of carbon from the air," NREL mechanical engineer Eric Kozubal, co-inventor of the Desiccant-Enhanced eVaporative air conditioner (DEVap), said.

"We'd been working with membranes, evaporative coolers and desiccants. We saw an opportunity to combine them into a single device for a product with unique capabilities."

Hot and Humid Climates are Tricky

Evaporative coolers are a lower-cost alternative to A/C in dry climates that don't get too hot or humid -- say, Denver, but not Phoenix or Miami. Water flows over a mesh, and a fan blows air through the wet mesh to create humid, cool air.

In humid climes, adding water to the air creates a hot and sticky building environment. Furthermore, the air cannot absorb enough water to become cold.

In Phoenix or Tucson, the evaporative cooler can bring down the temperature, but not enough to make it pleasant inside on a 100-degree day or during the four to eight week moist period known as monsoon season. The cooling bumps up against the wet bulb temperature, the lowest temperature to which air can be cooled by evaporating without changing the pressure. The wet bulb temperature could be 75 or 80 degrees on a mid-summer Tucson day. Typically, evaporative coolers only can bring the temperatures about 85 percent of the way to the wet bulb level.

So, for most of the country, refrigeration-based air conditioning is the preferred way of keeping cool.

Cooling Requires Temperature Drop and Less Moisture

Cooling comes in two forms -- sensible cooling, which is a temperature drop, and latent cooling, which comes from pulling the moisture out of the air.

One intriguing product already on the market in arid, temperate climates is the Coolerado cooler. It differs from a typical evaporative cooler by never increasing the moisture content of the supply air. It provides cool air through indirect evaporative cooling. Indirect evaporative systems use a purge air stream that removes heat from the product or supply air stream that is then directed into a building.

That way, the Coolerado can cool the air all the way to the wet-bulb temperature.

"It's a big improvement on evaporative cooling because it doesn't add moisture and still gives you cold air," Kozubal said. However, in a humid climate, it still does not provide cold air or humidity control.

DEVap: Liquid Desiccants, Permeable Membranes

The DEVap solves that problem. It relies on the desiccants' capacity to create dry air using heat and evaporative coolers' capacity to take dry air and make cold air.

"By no means is the concept novel, the idea of combining the two," Kozubal said. "But no one has been able to come up with a practical and cost-effective way to do it."

HVAC engineers have known for decades the value of desiccants to air conditioning. In fact, one of the pioneers of early A/C, Willis Haviland Carrier, knew of its potential, but opted to go the refrigeration route.

Most people know of desiccants as the pebble-sized handfuls that come with new shoes to keep them dry.The kind NREL uses are syrupy liquids -- highly concentrated aqueous salt solutions of lithium chloride or calcium chloride. They have a high affinity for water vapor, and can thus create very dry air.

Because of the complexity of desiccant cooling systems, they have traditionally only been used in industrial drying processes. Inventing a device simple enough for easy installation and maintenance is what has impaired desiccant cooling from entering into commercial and residential cooling markets.

To solve that problem, the NREL device uses thin membranes that simplify the process of integrating air flow, desiccants, and evaporative cooling. These result in an air conditioning system that provides superior comfort and humidity control.

The membranes in the DEVap A/C are hydrophobic, which means water tends to bead up rather than soak through the membranes. Imagine rain falling on a freshly waxed car. That property allows the membranes to control the liquid flows within the cooling core. "It's that property that keeps the water and the desiccant separated from the air stream," Kozubal said.

"We bring the water and liquid desiccant into DEVap's heat-mass exchanger core," Kozubal said. "The desiccant and evaporative cooling effect work together to create cold-dry air."

The air is cooled and dried from a hot-humid condition to a cold and dry condition all in one step. This all happens in a fraction of a second as air flows through the DEVap air conditioner. The result is an air conditioner that controls both thermal and humidity loads.

DEVap helps the environment in many ways. DEVap uses 50 percent to 90 percent less energy than top-of-the-line refrigeration-based air conditioning.

Because DEVap uses salt solutions rather than refrigerants, there are no harmful chlorofluorocarbons (CFCs) or hydrochlorofluorocarbons (HCFCs) to worry about. A pound of CFC or HCFC in refrigerant-based A/Cs contributes as much to global warming as 2,000 pounds of carbon dioxide. A typical residential size A/C has as much as 13 pounds of these refrigerants. The release of this much refrigerant is equivalent to burning more than 1,300 gallons of gasoline, or driving over 60,000 miles in a 2010 Toyota Prius. That's based on the Environmental Protection Agency's fuel efficiency rating for the 2010 Toyota Prius and on the standard of 19.5 pounds of carbon dioxide for every gallon of gasoline burned.

Traditional air conditioners use a lot of electricity to run the refrigeration cycle, but DEVap replaces that refrigeration cycle with an absorption cycle that is thermally activated. It can be powered by natural gas or solar energy and uses very little electricity.

This means that DEVap could become the most energy efficient way to cool your house whether you live in Phoenix, New York, or Houston.NREL has patented the DEVap concept, and Kozubal expects that over the next couple of years he will be working on making the device smaller and simpler and perfecting the heat transfer to make DEVap more cost effective.

Eventually, NREL will license the technology to industry, "We're never going to be in the air conditioner manufacturing business," said Ron Judkoff, Principle Program Manager for Building Energy Research at NREL. "But we'd like to work with manufacturers to bring DEVap to market and create a more efficient and environmentally benign air conditioning product."

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **DOE/National Renewable Energy Laboratory**.

http://www.sciencedaily.com/releases/2010/06/100621071943.htm

Could Grasslands Help Fight Global Warming? Scientists Dig Deep for Carbon Solution

Sampling grasslands in the Yorkshire Dales. (Credit: Image courtesy of Lancaster University)

ScienceDaily (June 22, 2010) — Lake District grasslands could be playing an important role in the fight against global warming.

Grasslands cover a vast area of the UK, forming the backbone of the livestock industry. However, they also play a crucial role in the global carbon cycle, storing vast amounts of carbon beneath them in their soils.

New research is being carried out by scientists from the Lancaster Environment Centre, Lancaster University, to work out how much carbon is being stored in UK grasslands and find out if it could potentially store even more. This would contribute to climate change mitigation, because carbon locked in soils isn't being released into the atmosphere where it contributes to global warming.

Teams of scientists from the Universities of Lancaster and Reading, and North Wyke Research, have begun sampling a large number of sites across England, including grasslands in the Lake District at Glenridding, Grasmere, Thirlmere, the Newlands Valley and Skiddaw, and in the Yorkshire Dales.

The five year study -- funded by a £650,000 grant from the UK Department for Environment, Food and Rural Affairs -- will improve understanding of how grassland can be managed to protect carbon stored in soil, while performing other key roles such as biodiversity conservation and the maintenance of viable agricultural production.

A major part of the project is a national survey, now underway, to measure how much carbon is actually stored in UK grasslands and how this carbon is affected by the way that grasslands are managed.

Other studies will also test whether enhancing botanical diversity increases carbon storage in grassland soils, as well as bringing additional benefits such as nutrient retention and pollination. This will be mainly tested using a long term plant diversity restoration experiment at Colt Park, Yorkshire Dales, and experiments at Lancaster University.

Professor Richard Bardgett, Lancaster Environment Centre, who leads the project said: "As far as I know, this is the first survey of its kind, and certainly the first to measure carbon in grassland soils to depth. Not only do we have to sample a wide range of grassland types around the country- including many sites in the Yorkshire Dales and Lakes -- but we also have to dig deep, to capture the carbon that can be stored as much as a metre down the soil horizon.

"Soil is often overlooked in the climate change debate, but it has an incredibly important role to play. This is because most carbon on land is stored in the soil, and the loss of the carbon to the atmosphere could exacerbate climate change.

"Ultimately, we want to provide a scientific basis for the management of carbon storage in UK grassland -- helping offset carbon emissions while also providing other potential benefits to the ecosystem."

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Lancaster University**.

http://www.sciencedaily.com/releases/2010/06/100621121256.htm

Oceanographers Call for More Ocean Observing in Antarctica

Scientists deployed from a research vessel get close to the ice in Antarctica. This kind of observing, Rutgers' Oscar Schofield writes, is not enough to keep up with the pace of climate change in Antarctica. (Credit: Image courtesy of Rutgers University)

ScienceDaily (June 22, 2010) — Rutgers' Oscar Schofield and five colleagues from other institutions have published in *Science,* calling for expanded ocean-observing in the Antarctic, particularly in the Western Antarctic Peninsula, or WAP.

This mountainous arm of the continent stretches north toward South America. In their review paper, the co-authors, who have done research in the Antarctic, often together, argue that research in this region is imperative because the WAP's climate is changing faster than the climate in the rest of the continent, and the Antarctic climate is changing faster than anywhere else on the planet. For a description of some of the research supporting this understanding, click here and here.

The authors' case for a greatly expanded ocean-observing capability in the peninsula is stark. They observe that eighty-seven percent of the peninsula's glaciers are in retreat, the ice season has shortened by 90 days, and perennial sea ice is no longer a feature of this environment. They also point out that these changes are accelerating.

Until recently, most oceanographic research in the Antarctic was done from government-funded ships. Ships are expensive, limited by harsh weather, and only useful during the Antarctic summer. Scientists also have been using satellite data for the past 30 years, but since the Antarctic is often cloud-covered, such data are often incomplete. Schofield and his colleagues suggest a "nested, multi-platform" approach to Antarctic research. This strategy would employ ships, satellites, drifting sensors, submersible robots, and sensors

mounted on animals such as seals and whales. The authors write that such a strategy should quantify a heat budget (the sum of incoming and outgoing heat) for the atmosphere and ocean, help scientists understand how the deep ocean is interacting with shelf waters, how this flux changes with time, and how this affects regional marine climate, ice dynamics and ecology.

The authors write that the ocean surrounding Antarctica is warming and that this warming has driven the deglaciation of the peninsula. They write that the interplay between ice, atmosphere and ocean in the in the peninsula produces a positive feedback -- a situation in which a system responds to changes by amplifying subsequent changes. In the case of the Western Antarctic Peninsula, this means that ice, ocean and atmosphere work to increase each other's temperature and the rate at which their temperatures increase. However, the authors report that the mechanism of this interplay is not well understood, and expanded ocean-observing systems will help scientific understanding.

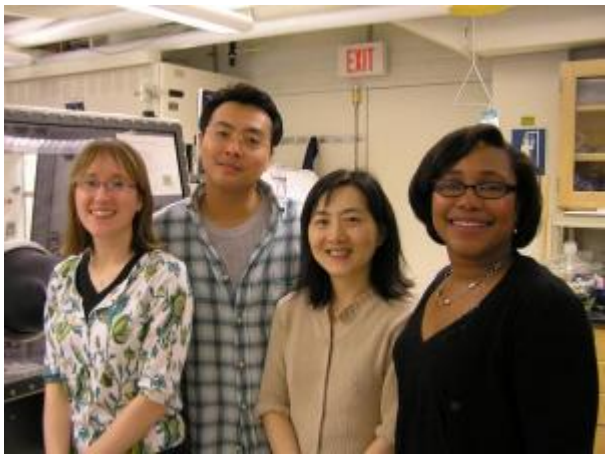
Schofield is a professor of marine science and co-director of the Coastal Ocean Observation Laboratory in the Institute of Marine and Coastal Sciences, part of the School of Environmental and Biological Sciences at Rutgers. His co-authors are Hugh Ducklow, of the Marine Biological Laboratory in Woods Hole, Mass.; Douglas G. Martinson of Columbia University's Lamont-Doherty Earth Observatory; Michael P. Meredith, of the British Antarctic Survey; Mark A. Moline, of California Polytechnic University, San Luis Obispo; and William R. Fraser of the Polar Ocean Research Group in Sheridan, Mont., who does most of his work at Palmer Station, Antarctica.

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Rutgers University**.

http://www.sciencedaily.com/releases/2010/06/100618112135.htm

Using Carbon Nanotubes in Lithium Batteries Can Dramatically Improve Energy Capacity



From left, students Betar Gallant and Seung Woo Lee and professors Yang Shao-Horn and Paula Hammond, in one of the labs where they did research on the use of carbon nanotubes in lithium batteries. (Credit: Image courtesy of MIT)

ScienceDaily (June 21, 2010) — Batteries might gain a boost in power capacity as a result of a new finding from researchers at MIT. They found that using carbon nanotubes for one of the battery's electrodes produced a significant increase -- up to tenfold -- in the amount of power it could deliver from a given weight of material, compared to a conventional lithium-ion battery. Such electrodes might find applications in small portable devices, and with further research might also lead to improved batteries for larger, more power-hungry applications.

To produce the powerful new electrode material, the team used a layer-by-layer fabrication method, in which a base material is alternately dipped in solutions containing carbon nanotubes that have been treated with simple organic compounds that give them either a positive or negative net charge. When these layers are alternated on a surface, they bond tightly together because of the complementary charges, making a stable and durable film.

The findings, by a team led by Associate Professor of Mechanical Engineering and Materials Science and Engineering Yang Shao-Horn, in collaboration with Bayer Chair Professor of Chemical Engineering Paula Hammond, are reported in a paper published June 20 in the journal *Nature Nanotechnology*. The lead authors are chemical engineering student Seung Woo Lee PhD '10 and postdoctoral researcher Naoaki Yabuuchi.

Batteries, such as the lithium-ion batteries widely used in portable electronics, are made up of three basic components: two electrodes (called the anode, or negative electrode, and the cathode, or positive electrode) separated by an electrolyte, an electrically conductive material through which charged particles, or ions, can move easily. When these batteries are in use, positively charged lithium ions travel across the electrolyte to the cathode, producing an electric current; when they are recharged, an external current causes these ions to move the opposite way, so they become embedded in the spaces in the porous material of the anode.

In the new battery electrode, carbon nanotubes -- a form of pure carbon in which sheets of carbon atoms are rolled up into tiny tubes -- "self-assemble" into a tightly bound structure that is porous at the nanometer scale (billionths of a meter). In addition, the carbon nanotubes have many oxygen groups on their surfaces, which can store a large number of lithium ions; this enables carbon nanotubes for the first time to serve as the positive electrode in lithium batteries, instead of just the negative electrode.

This "electrostatic self-assembly" process is important, Hammond explains, because ordinarily carbon nanotubes on a surface tend to clump together in bundles, leaving fewer exposed surfaces to undergo reactions. By incorporating organic molecules on the nanotubes, they assemble in a way that "has a high degree of porosity while having a great number of nanotubes present," she says.

Lithium batteries with the new material demonstrate some of the advantages of both capacitors, which can produce very high power outputs in short bursts, and lithium batteries, which can provide lower power steadily for long periods, Lee says. The energy output for a given weight of this new electrode material was shown to be five times greater than for conventional capacitors, and the total power delivery rate was 10 times that of lithium-ion batteries, the team says. This performance can be attributed to good conduction of ions and electrons in the electrode, and efficient lithium storage on the surface of the nanotubes.

In addition to their high power output, the carbon nanotube electrodes showed very good stability over time. After 1,000 cycles of charging and discharging a test battery, there was no detectable change in the material's performance.

The electrodes the team produced had thicknesses up to a few microns, and the improvements in energy delivery only were seen at high-power output levels. In future work, the team aims to produce thicker electrodes and extend the improved performance to low-power outputs as well, they say. In its present form, the material might have applications for small, portable electronic devices, says Shao-Horn, but if the reported high power capability were demonstrated in a much thicker form -- with thicknesses of hundreds of microns rather than just a few -- it might eventually be suitable for other applications such as hybrid cars.

While the electrode material was produced by alternately dipping a substrate into two different solutions -- a relatively time-consuming process -- Hammond suggests that the process could be modified by instead spraying the alternate layers onto a moving ribbon of material, a technique now being developed in her lab. This could eventually open the possibility of a continuous manufacturing process that could be scaled up to high volumes for commercial production, and could also be used to produce thicker electrodes with a greater power capacity. "There isn't a real limit" on the potential thickness, Hammond says. "The only limit is the time it takes to make the layers," and the spraying technique can be up to 100 times faster than dipping, she says.

Lee says that while carbon nanotubes have been produced in limited quantities so far, a number of companies are currently gearing up for mass production of the material, which could help to make it a viable material for large-scale battery manufacturing.

Story Source:

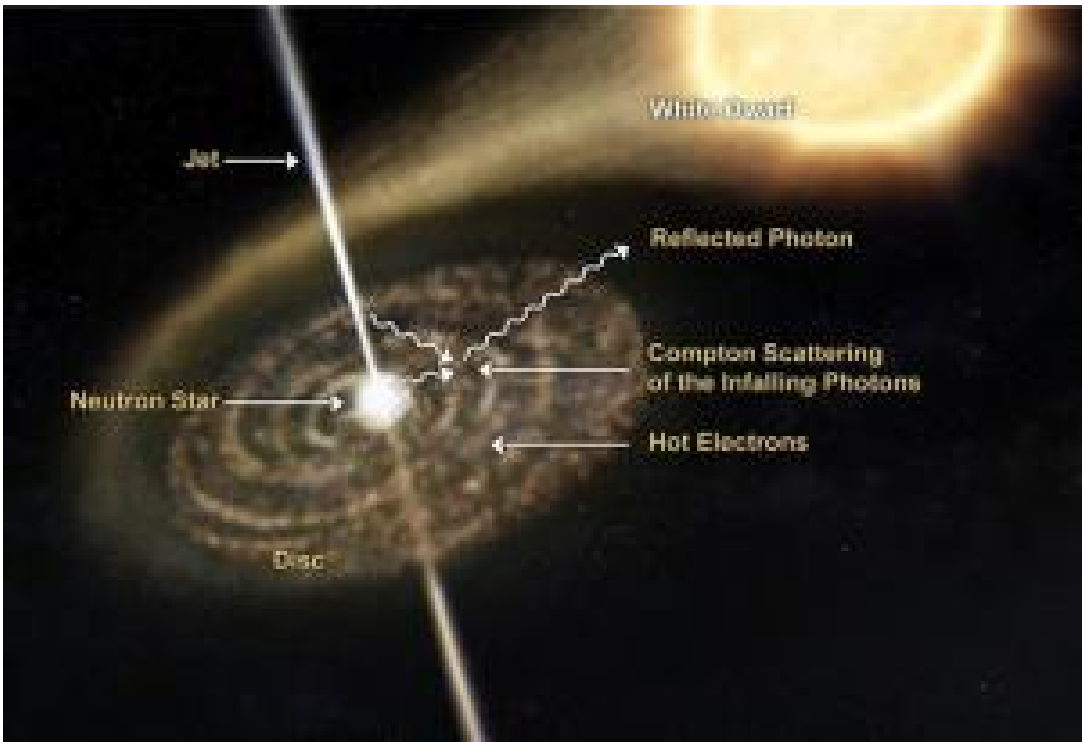
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Massachusetts Institute of Technology**. The original article was written by David Chandler, MIT News Office.

Journal Reference:

1. Seung Woo Lee, Naoaki Yabuuchi, Betar M. Gallant, Shuo Chen, Byeong-Su Kim, Paula T. Hammond, Yang Shao-Horn. **High-power lithium batteries from functionalized carbon-nanotube electrodes**. *Nature Nanotechnology*, 2010; DOI: 10.1038/nnano.2010.116

http://www.sciencedaily.com/releases/2010/06/100620200808.htm

Extreme Gravity Effects Revealed by Oxygen for the First Time in Neutron Star That 'Eats' White Dwarf



Neutron star 'eats' oxygen-rich white dwarf in a peculiar binary system. (Credit: ESA)

ScienceDaily (June 21, 2010) — Astronomers from SRON Netherlands Institute for Space Research and Utrecht University have found blurred oxygen signatures in the X-rays from a neutron star that 'eats' a white dwarf. For the first time the effects of extreme gravity are revealed by oxygen instead of iron atoms.

Although strong gravity near neutron stars and black holes has been studied before in a similar way, this result is unique. Until now, only blurred X-ray signatures of iron atoms have been observed in the X-rays from a neutron star. However, the characteristics of these so called 'iron lines' are disputed, which makes them less suited for extreme gravity field measurements.

The neutron star has been studied before but now Oliwia Madej, PhD student at Utrecht University and SRON Netherlands Institute for Space Research, has found blurred oxygen signatures in the X-rays from the star. She made this discovery in an archival observation performed by ESA's XMM-Newton observatory, which is equipped with the SRON reflection grating spectrometer (RGS) that is extemely sensitive in these particular wavelenghts. The research was carried out under supervision of SRON-researcher Peter Jonker.

The neutron star that the astronomers observed is part of a binary system called 4U 0614+091. In the binary, the neutron star and a white dwarf closely orbit each other in roughly 50 minutes. The white dwarf -- basically a burnt out star -- orbits at such a small distance from the neutron star that the oxygen-rich gas is pulled off the dwarf and starts closely swirling around the neutron star in a disk.

Extreme gravity

"Normally, hot oxygen atoms emit X-rays at a specific energy," Madej explains. "But because of the extreme gravity and the hot gas in the disk around the neutron star, this oxygen signature in the X-ray data is blurred." From the shape of the blur Madej tried to estimate the inner radius of the oxygen-rich disk around the neutron star, which should give an idea of the maximum radius that the neutron star could possibly have.

"Unfortunately, the current data are not yet good enough to give a definitive answer on the size of a neutron star," Peter Jonker admits. "To determine this in greater detail we need more observation time. And when we find the signature of iron molecules as well, we can now compare the characteristics of the two emission lines. Measured together, uncertainties about the measurements of the iron line can be taken away, which will guide the interpretation in other systems where only iron has been seen. All in all our observations are definitely an important step on the way towards a better understanding of the extreme conditions around and inside a neutron star."

Neutron stars -- shaped out of the collapsing cores of massive stars -- are the most compact objects with a surface in the universe. A neutron star has a slightly higher mass compared to a white dwarf, but the matter is squeezed into a ball of only 10-20 km in diameter. At these high densities, normal atoms cannot exist anymore. Anything denser would collapse into a black hole. Therefore, astronomers are very interested in the state of the matter inside a neutron star.

The results of the research appear in the *Monthly Notices of the Royal Astronomical Society*.

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **SRON Netherlands Institute for Space Research**.

Journal Reference:

1. O.K. Madej, P.G. Jonker, A.C. Fabian, C. Pinto, F. Verbunt, J. de Plaa. **A relativistically broadened O VIII Lyalpha line in the ultra-compact X-ray binary 4U 0614 091**. *Monthly Notices of the Royal Astronomical Society*, 2010; (accepted for publication) [link]

http://www.sciencedaily.com/releases/2010/06/100621084729.htm

Ultimate Cold Case: Anthropologist 'Bones Up' on Site of Ancient Invasion

Sandra Garvie-Lok is looking for the real story behind a 1,500-year-old murder. (Credit: Image courtesy of University of Alberta)

ScienceDaily (June 21, 2010) — The body was found in a small, graffiti-stained tunnel. Robbery was likely not the motive, as his possessions and cash were found with him.

The University of Alberta's Sandra Garvie-Lok can't tell exactly how the victim on her table died, but she has a good idea. Given the visible previous cranial trauma on the body, the events that took place around the time of the murder and the location where his remains were found, she is willing to bet that this John Doe was murdered. Yet, no suspect will ever be tried or convicted for the crime. And she's OK with that.

That's because Garvie-Lok is an anthropologist, and her "victim" died almost 1,500 years ago in the ancient Greek city of Nemea during the Slavic invasion of Greece. Garvie-Lok, whose findings on her deceased subject were recently published in the *International Journal of Historical Archaeology*, suggests the victim was likely an eyewitness to Slavic invasion of Nemea. The deceased possibly used the tunnel entrance as an escape from the invaders, where he died/was killed.

"The Slavs and Avars (another group of eastern European peoples) were pretty brutal," said Garvie-Lok, a professor in the department of anthropology. "If he was hiding in that unpleasant place, he was probably in a lot of danger. So, he hid out, but he didn't make it."

A specialist in osteology -- a field of anthropology that studies bones -- Garvie-Lok was called in to the site to try to determine how the subject died. However, aside from the damage to the skull, which Garvie-Lok says are not related to the fatal injury that caused his death, there are no markings on the bones that would give her a definitive idea of the circumstances of the victim's final hours or days.

But, she knows from the region's history, and from how he was found, that he lived during a very turbulent time. Like a detective, she pieces together a probable scenario of what happened to around the time he succumbed to his injuries. Add into the mystery that he was found with some personal possession and several coins, and Garvie-Lok can put a bit more together about his life.

"It was common in Greece when things fell apart like this for people to bury coins under a rock or inside a wall, hoping that whoever was coming through wouldn't find it and maybe they could collect the coins and move on after things calmed down," said Garvie-Lok. "Of course, things didn't calm down for this guy."

The ancient fatality was likely just a local peasant farmer and not a soldier, she noted, since it was uncommon for the leaders of the Byzantine Empire to conscript. While it is possible that he was simply a "wrong place, wrong time" victim of a gallop-by spearing, Garvie-Lok says he may have decided to join the fight in the hopes of defending himself, his family and his community. "Or he was pressed into service because everything was just going south, we can't be sure," says Garvie-Lok. "Either way, that he was hiding with his possession when he died is a pretty clear reflection that, for him, his world was ending," she said.

If her work sounds a lot like a form of ancient-crime CSI, Garvie-Lok agrees that while there are some parallels to solving mysteries, both ancient and current-day, her job demands far more time and scrutiny than an hour-long television show depicts. Observing the surroundings of where things are found, looking for small clues and piecing together tiny bits of detail to try to put together a probable theory of what happened are traits that anthropologists have in common in with police scientists. The advantage in current crime-scene investigation is that police can formulate and hypothesize about how a crime was committed and then fill in more details when a suspect confesses. Her work, she muses, is a little more vague.

"In this job, you're always talking about likelihoods," she said."Until we develop a time machine, we can't go back and know for sure."

For the would-be forensics technician who expects that the work will be much like it is on TV -- "the whole 'we've-got-the-answer-in-12-hours' thing" -- as she puts it, Garvie-Lok cautions that her work is much more laborious and time-consuming. Working in often-adverse conditions and facing long hours poring over the minutiae of a site -- or a body -- is what it is all about. That is where the story is found, and that is what draws her to this work.

"This kind of connection to people's lives is why I got into this," said Garvie-Lok. "I really do feel while I'm studying the bones that I'm touching someone else's life, I'm reaching out to the past.

"That's why I like this job."

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **University of Alberta**. The original article was written by Jamie Hanlon.

Journal Reference:

1. Sandra Garvie-Lok. **A Possible Witness to the Sixth Century Slavic Invasion of Greece from the Stadium Tunnel at Ancient Nemea**. *International Journal of Historical Archaeology*, 2010; 14 (2): 271 DOI: 10.1007/s10761-010-0107-9

http://www.sciencedaily.com/releases/2010/06/100621091234.htm

3.6 Million-Year-Old Relative of 'Lucy' Discovered: Early Hominid Skeleton Confirms Human-Like Walking Is Ancient

Anatomically arranged elements of partial skeleton KSD-VP-1/1. The male Australopithecus afarensis specimen found in Ethiopia was nicknamed "Kadanuumuu." (Credit: Yohannes Haile-Selassie, Liz Russell, Cleveland Museum of Natural History. Used with permission from the Proceedings of the National Academy of Sciences.)

ScienceDaily (June 21, 2010) — Meet "Lucy's" Great-Grandfather. Cleveland Museum of Natural History Curator and Head of Physical Anthropology Dr. Yohnannes Haile-Selassie led an international team that discovered and analyzed a 3.6 million-year-old partial skeleton found in Ethiopia. The early hominid is 400,000 years older than the famous "Lucy" skeleton and is significantly larger in size. Research on the new specimen reveals that advanced human-like, upright walking occurred much earlier in the evolutionary timeline than previously thought.

Haile-Selassie is the first author of the initial analysis of the specimen, which will be published in the online early edition of the *Proceedings of the National Academy of Sciences* during the week of June 21, 2010.

The partial skeleton belongs to "Lucy's" species, *Australopithecus afarensis*. It was found in the Woranso-Mille area of Ethiopia's Afar region by a team led by Haile-Selassie that excavated of the skeleton over five years following the discovery in 2005 of the lower arm bone. The team recovered the most complete clavicle and one of the most complete shoulder blades ever found in the human fossil record. A significant portion of the rib cage was also found.

The specimen was nicknamed "Kadanuumuu" (kah-dah-nuu-muu) by the authors. This means "big man" in the Afar language and reflects its large size. The male hominid stood between 5 to 5 ½ feet tall, while "Lucy" stood only 3 ½ feet tall.

"This individual was fully bipedal and had the ability to walk almost like modern humans," said Haile-Selassie. "As a result of this discovery, we can now confidently

say that 'Lucy' and her relatives were almost as proficient walking on two legs as we are, and that the elongation of our legs came earlier in our evolution that previously thought."

He explained, "All of our understanding of *Australopithecus afarenis'* locomotion was dependent on 'Lucy.' Because she was an exceptionally small female with absolutely short legs, this gave some researchers the impression that she was not fully adapted to upright walking. This new skeleton falsifies that impression because if 'Lucy's' frame had been as large as this specimen, her legs would also have been proportionally longer."

Kent State University Professor Dr. C. Owen Lovejoy was a co-author of the research and helped analyze the skeleton. When comparing it to "Lucy," Lovejoy said, "They both have pelves, a complete lower limb bone and elements of the forelimb, vertebral column and thorax. However, the new specimen has more complete ribs and a nearly complete scapula, which tells us much more about body form in *Australopithecus afarensis* than 'Lucy' was able to alone."

Authors of the research include Cleveland scientists Dr. Bruce Latimer, interim director of the Center for Human Origins of the Institute for the Science of Origins at Case Western Reserve University, and Dr. Beverly Saylor, associate professor of geological sciences at Case Western Reserve University. Other co-authors are from Addis Ababa University in Ethiopia, Berkeley Geochronology Center and Stanford University.

Australopithecus afarenis is the best-known direct early human ancestor. Until now, the only partial skeleton assigned to this species was "Lucy," a 3.2 million-year-old female individual, which was discovered in 1974 by a team led by then Museum curator Dr. Donald Johanson.

The analysis of "Kadanuumuu" indicates that the shoulder and rib cage of this species were different from those of chimpanzees. "These findings further confirm what we concluded from the 'Ardi' specimen -- that chimpanzees have undergone a great deal of specialized evolution since we shared a last common ancestor with them," said Lovejoy.

"Ardi," or *Ardipithecus ramidus* is a 4.4 milion-year-old hominid species that was unveiled in October 2009 by a team that included Haile-Selassie, Lovejoy, and Museum scientists and associate researchers Dr. Linda Spurlock, Dr. Bruce Latimer and Dr. Scott Simpson. "Ardi" was named by the journal *Science* as breakthrough discovery of the year. Click here to find out more about "Ardi."

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Cleveland Museum of Natural History**, via EurekAlert!, a service of AAAS.

Journal Reference:

1. Selassie Y, et al. **An Early Australopithecus afarensis Postcranium from Woranso-Mille, Ethiopia**. *Proceedings of the National Academy of Sciences*, 2010; DOI: 10.1073/pnas.1004527107

http://www.sciencedaily.com/releases/2010/06/100621151119.htm

Super-Complex Organic Molecules Found in Interstellar Space

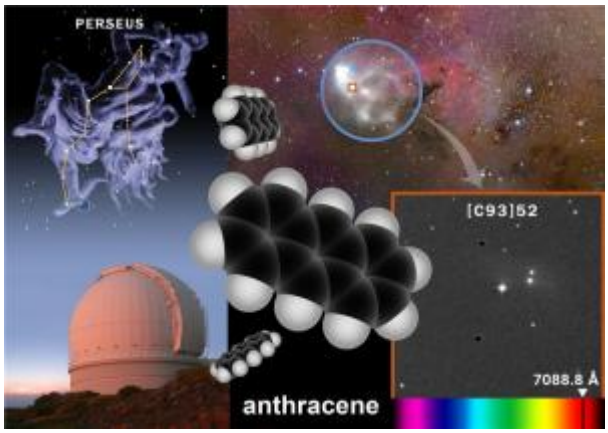


Image of the anthracene band recently identified in the Perseus star formation region by researchers from the IAC and the University of Texas. This molecule is formed by three hexagonal rings of carbon atoms surrounded by hydrogen atoms. (Credit: Gaby Perez and Susana Iglesias-Groth)

ScienceDaily (June 21, 2010) — A team of scientists from the Instituto Astrofísica de Canarias (IAC) and the University of Texas has succeeded in identifying one of the most complex organic molecules yet found in the material between the stars, the so-called interstellar medium. The discovery of anthracene could help resolve a decades-old astrophysical mystery concerning the production of organic molecules in space.

The researchers report their findings in the journal *Monthly Notices of the Royal Astronomical Society*.

'We have detected the presence of anthracene molecules in a dense cloud in the direction of the star Cernis 52 in Perseus, about 700 light years from the Sun,' explains Susana Iglesias Groth, the IAC researcher heading the study.

In her opinion, the next step is to investigate the presence of amino acids. Molecules like anthracene are prebiotic, so when they are subjected to ultraviolet radiation and combined with water and ammonia, they could produce amino acids and other compounds essential for the development of life

'Two years ago,' says Iglesias, 'we found proof of the existence of another organic molecule, naphthalene, in the same place, so everything indicates that we have discovered a star formation region rich in prebiotic chemistry.' Until now, anthracene had been detected only in meteorites and never in the interstellar medium. Oxidized forms of this molecule are common in living systems and are biochemically active. On our planet, oxidized anthracene is a basic component of aloe and has anti-inflammatory properties.

The new finding suggests that a good part of the key components in terrestrial prebiotic chemistry could be present in interstellar matter.

Since the 1980s, hundreds of bands found in the spectrum of the interstellar medium, known as diffuse spectroscopic bands, have been known to be associated with interstellar matter, but their origin has not been identified until now. This discovery indicates that they could result from molecular forms based on anthracene

or naphthalene. Since they are widely distributed in interstellar space, they might have played a key role in the production of many of the organic molecules present at the time of the formation of the Solar System.

The results are based on observations carried out at the William Herschel Telescope at Roque de los Muchachos Observatory on La Palma in the Canary Islands and with the Hobby-Eberly Telescope in Texas in the United States.

Story Source:

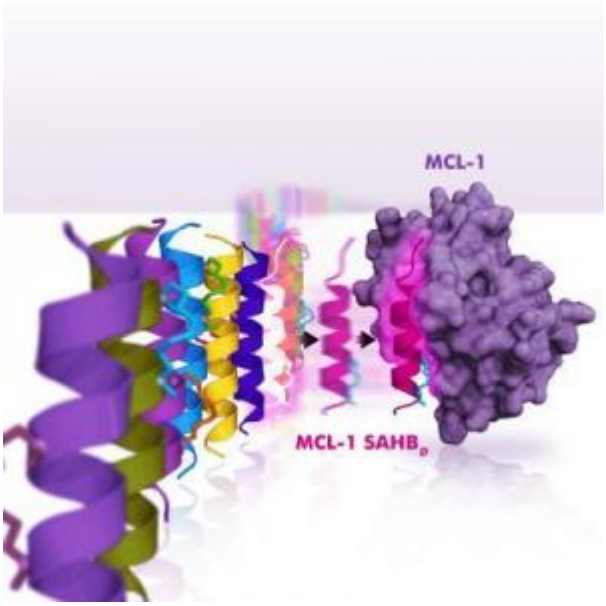
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Royal Astronomical Society (RAS)**, via AlphaGalileo.

Journal Reference:

1. S. Iglesias-Groth, A. Manchado, R. Rebolo, J. I. Gonzalez Hernandez, D. A. Garcia-Hernandez, D.L. Lambert. **Anthracene cations toward the Perseus molecular complex**. *Monthly Notices of the Royal Astronomical Society*, 2010; (in press) [link]

http://www.sciencedaily.com/releases/2010/06/100621074446.htm

Molecular Discovery Suggests New Strategy to Fight Cancer Drug Resistance



By leveraging nature's solution to ligand selectivity, Stewart et al. developed a selective inhibitor of anti-apoptotic MCL-1, which has emerged as a formidable survival factor for a wide variety of cancers. By screening a panel of stapled peptide helices of BCL-2 family protein interaction domains, the team discovered that, ironically, MCL-1's own BH3 death domain helix is a uniquely exclusive MCL-1 inhibitor that resensitizes cancer cells to select apoptotic stimuli that are especially blunted by MCL-1 expression. (Credit: Dana-Farber Cancer Institute)

ScienceDaily (June 21, 2010) — Scientists at Dana-Farber Cancer Institute have found a way to disable a common protein that often thwarts chemotherapy treatment of several major forms of cancer.

The researchers discovered, surprisingly, that they could exploit a small portion of this anti-death protein, called MCL-1, to make a molecular tool that specifically blocked MCL-1's "pro-survival" action, allowing standard cancer drugs to kill the tumor cells by apoptosis, or programmed cell death.

"We think this is a very important step toward developing an inhibitor of MCL-1, which is emerging as a critical survival factor in a broad range of human cancers, including leukemia, lymphoma, multiple myeloma, melanoma, and poor-prognosis breast cancer to name just a few," said Loren Walensky, MD, PhD, a pediatric oncologist and chemical biologist at Dana-Farber and Children's Hospital Boston.

He is the senior author of the report being published June 20 on the website of *Nature Chemical Biology*. The first author is Michelle Stewart, a graduate student in the Walensky lab.

The researchers showed in lab experiments that combining the MCL-1 inhibitor with a class of conventional agents that can be rendered ineffective by MCL-1 resensitized the cancer cells to the drugs. The MCL-blocking compound is now being advanced to testing in animal models.

MCL-1 belongs to the BCL-2 family, a yin-and-yang collection of proteins that control the process of apoptosis, which is designed to rid the body of unneeded cells during embryonic development or cells that have become damaged or cancerous. The "pro-death" BCL-2 members form a pathway that triggers cellular self-destruction, while "pro-survival" members -- of which MCL-1 is one -- establish blockades in the death pathway, often by binding to pro-death proteins and disabling them.

Cancer cells exploit the survival pathway by over-expressing anti-apoptotic proteins such as MCL-1, which makes chemotherapy drugs less effective. Developing drugs to specifically target survival proteins like MCL-1 has been challenging, but Walensky has been making progress on that front.

A small, coiled peptide unit called BH3, which is known as the "death domain," is a key interaction point between pro- and anti-apoptotic proteins. Walensky previously showed that an isolated BH3 coiled structure could be reinforced by chemical "staples" and targeted to the BH3-binding domains of BCL-2 survival proteins, causing the cancer cells in which they are overexpressed to self-destruct.

BH3 domains differ in subtle but important ways from one another, like a set of keys for different locks. Walensky said that molecular mimics of these domains are showing great promise in early clinical trials, yet most of these drugs block three or more BCL-2 family proteins, rather than homing in on one specific cancer-causing target. "An ideal pharmacologic toolbox would contain agents that target individual BCL-2 family proteins, subsets, and all members," explained Walensky, who is also an assistant professor of pediatrics at Harvard Medical School.

In the current research, Walensky and Stewart searched through BH3 domains in cells hoping to find one that could bind to MCL-1 -- but no other protein -- and serve as a specific inhibitor of this formidable cancer protein. After combing a collection of BH3 domains, it turned out the one they were looking for was right in front of their eyes -- the BH3 domain of MCL-1 itself.

The helical BH3 domain of MCL-1 is located within a small "pocket" in the protein structure, and acts as a dock to enable binding of other proteins. It is by means of this docking unit that MCL-1 "traps" pro-death proteins and keeps them from triggering apoptosis in cancer cells. The scientists didn't expect to find that MCL-1's own BH3 domain could, when inserted into the pocket, inhibit its own pro-survival behavior.

"When we uncovered nature's solution to selective MCL-1 targeting, we were surprised by the ironic twist," said Stewart.The Dana-Farber investigators were also able to analyze the three-dimensional structure of the key parts of the MCL-1 docking mechanism and discover why it binds so specifically to its target.

"Our data provide a blueprint for the development of novel therapeutics to reactive apoptosis in diseases driven by pathologic MCL-1-mediated cell survival and chemoresistance," they wrote.Other authors of the report are Emiko Fire, PhD, and Amy Keating, PhD, of the Massachusetts Institute of Technology.

The research was supported by grants from the National Institutes of Health.

Story Source:

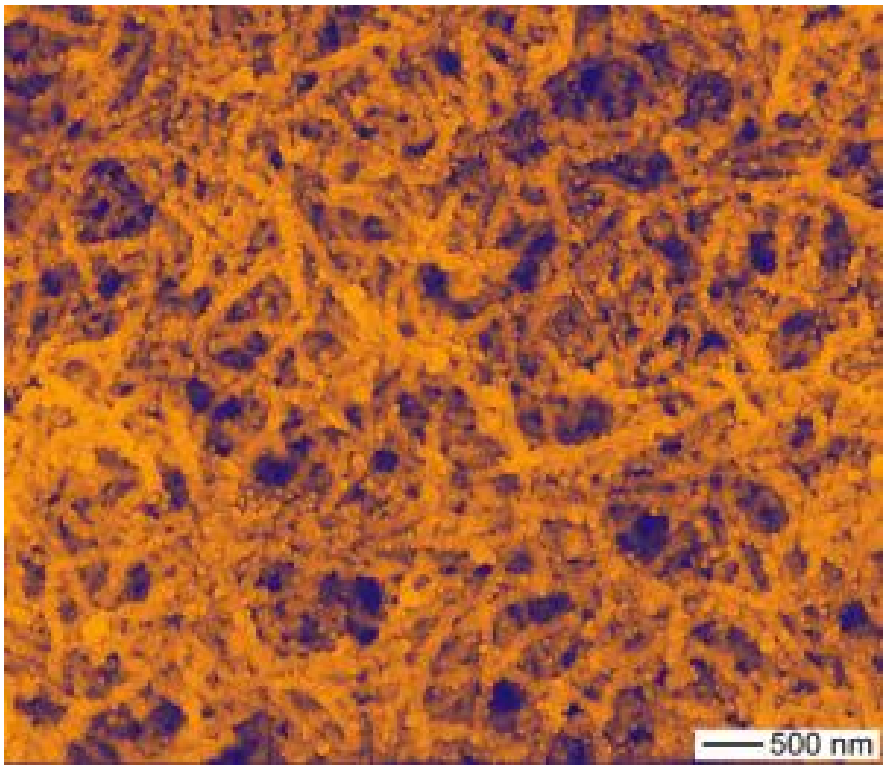
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Dana-Farber Cancer Institute**, via EurekAlert!, a service of AAAS.

Journal Reference:

1. Michelle L Stewart, Emiko Fire, Amy E Keating & Loren D Walensky. **The MCL-1 BH3 helix is an exclusive MCL-1 inhibitor and apoptosis sensitizer**. *Nature Chemical Biology*, 20 June 2010 DOI: 10.1038/nchembio.391

http://www.sciencedaily.com/releases/2010/06/100620155750.htm

Gold Nanoparticles Create Visible-Light Catalysis in Nanowires



The gold-coated silver chloride nanowires at the microscopic level. (Credit: Image courtesy of DOE/Argonne National Laboratory)

ScienceDaily (June 21, 2010) — A scientist at the U.S. Department of Energy's (DOE) Argonne National Laboratory has created visible-light catalysis, using silver chloride nanowires decorated with gold nanoparticles, that may decompose organic molecules in polluted water.

"Silver nanowires have been extensively studied and used for a variety of applications, including transparent conductive electrodes for solar cells and optoelectronic devices," said nanoscientist Yugang Sun of Argonne's Center for Nanoscale Materials. "By chemically converting them into semiconducting silver chloride nanowires, followed by adding gold nanoparticles, we have created nanowires with a completely new set of properties that are significantly different from the original nanowires."

Traditional silver chloride photocatalytic properties are restricted to ultraviolet and blue light wavelengths, but with the addition of the gold nanoparticles, they become photocatalytic in visible light. The visible light excites the electrons in the gold nanoparticles and initiates reactions that culminate in charge separation on the silver chloride nanowires. Tests have already shown that gold-decorated nanowires can decompose organic molecules such as methylene blue.

"If you were to create a film of gold-decorated nanowires and allow polluted water to flow through it, the organic molecules may be destroyed with visible irradiation from conventional fluorescent light bulbs or the sun," Sun said.

Sun started with traditional silver nanowires that were oxidized with iron chloride to create silver chloride nanowires. A sequential reaction with sodium tetrachloroaurate deposited the gold nanoparticles on the wires.

Sun said it is possible to use a similar mechanism to deposit other metals such as palladium and platinum onto the silver chloride nanowires and create new properties, such as the ability to catalyze the splitting of water into hydrogen with sunlight.

A paper on this research was published in the *Journal of Physical Chemistry C.*

Funding was provided by the U.S. Department of Energy Office of Science. The Center for Nanoscale Materialsat Argonne National Laboratory is one of the five DOE Nanoscale Science Research Centers (NSRCs), premier national user facilities for interdisciplinary research at the nanoscale, supported by the DOE Office of Science.

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **DOE/Argonne National Laboratory**.

http://www.sciencedaily.com/releases/2010/06/100615122534.htm

Gene Therapy Reverses Type 1 Diabetes in Mice, Experimental Technique Shows

In a new study using gene therapy in mice, researchers say they have developed an experimental cure for Type 1 diabetes. (Credit: iStockphoto)

ScienceDaily (June 21, 2010) — Researchers have developed an experimental cure for Type 1 diabetes, a disease that affects about one in every 400 to 600 children and adolescents.

Results of the research in a mouse model of Type 1 diabetes are being presented at The Endocrine Society's 92nd Annual Meeting in San Diego.

Using gene therapy, the team from Baylor College of Medicine in Houston tried to counter the two defects that cause Type 1 diabetes: autoimmune attack and destruction of the insulin-producing beta cells. They used nonobese diabetic mice, which spontaneously develop diabetes due to autoimmunity, just as humans do with Type 1 diabetes.

"A single treatment cured about 50 percent of the diabetic mice, restoring their blood sugar to normal so that they no longer need insulin injections," said study co-author Lawrence Chan, MD, DSc, chief of Baylor's diabetes, endocrinology and metabolism division.

Type 1 diabetes occurs when the body's immune system attacks and destroys the beta cells in the pancreas, the insulin "factory" of the body. The resulting near-complete deficiency of insulin -- the hormone that controls blood sugar -- leads to a buildup of high blood sugar and thus diabetes.

In past studies of their original gene therapy, Chan's group was able to stimulate new formation of beta cells in the liver and restore insulin production and normal blood sugar levels in more than 100 mice with chemically induced diabetes. However, in nonobese diabetic mice the treatment failed to reverse Type 1 diabetes because the mouse's immune system killed the newly formed beta cells, he said.

In this research, which was funded by the National Institute of Diabetes, Kidney and Digestive Diseases, Chan said they "added to the original gene therapy approach a protective gene that shields the newly formed beta cells from autoimmune attack." The added gene was for interleukin-10, an important regulator of the immune system. Past studies showed that interleukin-10 can prevent diabetes development in mice but cannot reverse the disease once it has developed because of the lack of beta cells.

However, when the researchers combined the gene therapy with interleukin-10 into a single intravenous injection, the treatment showed a complete reversal of diabetes in half of the mice during more than 20 months' follow-up. Although the therapy did not reverse autoimmunity throughout the body, it protected the new beta cells from the local destructive effect of autoimmunity, Chan explained.

"We developed a protective 'moat' around the new beta cells," he said. "We are now developing other strategies to try to fortify the newly formed beta cells and give them better weapons in addition to the moat, in order to increase the treatment's cure rate."

Why the gene therapy did not work in all the mice is unclear. However, Chan said the treated mice that did not have improvements in their blood sugar did gain weight and lived a little longer than untreated mice.

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **The Endocrine Society**, via EurekAlert!, a service of AAAS.

http://www.sciencedaily.com/releases/2010/06/100621091211.htm

Polar Oceans Key to Temperature in the Tropics

Icebreaker in the Arctic. Scientists have found that the ocean temperature at the earth's polar extremes has a significant impact thousands of miles away at the equator. (Credit: iStockphoto)

ScienceDaily (June 21, 2010) — Scientists have found that the ocean temperature at Earth's polar extremes has a significant impact thousands of miles away at the equator.

Newcastle University's Dr Erin McClymont is part of an international team of researchers who have published research in *Science* June 18, 2010 demonstrating a close link between the changes in the subpolar climate and the development of the modern tropical Pacific climate around two million years ago.

The team believes this solves another piece of the puzzle concerning oceanic behaviour and its influence on climate.

This research, led by the Institut de Ciència i Tecnologia Ambientals in Barcelona, studied the Northern Pacific and Southern Atlantic sea-surface temperatures from the Pliocene Era (3.65 million years ago) to the present day. Data obtained during the reconstruction indicates that the regions close to the poles of both oceans have played a fundamental role in the way the tropical climate has evolved.

The cooling and expansion of polar waters between 1.8 and 1.2 million years ago increased the temperature difference between the equator and the poles. This intensified atmospheric circulation and helped to develop the modern day 'cold tongue' in the east Pacific.

Created by a shallow thermocline -- the layer of ocean water in which temperatures fall rapidly -- the cold tongue brings cold, deep waters to the surface in the east tropical Pacific. Under the warmer climate of the Pliocene, the thermocline was deeper and the cold tongue was much smaller, creating a situation more like the 'El Niño' events that hit the Pacific every three to five years.

"Our results show that the polar oceans play a key role in the global climate, and that one outcome of a rise in global temperature could be an increase in the depth of the thermocline and contraction of the cold tongue in the eastern Pacific," said Dr McClymont. "The high-latitudes are currently experiencing large climate changes, and our data show that this could impact on tropical climates as we saw in the Pliocene."

The study of Pliocene climate has been the subject of intense research as this era represents the most recent climatic period in Earth's history when average temperatures were significantly higher than today over a sustained period. As a result, the Pliocene is thought to be the closest predictor of Earth's climate in the future.

How it works: Analysing deep sea 'fossils'

Researchers analysed marine sediment collected by the international Integrated Ocean Drilling Program, which is supported in the UK by the Natural Environment Research Council (NERC). Sediment cores were drilled in water depths exceeding 3km to measure the composition of alkenones -- highly resistant organic compounds produced by phytoplankton.The phytoplankton live in the surface ocean and change their alkenone chemistry in response to temperature changes. The researchers used these 'biomarkers' or 'chemical fossils' to reconstruct the temperatures of the surface ocean.

"These molecules are 'fossils' in the same way that shells or fish fall to the bottom of the ocean and are preserved," said Dr McClymont, who is a member of the Quaternary Research Group within Newcastle University's School of Geography, Politics and Sociology. "Molecules which remained from the phytoplankton were gradually buried beneath layers of sediment beneath the ocean floor, and by analysing these we were able to reconstruct the temperatures of the surface ocean in the past."Reconstruction of the surface temperature in the Northern Pacific and Southern Atlantic has enabled a simultaneous sea-surface cooling to be identified in the subpolar regions of the two hemispheres in the period between 1.8 and 1.2 million years ago. This finding coincides with the formation of the equatorial Pacific cold tongue -- which currently almost disappears during any El Niño conditions.

Previous studies have shown that, during the warm conditions of the Pliocene, this cold tongue was not present, creating a situation similar to a permanent El Niño situation in the equatorial Pacific.(i) The research is based on Dr Alfredo Martínez-García's doctoral thesis, who is currently a researcher with both the Swiss Federal Institute of Technology, ETH Zurich, and with the DFG-Leibniz Centre at the University of Postdam, Germany). The thesis was undertaken at the UAB and directed by Dr Antoni Rosell Melé, an ICTA ICREA researcher and adjunct professor with the Department of Geography. This work was carried out in collaboration with Dr Gerald H. Haug, of ETH and DFG-Leibniz Centre; Dr Erin L. McClymont of Newcastle University (UK); and Dr Rainer Gersonde, of the Alfred Wegener Institute (Germany).

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Newcastle University**.

Journal Reference:

1. Alfredo Martínez-García, A; Rosell-Melé, A; McClymont E L; Gersonde R; Haug G. H. **Subpolar link to the emergence of the modern equatorial Pacific cold tongue**. *Science*, 18 June 2010 DOI: 10.1126/science.1184480

http://www.sciencedaily.com/releases/2010/06/100617143934.htm

New Research Sheds Light on Antarctica's Melting Pine Island Glacier

Autosub -- autonomous underwater vehicle. (Credit: Image courtesy of British Antarctic Survey)

ScienceDaily (June 21, 2010) — New results from an investigation into Antarctica's potential contribution to sea level rise are reported by scientists from the British Antarctic Survey (BAS), Lamont-Doherty Earth Observatory (LDEO) and the National Oceanography Centre in the journal *Nature Geoscience*.

Thinning ice in West Antarctica is currently contributing nearly 10 per cent of global sea level rise and scientists have identified Pine Island Glacier (PIG) as a major source. As part of a series of investigations to better understand the impact of melting ice on sea level an exciting new discovery has been made. Using Autosub (an autonomous underwater vehicle) to dive deep and travel far beneath the pine Island Glacier's floating ice shelf, scientists captured ocean and sea-floor measurements, which revealed a 300m high ridge (mountain) on the sea floor.

Pine Island Glacier was once grounded on (sitting on top of) this underwater ridge, which slowed its flow into the sea. However, in recent decades it has thinned and disconnected from the ridge, allowing the glacier to move ice more rapidly from the land into the sea. This also permitted deep warm ocean water to flow over the ridge and into a widening cavity that now extends to an area of 1000 km² under the ice shelf. The warm water, trapped under the ice, is causing the bottom of the ice shelf to melt, resulting in continuous thinning and acceleration of the glacier.

Lead author Dr Adrian Jenkins of British Antarctic Survey said, "The discovery of the ridge has raised new questions about whether the current loss of ice from Pine Island Glacier is caused by recent climate change or is a continuation of a longer-term process that began when the glacier disconnected from the ridge.

"We do not know what kick-started the initial retreat from the ridge, but we do know that it started some time prior to 1970. Since detailed observations of Pine Island Glacier only began in the 1990s, we now need to use other techniques such as ice core analysis and computer modelling to look much further into the glacier's history in order to understand if what we see now is part of a long term trend of ice sheet contraction. This work is vital for evaluating the risk of potential wide-spread collapse of West Antarctic glaciers."

Co-author Stan Jacobs adds: "Since our first measurements in the Amundsen Sea, estimates of Antarctica's recent contributions to sea level rise have changed from near-zero to significant and increasing. Now finding that the PIG's grounding line has recently retreated more than 30 km from a shallow ridge into deeper water, where it is pursued by a warming ocean, only adds to our concern that this region is indeed the 'weak underbelly' of the West Antarctic Ice Sheet. Increased melting of continental ice also appears to be the primary cause of persistent ocean freshening and other impacts, both locally and downstream in the Ross Sea."

Story Source:

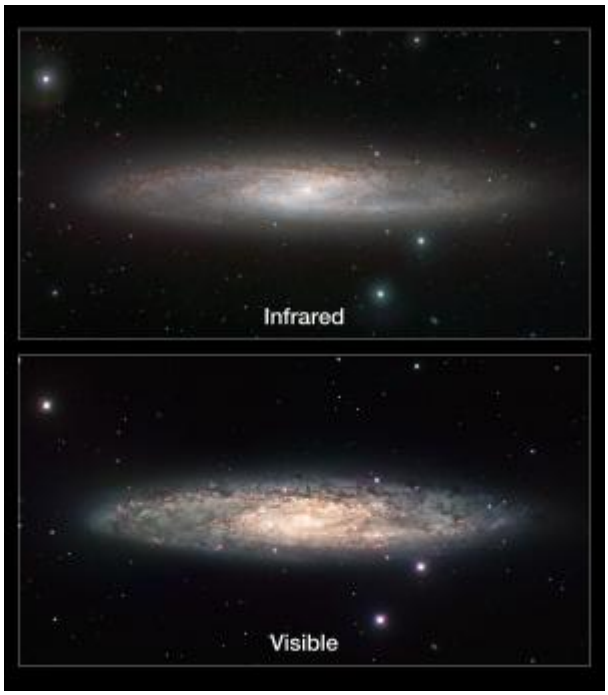
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **British Antarctic Survey**.

Journal Reference:

1. Adrian Jenkins, Pierre Dutrieux, Stanley S. Jacobs, Stephen D. McPhail, James R. Perrett, Andrew T. Webb, David White. **Observations beneath Pine Island Glacier in West Antarctica and implications for its retreat**. *Nature Geoscience*, 2010; DOI: 10.1038/ngeo890

http://www.sciencedaily.com/releases/2010/06/100620200810.htm

VISTA Views the Sculptor Galaxy



Infrared/visible light comparison of views of the Sculptor Galaxy. (Credit: ESO/J. Emerson/VISTA. Acknowledgment: Cambridge Astronomical Survey Unit)

ScienceDaily (June 21, 2010) — A spectacular new image of the Sculptor Galaxy (NGC 253) has been taken with the European Southern Observatory's VISTA telescope at the Paranal Observatory in Chile as part of one of its first major observational campaigns. By observing in infrared light VISTA's view is less affected by dust and reveals a myriad of cooler stars as well as a prominent bar of stars across the central region. The VISTA image provides much new information on the history and development of the galaxy.

The Sculptor Galaxy (NGC 253) lies in the constellation of the same name and is one of the brightest galaxies in the sky. It is prominent enough to be seen with good binoculars and was discovered by Caroline Herschel from England in 1783. NGC 253 is a spiral galaxy that lies about 13 million light-years away. It is the brightest member of a small collection of galaxies called the Sculptor Group, one of the closest such groupings to our own Local Group of galaxies. Part of its visual prominence comes from its status as a starburst galaxy, one in the throes of rapid star formation. NGC 253 is also very dusty, which obscures the view of many parts of the galaxy (eso0902). Seen from Earth, the galaxy is almost edge on, with the spiral arms clearly visible in the outer parts, along with a bright core at its centre.

VISTA, the Visible and Infrared Survey Telescope for Astronomy, the latest addition to ESO's Paranal Observatory in the Chilean Atacama Desert, is the world's largest survey telescope. After being handed over to ESO at the end of 2009, the telescope was used for two detailed studies of small sections of the sky before it embarked on the much larger surveys that are now in progress. One of these "mini surveys" was a detailed study of NGC 253 and its environment.

As VISTA works at infrared wavelengths it can see right through most of the dust that is such a prominent feature of the Sculptor Galaxy when viewed in visible light. Huge numbers of cooler stars that are barely detectable with visible-light telescopes are now also seen. The VISTA view reveals most of what was hidden by the thick dust clouds in the central part of the disc and allows a clear view of a prominent bar of stars across the nuclear region -- a feature that is not seen in visible light pictures. The majestic spiral arms now spread over the whole disc of the galaxy.

The spectacular viewing conditions VISTA shares with ESO's Very Large Telescope (VLT), located on the next mountain peak, also allow VISTA images to be exceptionally sharp for a ground-based telescope.

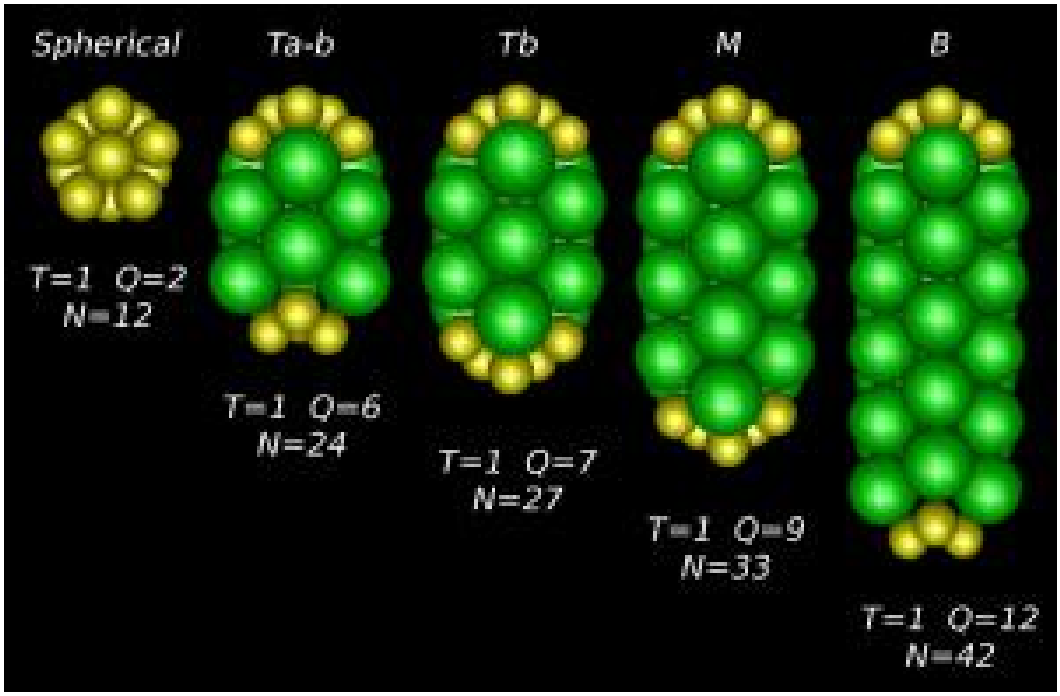
With this powerful instrument at their command astronomers wanted to peel away some of the mysteries of the Sculptor Galaxy. They are studying the myriad of cool red giant stars in the halo that surrounds the galaxy, measuring the composition of some of NGC 253's small dwarf satellite galaxies, and searching for as yet undiscovered new objects such as globular clusters and ultra-compact dwarf galaxies that would otherwise be invisible without the deep VISTA infrared images. Using the unique VISTA data they plan to map how the galaxy formed and has evolved.

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **European Southern Observatory**.

http://www.sciencedaily.com/releases/2010/06/100616102800.htm

Physical Model Describes Structures of Viral Capsids



Gallery of the bacilliform structures proposed by the physical model for the different sizes of alfalfa mosaic virus. (Credit: Image courtesy of Universidad de Barcelona)

ScienceDaily (June 21, 2010) — The genetic material of viruses is shielded by a protective protein covering called a capsid. The UB researchers David Reguera and Antoni Luque, of the Department of Fundamental Physics, have uncovered the strict selection rules that define capsid structure in spherical and bacilliform viruses, which they report in two papers published in the *Proceedings of the National Academy of Sciences* and the *Biophysical Journal*.

The main conclusion of the study is that viral capsids can only adopt a finite range of radii, lengths and protein numbers, making it possible to calculate and characterize all of their possible structures. "This model marks an important step towards understanding the viral assembly process and opens the way for controlling this process for applications in biotechnology, such as gene therapy, and applications in nanotechnology, for example in the creation of nanoscale moulds with highly precise dimensions for designing nanostructures," explains David Reguera.

Viral capsids are formed through a process of self-assembly governed by a universal physical principle: energy minimization. Based on this knowledge, it was possible to identify the potentially optimal architectures of viral capsids; that is, those structures which minimize the energy requirement. As Reguera explains, "we have found that the well-defined geometry observed in different spherical and bacilliform viruses is a product of free-energy minimization in the interaction between the different structural units of which the capsid is composed."

Since the 1960s scientsts have known that spherical viruses adopt a clearly defined structure with icosahedral symmetry, formed by groups of six and five proteins (hexamers and pentaments, respectively), similar to the panel structure of a football, for example. In the case of bacilliform viruses, however, the structure had not been clearly identified. The results of this new study suggest that the capsids of bacilliform viruses are generally formed by a tube-like central body, the ends of which are closed by isocahedral caps centred on one of the three axes of symmetry. These structures are similar to those of fullerenes and carbon nanotubes and have the advantage of being highly stable and resistant.

Reguera and Luque, with support from the researcher Roya Zandi, of the University of California, applied a simple physical model and found that the local energy is minimal for bacilliform capsids formed by a specific, discrete number of proteins distributed in a cylindrical body of hexamers and closed by isocahedral caps centred along the 5-, 3- and 2-fold axes.

The study corroborates the existence of this type of viral structure and, with the complimentary geometric model, serves as the basis for reproducing the architecture of spherical and bacilliform viruses *in vivo* and *in vitro* and for making informed predictions. The models have been successfully applied to several known viruses and confirm many of the hypotheses from earlier studies regarding the structure of the alfala mosaic virus, which adopts different lengths depending on the quantity of genetic material contained. Given that the different lengths correspond to the rules set out in the model, it has been possible to obtain definitive models of the finite possible structures.

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Universidad de Barcelona**.

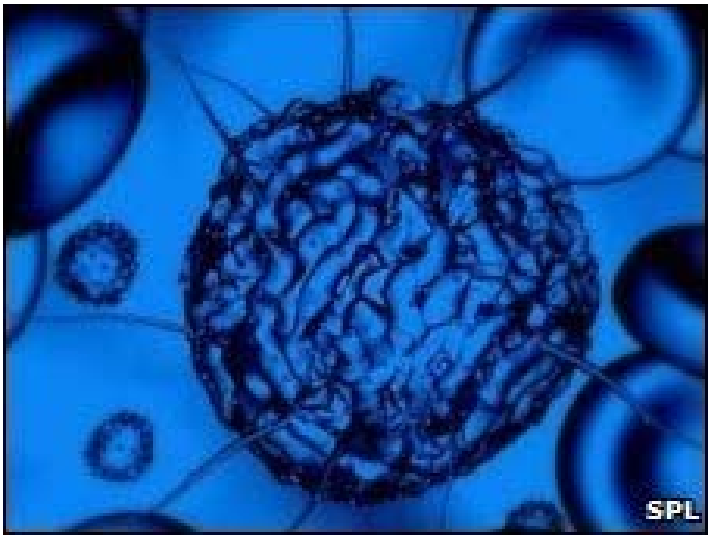
Journal References:

1. Antoni Luque, David Reguera. **The Structure of Elongated Viral Capsids**. *Biophysical Journal*, 2010; 98 (12): 2993 DOI: 10.1016/j.bpj.2010.02.051
2. Antoni Luque, Roya Zandi, David Reguera. **Optimal architectures of elongated viruses**. *Proceedings of the National Academy of Sciences*, 2010; 107 (12): 5323 DOI: 10.1073/pnas.0915122107

http://www.sciencedaily.com/releases/2010/06/100616090221.htm

Stem cell therapy 'damage' seen in kidney disease case

Page last updated at 21:09 GMT, Thursday, 17 June 2010 22:09 UK



There are hopes that stem cell therapy can be used to tackle many diseases

A new complication has been seen in a patient with kidney disease who received stem cell therapy, scientists have warned.

Stem cells were injected into the kidney, but the patient suffered tissue damage and died from an infection.

The Canadian and Thai researchers said the findings published in the Journal of the American Society of Nephrology showed caution was needed.

Experts said there was a gap between research and treatment.

Many scientists hope stem cell therapy can be used to treat a wide range of diseases.

It has been shown that it is possible to reprogram adult stem cells, taken from bone marrow, to become a range of specific cell types - including kidney cells.

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We believe that this is either formed directly by the stem cells that were injected or that the stem cells caused these masses to form

Dr Duangpen Thirabanjasak, Chulalongkorn University

And animal studies have indicated that injecting stem cells directly into organs, including the kidney, is safe.

The patient in this case had been treated by a private clinic.

Researchers from Chulalongkorn University in Bangkok, Thailand, and Paul Scott Thorner, from the University of Toronto, were involved in removing and analysing the kidney.

They found that the patient had not benefited at all from the treatment, but had actually developed tissue damage called angiomyeloproliferative lesions at the injection sites. These were found to be clusters of blood vessels and bone marrow cells.

Enthusiasm 'premature'

Dr Duangpen Thirabanjasak, from Chulalongkorn University, who led the research, said: "This type of lesion has never been described before in patients, and we believe that this is either formed directly by the stem cells that were injected or that the stem cells caused these masses to form."

And she warned that, because they had not been seen before, no-one knew how the lesions might have developed over time.

The authors conclude that their findings should serve as a warning to clinical investigators that the development of blood vessel and bone marrow masses may be a possible complication of stem cell therapy.

And they said more work was needed to identify why the masses formed, and how this could be avoided.

Writing in the journal, Andras Nagy, of Toronto's Mount Sinai Hospital, and Susan Quaggin, of the University of Toronto, said caution was needed over stem cell therapies - especially if they were being offered by unregulated private clinics.

They added: "Premature enthusiasm and protocols that are not fully vetted are dangerous and result in negative publicity for the field of stem cell research, and more importantly, may result in disastrous outcomes with no benefit to the patient.

"Although there is promise, a large gap still exists between scientific knowledge and clinical translation for safe and effective stem cell-based therapies.

http://news.bbc.co.uk/1/hi/health/10354112.stm

Lung cancer risk 'cut by B vitamin'

Page last updated at 23:29 GMT, Tuesday, 15 June 2010 00:29 UK

By Michelle Roberts
Health reporter, BBC News

Lung cancer is the second most common cancer in the UK after breast

People with plenty of a B-vitamin in their blood appear to be at a reduced risk of lung cancer, even if they smoke, a European study suggests.

High levels of Vitamin B6 and the amino acid methionine cut the risk by half, a study of 400,000 people suggested.

These occur naturally in nuts, fish and meat or can be taken as supplements.

But experts told the Journal of the American Medical Association that stopping smoking remained the best way of reducing lung cancer risk.

And, as yet, it is too early to say that taking vitamins would provide any extra protection, they say.

Higher vitamin levels could simply reflect healthier lifestyles.

More studies are needed before scientists can be confident that increasing levels of B-vitamins in the diet can reduce the risk of lung cancer, and also to understand why this might be, says the World Cancer Research Fund (WCRF) which was involved in the research.

Healthy diet

Dr Panagiota Mitrou, of the WCRF, said: "These findings are really exciting as they are important for understanding the process of lung cancer and could have implications for prevention.

"But while this is an important study, it is vital that we get the message across to smokers that increasing intake of B-vitamins is not - and never will be - a substitute for stopping smoking."

Vitamin B levels might be higher in people who eat a healthy diet, and this in itself can help reduce the risk of cancer

Dr Joanna Owens Cancer Research UK

However, it could mean that ex-smokers and people who have never smoked can do something positive to reduce their risk of lung cancer, she said.

The study looked at nearly 400,000 people from 10 European countries over eight years.

They included people who had never smoked, current smokers and ex-smokers.

Regardless of their smoking status, the people with higher circulating levels of both Vitamin B6 and methionine in their blood appeared to be protected against lung cancer.

Far fewer of them developed lung tumours over the course of the study compared with those with the lowest levels of the essential nutrients - 129 people versus 408 respectively, out of a total of 899 cancer cases overall.

Dr Paul Brennan, lead researcher of the study from the International Agency for Research on Cancer, said: "If further research does confirm our findings then the next step would be to identify the optimum B-vitamin levels for reducing future cancer risk."

Dr Joanna Owens, of Cancer Research UK, said: "Although this study suggests a link between vitamin B levels in the blood and reduced risk of lung cancer, this doesn't prove that vitamin B can directly protect against the disease.

"Vitamin B levels might be higher in people who eat a healthy diet, and this in itself can help reduce the risk of cancer.

"The most important way to prevent lung cancer is to stop smoking. No amount of vitamins can counteract the risks posed by smoking."

http://news.bbc.co.uk/1/hi/health/10318410.stm

Fading data could improve privacy

Page last updated at 07:55 GMT, Wednesday, 16 June 2010 08:55 UK

By Mark Ward
Technology correspondent, BBC News

Our digital footprint should be allowed to fade over time thinks researcher

Privacy could be enhanced if data was allowed to fade, suggests research.

Dutch researcher Dr Harold van Heerde is looking into ways to gradually "degrade" the information that sites gather about visitors.

Slowly swapping details for more general information can help guard against accidental disclosure, he said.

"There are so many weak points in security that you can never be sure that your data is safe," said Dr van Heerde.

'Data danger'

The research project carried out by Dr van Heerde from the Centre for Telematics and Information Technology (CTIT) at the University of Twente looked into ways to change the way databases manage information about users and customers.

The ability of those databases to gather information tempts companies and organisations to hoard information just in case it proves valuable, Dr van Heerde told BBC News.

The dangers of having data about us stored more or less permanently in many different places around the web have been proved many times when that information is leaked by accident or design, said Dr van Heerde.

"People make mistakes, people can be bribed," he said. "You cannot protect this data, you cannot be sure it's not been disclosed, privacy policies are simply too weak."

Instead of simply refusing to use services that gather data, Dr van Heerde believes it would be better for people to surrender data knowing that there was a policy that determined how it degraded over time.

At initial use to secure a transaction or get useful information from a search all relevant details might be stored. Subsequently details would slowly be swapped for more general information.

In the case of a location-specific search information about a user's exact GPS co-ordinates could be swapped for a street name, then a neighbourhood and then just a city.

"You can slowly replace details with a more general value," he said.

As well as limiting the impact of any disclosure, such a policy might also force companies to be more explicit about what data they gather and what they will use it for.

"In most cases there's no good reason for them storing data for so long," he said.

http://news.bbc.co.uk/1/hi/technology/10324209.stm

Kuiper Belt world measured in star pass

Page last updated at 18:46 GMT, Wednesday, 16 June 2010 19:46 UK

By Katia Moskvitch
Science reporter, BBC News

The Kuiper Belt is home to several dwarf planets, one of which is Pluto

Astronomers say they have observed, for the first time, a distant icy world orbiting beyond Neptune as it passed briefly in front of a bright star.

This "stellar occultation" occurs when a planetary body hides a star as it moves across the sky.

A US-led team of 18 astronomy groups used the occasion to study KBO 55636 from the Kuiper Belt on the outskirts of the Solar System.

They tell the journal Nature that the occultation lasted only 10 seconds.

But this was enough time to determine the object's size and albedo, or reflectivity, the team said.

The Kuiper Belt is a collection of space objects, remnants from the Solar System's formation.

These objects lie beyond the orbit of the Solar System's most remote planet, Neptune.

The Kuiper Belt is similar to the asteroid belt, but instead of being composed of mainly rock and metal, most of its bodies are frozen volatiles - methane, ammonia and water.

Space impact

So far, scientists have detected over a thousand Kuiper Belt Objects (KBOs), but they believe that there may be as many as 70,000 of them.

The lead author of the study, MIT professor of planetary astronomy, James Elliot, told BBC News that the recently observed KBO 55636 probably formed as a result of a space collision about one billion years ago.

He said that a dwarf planet known as Haumea might have been hit by another object, and this impact caused Haumea's icy mantle to break into a dozen smaller pieces, including KBO 55636.

The Kuiper Belt is home to several dwarf planets, one of which is Pluto.

Prof Elliot explained that in order to spot KBO 55636 as it passed in front of a star, he had to get together a team of 42 astronomers from 18 observation stations located in Australia, South Africa, Mexico and the US.

"For several years, we've been accurately measuring the position of the KBO.

"With an accurate orbit, we just projected where it was going to be in the sky and looked for stars that it might occult."

The scientist explained that it was hard to predict exactly where the KBO would pass.

In order "to be on the safe side", his team used a number of observation stations along a 5,900km stretch of the Earth's surface that corresponded to the predicted shadow path of the space body.

"It was our way of hedging our bets," he said.

Out of the 18 telescopes aimed at the sky, only two stations, both in Hawaii, managed to detect the 10-second-long stellar occultation.

High albedo

The researchers then measured the exact amount of time that the star was blocked from view and the velocity of the KBO's shadow moving across Hawaii.

Using this data, the team determined the object's size - about 300km in diameter - and its albedo, or ability to reflect light.

The scientists thought that the surface of KBO 55636 would be rather dull, unable to reflect much light due to space weathering, dust accumulation and bombardment by cosmic rays.

But the results were unexpected, said Prof Elliot.

"We found out that this object is much smaller than we thought before and that it is very reflective - it reflects most of the light that hits the surface."

He explained that the surface is probably made of ice - very much like the surface of Pluto.

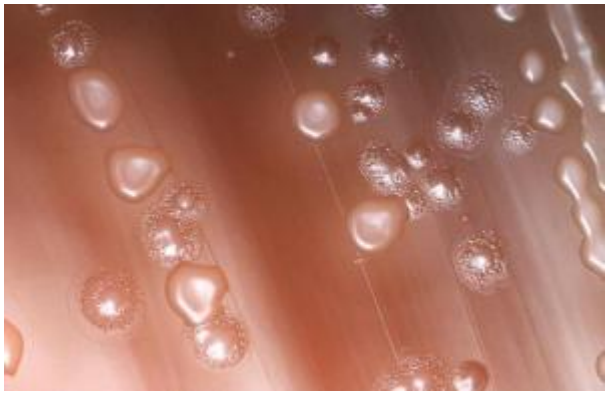
But bigger objects, such as Pluto or Saturn's moon Enceladus, are able to brighten their surfaces with a fresh supply of ice from processes such as cryovolcanism which sees ice - not lava - spew from the interior of the objects.

This explanation did not really apply to the KBO due to its tiny size and the time it had spent floating in space, said the professor.

"I am not sure [why the albedo is so high]. Maybe because water-ice surfaces are more robust and don't get darkened by cosmic ray impacts and other things that darken other surfaces."

http://news.bbc.co.uk/1/hi/science_and_environment/10333601.stm

Battle of the Bugs Leaves Humans as Collateral Damage



Streptococcus pneumoniae bacterial colonies. (Credit: CDC/ Dr. Richard Facklam)

ScienceDaily (June 21, 2010) — It's a tragedy of war that innocent bystanders often get caught in the crossfire. But now scientists at the University of Pennsylvania and the University of Oxford have shown how a battle for survival at a microscopic level could leave humans as the unlikely victims.

In work funded by the US Public Health Service and the Wellcome Trust, the researchers have found a possible explanation for why some bacteria turn nasty, even at great risk to their own survival.

The body is home to a wide range of bacteria which in the vast majority of cases exist quietly, causing no harm. Sometimes, a bacterium will evolve properties which are potentially deadly to its human host. But evolution comes at a cost and this presents a paradox: why should it harm its host when this could result in the demise of the bacteria themselves?

"For many microbes, living in harmony with their host is the best option, so why do some suddenly turn nasty?" asks Dr Sam Brown, a Wellcome Trust Research Career Development Fellow at the University of Oxford. "Sometimes the answer is obvious -- for example, the cold virus makes its host sneeze, helping it spread wider. But for other bacteria and viruses, which do not normally cause disease, the reason isn't at all clear."

In a study published June 17 in *Current Biology*, scientists have modelled in mice how a commonly-found bacterium known as *Streptococcus pneumoniae* interacts with other bacteria, showing that competition for space between rival bacteria can cause deadlier forms of bacteria to evolve. *S. pneumoniae* usually exists in the nasal passage, where it sits quietly: as many as two in five people in some countries will carry the bug without being aware of it.

When *S. pneumoniae* is forced to share space with *Haemophilus influenzae*, another common and ordinarily asymptomatic bacterium, the two begin a tussle for space. But *H. influenzae* has an extra trick up its sleeve, calling on our immune system to help get rid of its competitor by recruiting white blood cells called neutrophils, which surround and attack the *S. pneumoniae* bacteria.

"Many bacteria are not a problem to our immune system, so can be left alone," explains Dr. Lysenko. "But the *H. influenzae* bacteria stir up trouble, saying to the body, '*S. pneumoniae* are bad guys -- beat them up'. The neutrophils respond, attacking the innocent bacteria and thus helping *H. influenzae* to survive."

Many strains of *S. pneumoniae* exist, each coated with a thick sugar capsule. In some strains, the capsule is particularly protective, and appears to act as armour against the host's immune response. This allows the bacterium to enter the blood stream where it can go on to replicate and cause serious diseases such as pneumonia, bacteraemia (blood infection), septicaemia and meningitis.

The researchers tested different combinations of three bacteria -- two pneumococcal strains (armoured and un-armoured), and *H. influenzae*. They found that when a sufficient amount of *H. influenzae* was present, the more virulent, armoured strain of *S. pneumoniae* began to out-compete its rivals: its thick sugar coating was allowing it to escape attack from the neutrophils, but this property also made it more deadly when it entered the blood stream.

Dr Brown concludes: "Creating a new armour is costly to *S. pneumoniae* in terms of the energy expended to make it, but it means the bacterium wins the battle with *H. influenzae*. However, it also means that if *S. pneumoniae* enters the blood stream, the immune system is unable to stop its rampant progress. Our bodies are unable to cope and the armoured bug could pay the ultimate price: death to its host and death to itself."

According to Dr Jeff Weiser from the University of Pennsylvania School of Medicine, Philadelphia, the results could have implications for the development of new treatments and vaccines against infection.

"Our study demonstrates the complex interactions among the many microbial species that live in our bodies," he says. "Usage of antibiotics and vaccines is increasingly influencing these relationships, potentially tipping the outcome of the battle between competing microbes. Our ongoing war on infectious diseases should consider the effects of microbes on one another."

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Wellcome Trust**, via EurekAlert!, a service of AAAS.

Journal Reference:

1. Elena S. Lysenko, Rebeccah S. Lijek, Sam P. Brown, Jeffrey N. Weiser. **Within-Host Competition Drives Selection for the Capsule Virulence Determinant of Streptococcus pneumoniae**. *Current Biology*, 17 June 2010 DOI: 10.1016/j.cub.2010.05.051

http://www.sciencedaily.com/releases/2010/06/100617120714.htm

Comprehensive Look at Human Impacts on Ocean Chemistry

Scott C. Doney was co-chief scientist on an expedition in the South Atlantic on the NOAA ship Ronald H. Brown. He led a team trying to quantify the ocean uptake of anthropogenic CO_2. (Credit: Photo by John Bullister, NOAA/PMEL)

ScienceDaily (June 21, 2010) — Numerous studies are documenting the growing effects of climate change, carbon dioxide, pollution and other human-related phenomena on the world's oceans. But most of those have studied single, isolated sources of pollution and other influences.

Now, a marine geochemist at the Woods Hole Oceanographic Institution (WHOI) has published a report in the latest issue of the journal *Science* that evaluates the total impact of such factors on the ocean and considers what the future might hold.

"What we do on land -- agriculture, fossil fuel combustion and pollution -- can have a profound impact on the chemistry of the sea," says Scott C. Doney, a senior scientist at WHOI and author of the Science report. "A whole range of these factors have been studied in isolation but have not been put in a single venue."

Doney's paper represents a meticulous compilation of the work of others as well as his own research in this area, which includes ocean acidification, climate change, and the global carbon cycle.

He concludes that climate change, rising atmospheric carbon dioxide, excess nutrient inputs, and the many forms of pollution are "altering fundamentally the…ocean, often on a global scale and, in some cases, at rates greatly exceeding those in the historical and recent geological record."

The research documents several major trends, which include a shift in the acid-based chemistry of seawater, reduced subsurface oxygen, both in coastal waters and the open ocean, rising coastal nitrogen levels, and a widespread increase in mercury and other pollutants. "Human impacts are not isolated to coastal waters," Doney says. They "are seen around the globe."

Moreover, he says, "many of these changes in climate and ocean chemistry can compound each other, making the problem considerably worse for marine life." For example, warming and nutrient runoff both can trigger a decline in oxygen levels off the coast, according to Doney. And acidification, he says, may exacerbate coral bleaching.

Among Doney's findings:

- Global ocean pH and chemical saturation states are changing at an "unprecedented" rate, 30 to 100 times faster than temporal changes in the recent geological past, "and the perturbations will last many centuries to millennia."
- "Ocean acidification will likely reduce shell and skeleton growth by many marine calcifying species, including corals and mollusks."
- "Ocean acidification may also reduce the tolerance of some species to thermal stress…Polar ecosystems may be particularly susceptible…"
- Fertilizer runoff and nitrogen from fossil fuels are increasing the severity and duration of coastal hypoxia, or decreased oxygen.

Doney was part of an international consortium of scientists that reported recently that carbon dioxide emissions from fossil fuels have increased by almost a third over the last decade, rendering the Earth's future uncertain unless "CO2 emissions [are] drastically reduced." They attributed the rise to increasing production and trade of manufactured products, particularly from emerging economies, the gradual shift from oil to coal, and the planet's waning capacity to absorb CO2.

Doney led a team that developed ocean-model simulations for estimating the historical variations in air-sea CO2 fluxes. "Over the last decade, CO2 emissions have continued to climb despite efforts to control emissions," Doney said. "Preliminary evidence suggests that the land and ocean may be becoming less effective at removing CO2 from the atmosphere, which could accelerate future climate change."

In his Science paper, Doney calls for "a deeper understanding of human impacts on ocean biogeochemistry…Although some progress has been made on a nascent ocean observing system for CO2, the marine environment remains woefully undersampled for most compounds. The oceanographic community needs to develop a coordinated observational plan…"More detailed studies are needed, in particular, to look at the responses of cells and organisms to biochemical intruders to their undersea environment. "Lastly, Doney says, "targeted research is needed on the impacts on marine resources and fisheries, potential adaptation strategies, and the consequences for human and social economic systems."

The work was funded by WHOI and the Center for Microbial Oceanography, Research and Education.

Story Source:

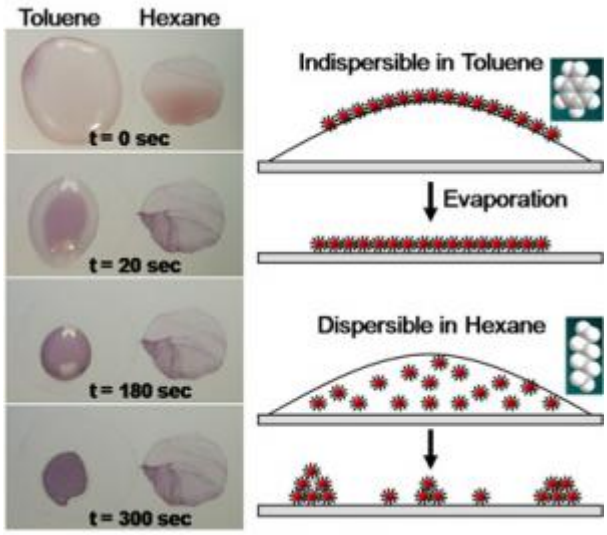
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Woods Hole Oceanographic Institution**.

Journal Reference:

1. Scott C. Doney. **The Growing Human Footprint on Coastal and Open-Ocean Biogeochemistry**. *Science*, 2010; 328 (5985): 1512-1516 DOI: 10.1126/science.1185198

http://www.sciencedaily.com/releases/2010/06/100617185131.htm

Ultra-Simple Method for Creating Nanoscale Gold Coatings Developed



Researchers at Rensselaer have developed a new, ultra-simple method for making layers of gold that measure only billionths of a meter thick. As seen in the research image, drops of gold-infused toluene applied to a surface evaporate within a few minutes and leave behind a uniform layer of nanoscale gold. The process requires no sophisticated equipment, works on nearly any surface, takes only 10 minutes, and could have important implications for nanoelectronics and semiconductor manufacturing. (Credit: Image courtesy of Rensselaer Polytechnic Institute)

ScienceDaily (June 21, 2010) — Researchers at Rensselaer Polytechnic Institute have developed a new, ultra-simple method for making layers of gold that measure only billionths of a meter thick. The process, which requires no sophisticated equipment and works on nearly any surface including silicon wafers, could have important implications for nanoelectronics and semiconductor manufacturing.

Sang-Kee Eah, assistant professor in the Department of Physics, Applied Physics, and Astronomy at Rensselaer, and graduate student Matthew N. Martin infused liquid toluene -- a common industrial solvent -- with gold nanoparticles. The nanoparticles form a flat, closely packed layer of gold on the surface of the liquid where it meets air. By putting a droplet of this gold-infused liquid on a surface, and waiting for the toluene to evaporate, the researchers were able to successfully coat many different surfaces -- including a 3-inch silicon wafer -- with a monolayer of gold nanoparticles.

"There has been tremendous progress in recent years in the chemical syntheses of colloidal nanoparticles. However, fabricating a monolayer film of nanoparticles that is spatially uniform at all length scales -- from nanometers to millimeters -- still proves to be quite a challenge," Eah said. "We hope our new ultra-simple method for creating monolayers will inspire the imagination of other scientists and engineers for ever-widening applications of gold nanoparticles."

Results of the study, titled "Charged gold nanoparticles in non-polar solvents: 10-min synthesis and 2-D self-assembly," were published recently in the journal *Langmuir*.

Whereas other synthesis methods take several hours, this new method chemically synthesizes gold nanoparticles in only 10 minutes without the need for any post-synthesis cleaning, Eah said. In addition, gold nanoparticles created this way have the special property of being charged on non-polar solvents for 2-D self-assembly.

Previously, the 2-D self-assembly of gold nanoparticles in a toluene droplet was reported with excess ligands, which slows down and complicates the self-assembly process. This required the non-volatile excess ligands to be removed in a vacuum. In contrast, Eah's new method ensures that gold nanoparticles float to the surface of the toluene drop in less than one second, without the need for a vacuum. It then takes only a few minutes for the toluene droplet to evaporate and leave behind the gold monoloayer.

"The extension of this droplet 2-D self-assembly method to other kinds of nanoparticles, such as magnetic and semiconducting particles, is challenging but holds much potential," Eah said. "Monolayer films of magnetic nanoparticles, for instance, are important for magnetic data storage applications. Our new method may be able to help inform new and exciting applications."

Co-authors on the paper are former Rensselaer undergraduate researchers James I. Basham '07, who is now a graduate student at Pennsylvania State University, and Paul Chando '09, who will begin graduate study in the fall at the City College of New York.

The research project was supported by Rensselaer, the Rensselaer Summer Undergraduate Research Program, the National Science Foundation (NSF) Research Experiences for Undergraduates, and the NSF's East Asia and Pacific Summer Institutes and Japan Society for the Promotion of Science.

Watch a video demonstration of this new fabrication process at:
http://www.youtube.com/watch?v=nqkwM9o1s-w

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Rensselaer Polytechnic Institute**.

Journal Reference:

1. Matthew N. Martin, James I. Basham, Paul Chando, Sang-Kee Eah. **Charged Gold Nanoparticles in Non-Polar Solvents: 10-min Synthesis and 2D Self-Assembly**. *Langmuir*, 2010; 26 (10): 7410 DOI: 10.1021/la100591h

http://www.sciencedaily.com/releases/2010/06/100616122154.htm

Canyon Carved in Just Three Days in Texas Flood: Insight Into Ancient Flood Events on Earth and Mars

This is an aerial photograph taken near the time of the 2002 flood event at Canyon Lake, Texas. Floodwaters overflowed Canyon Lake reservoir and carved the gorge downstream. (Credit: Comal County, Texas.)

ScienceDaily (June 21, 2010) — In the summer of 2002, a week of heavy rains in Central Texas caused Canyon Lake -- the reservoir of the Canyon Dam -- to flood over its spillway and down the Guadalupe River Valley in a planned diversion to save the dam from catastrophic failure. The flood, which continued for six weeks, stripped the valley of mesquite, oak trees, and soil; destroyed a bridge; and plucked meter-wide boulders from the ground. And, in a remarkable demonstration of the power of raging waters, the flood excavated a 2.2-kilometer-long, 7-meter-deep canyon in the bedrock.

According to a new analysis of the flood and its aftermath -- performed by Michael Lamb, assistant professor of geology at the California Institute of Technology (Caltech), and Mark Fonstad of Texas State University -- the canyon formed in just three days.

A paper about the research appears in the June 20 advance online edition of the journal *Nature Geoscience.*

Our traditional view of deep river canyons, such as the Grand Canyon, is that they are carved slowly, as the regular flow and occasionally moderate rushing of rivers erodes rock over periods of millions of years.

Such is not always the case, however. "We know that some big canyons have been cut by large catastrophic flood events during Earth's history," Lamb says.

Unfortunately, these catastrophic megafloods -- which also may have chiseled out spectacular canyons on Mars -- generally leave few telltale signs to distinguish them from slower events. "There are very few modern examples of megafloods," Lamb says, "and these events are not normally witnessed, so the process by which such erosion happens is not well understood." Nevertheless, he adds, "the evidence that is left behind, like boulders and streamlined sediment islands, suggests the presence of fast water" -- although it reveals nothing about the time frame over which the water flowed.

This is why the Canyon Lake flood is so significant. "Here, we know that all of the erosion occurred during the flood," Lamb says. "Flood waters flowed for several weeks, but the highest discharge -- during which the bulk of the erosion took place -- was over a period of just three days."

Lamb and Fonstad reached this conclusion using aerial photographs of the region taken both before and after the flood, along with field measurements of the topography of the region and measurements of the flood discharge. Then they applied an empirical model of the sediment-carrying capacity of the flood -- that is, the amount of soil, rocks, boulders, and other debris carried by the flood to produce the canyon.

The analysis revealed that the rate of the canyon erosion was so rapid that it was limited only by the amount of sediment the floodwaters could carry. This is in contrast to models normally applied to rivers where the erosion is limited by the rate at which the underlying rock breaks and is abraded.

The researchers argue that the rate of erosion was rapid because the flood was able to pop out and cart away massive boulders (a process called "plucking") -- producing several 10- to 12-meter-high waterfalls that propagated upstream toward the dam, along with channels and terraces. The flood was able to pluck these boulders because the bedrock below the soil surface of the valley was already fractured and broken.

The abrasion of rock by sediment-loaded waters -- while less significant in terms of the overall formation of the canyon -- produced other features, like sculpted walls, plunge pools at the bases of the waterfalls, and teardrop-shaped sediment islands. The sediment islands are particularly significant, Lamb says, because "these are features we see on Earth and on Mars in areas where we think large flow events have occurred. It's nice that here we're seeing some of the same features that we've interpreted elsewhere as evidence of large flow events."

The results, Lamb says, offer useful insight into ancient megafloods, both on Earth and on Mars, and the deep canyons they left behind. "We're trying to build models of erosion rates so we can go to places like Mars and make quantitative reconstructions of how much water was there, how long it lasted, and how quickly it moved," Lamb says. In addition, he says, "this is one of a few places where models for canyon formation can be tested because we know the flood conditions under which this canyon formed."

Story Source:

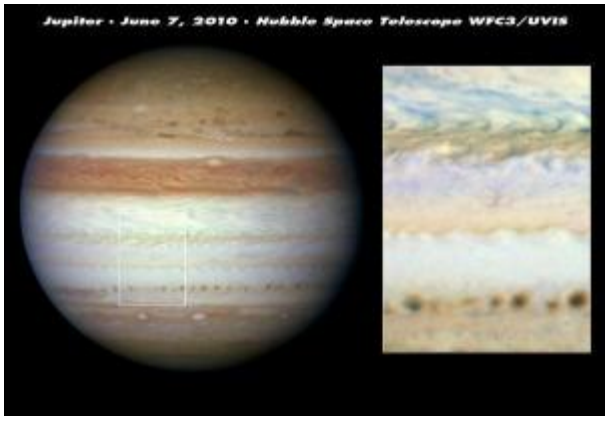
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **California Institute of Technology**, via EurekAlert!, a service of AAAS.

Journal Reference:

1. Michael P. Lamb, Mark A. Fonstad. **Rapid formation of a modern bedrock canyon by a single flood event**. *Nature Geoscience*, 2010; DOI: 10.1038/ngeo894

http://www.sciencedaily.com/releases/2010/06/100620155748.htm

Hubble Scrutinizes Site of Mysterious Flash and Missing Cloud Belt on Jupiter



(Credit: Image courtesy of ESA/Hubble Information Centre)

ScienceDaily (June 20, 2010) — New and detailed observations from the NASA/ESA Hubble Space Telescope have provided insights into two recent events on Jupiter: the mysterious flash of light seen on 3 June and the recent disappearance of the planet's dark Southern Equatorial Belt.

At 22:31 (CEST) on June 3, 2010, Australian amateur astronomer Anthony Wesley saw a two-second-long flash of light on the disc of Jupiter. He was watching a live video feed from his telescope. In the Philippines, amateur astronomer Chris Go confirmed that he had simultaneously recorded the transitory event on video. Wesley was the discoverer of the now world-famous July 2009 impact.

Astronomers around the world suspected that something significant must have hit the giant planet to unleash a flash of energy bright enough to be seen here on Earth, about 770 million kilometres away. But they didn't know how just how big it was or how deeply it had penetrated into the atmosphere. Over the past two weeks there have been ongoing searches for the "black-eye" pattern of a deep direct hit like those left by former impactors.

The sharp vision and ultraviolet sensitivity of the Wide Field Camera 3 aboard the NASA/ESA Hubble Space Telescope were used to seek out any trace evidence of the aftermath of the cosmic collision. Images taken on 7 June -- just over three days after the flash was sighted -- show no sign of debris above Jupiter's cloud tops. This means that the object didn't descend beneath the clouds and explode as a fireball. If it had done, then dark sooty blast debris would have been ejected and would have rained down onto the clouds.

Instead the flash is thought to have come from a giant meteor burning up high above Jupiter's cloud tops, which did not plunge deep enough into the atmosphere to explode and leave behind any telltale cloud of debris, as seen in previous Jupiter collisions.

"The cloud tops and the impact site would have appeared dark in the ultraviolet and visible images due to debris from an explosion," says team member Heidi Hammel of the Space Science Institute in Boulder, Colorado, USA. "We can see no feature that has those distinguishing characteristics in the known vicinity of the impact, suggesting there was no major explosion and no 'fireball'."

Dark smudges marred Jupiter's atmosphere when a series of fragments of Comet Shoemaker-Levy 9 hit Jupiter in July 1994. A similar phenomenon occurred in July 2009 when a suspected asteroid slammed into Jupiter. The latest intruder is estimated to be only a fraction of the size of these previous impactors and is thought to have been a meteor.

"Observations of these impacts provide a window on the past -- onto the processes that shaped our Solar System in its early history," says team member Leigh Fletcher of the University of Oxford, UK. "Comparing the two collisions -- from 2009 and 2010 -- will hopefully yield insights into the types of impact processes in the outer Solar System, and the physical and chemical response of Jupiter's atmosphere to these amazing events."

As a bonus, Hubble's observations also allowed scientists to get a close-up look at changes in Jupiter's atmosphere following the disappearance of the dark cloud feature known as the Southern Equatorial Belt several months ago.

In the Hubble view, a slightly higher altitude layer of white ammonia ice crystal clouds appears to obscure the deeper, darker belt clouds. "Weather forecast for Jupiter's Southern Equatorial Belt: cloudy with a chance of ammonia," Hammel says.

The team predicts that these ammonia clouds should clear out in a few months, as they have done in the past. The clearing of the ammonia cloud layer should begin with a number of dark spots like those seen by Hubble along the boundary of the south tropical zone.

"The Hubble images tell us these spots are holes resulting from localised downdrafts. We often see these types of holes when a change is about to occur," Simon-Miller says.

"The Southern Equatorial Belt last faded in the early 1970s. We haven't been able to study this phenomenon at this level of detail before," Simon-Miller adds. "The changes of the last few years are adding to an extraordinary database on dramatic cloud changes on Jupiter."

The Hubble Space Telescope is a project of international cooperation between ESA and NASA.

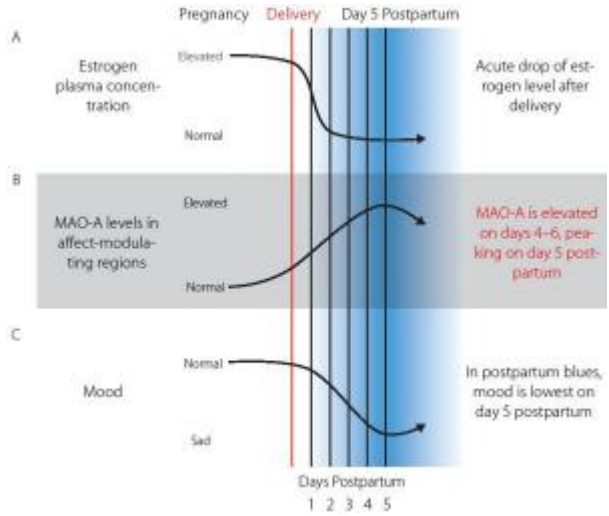
The Jupiter Impact Science Team consists of Amy Simon-Miller (NASA Goddard Space Flight Center, USA); John T. Clarke (Boston University, USA); Leigh Fletcher (University of Oxford, UK); Heidi B. Hammel (Space Science Institute, USA); Keith S. Noll (Space Telescope Science Institute, USA); Glenn S. Orton (Jet Propulsion Laboratory, USA); Agustin Sanchez-Lavega (Universidad del Pais Vasco, Spain); Michael H. Wong and Imke de Pater (University of California -- Berkeley, USA).

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **ESA/Hubble Information Centre**.

http://www.sciencedaily.com/releases/2010/06/100616102856.htm

More Than Just Baby Blues: How Postpartum Depression Arises and How It Could Be Prevented



Monoamine model of postpartum blues. A: After delivery, estrogen levels drop 100- to 1000fold; the estrogen decline is greatest during the first 3 to 4 days postpartum, with a modest decline thereafter. B: Monoamine oxidase A (MAO-A) levels are significantly greater in the early postpartum period, with a peak on day 5 postpartum. C: In the early postpartum period, up to 70% of mothers experience sadness, mood lability, anxiety, insomnia, poor appetite, and irritability, with mood being lowest on day 5 postpartum. (Credit: Max Planck Institute for Human Cognitive and Brain Sciences)

ScienceDaily (June 20, 2010) — Within the first week after giving birth, up to 70 percent of all women experience symptoms of the baby blues. While most women recover quickly, up to 13 percent of all new mothers suffer from symptoms of a clinical-level postpartum depression.

Postpartum depression is defined as a major depressive episode starting within 4 weeks after delivery and is a significant public health problem. Postpartum blues represents a major risk factor for developing postpartum depression and severe postpartum blues symptoms can be viewed as a prodromal stage for postpartum depression.

Julia Sacher from the MPI for Human Cognitive and Brain Sciences in Leipzig and her colleague Jeffrey H. Meyer from the Centre for Addiction and Mental Health in Toronto, Canada, could now reveal an increase of the enzyme MAO-A throughout the female brain in the immediate postpartum period and propose a novel, neurobiological model for postpartum blues

The research appears in the *Archives of General Psychiatry* (May 26, 2010).

For most women, the birth of their baby is one of the most strenuous but also happiest days in their lives. So it is very difficult to understand why almost three-quarters of all women feel down shortly after giving birth. They can suffer from extreme sadness, mood swings, anxiety, sleeplessness, loss of appetite, and irritability. For a long time, the reasons for this have been unclear. What has been known is that in the first three to four days after giving birth, estrogen levels drop 100 to 1000 fold.

In the current study researchers have discovered that proportional to this estrogen-loss, levels of the enzyme monoamine oxidase A (MAO-A) increase dramatically throughout the female brain. The enzyme can be found in higher concentrations in glial cells and monoamine-releasing neurons, where it breaks down the neurotransmitters serotonin, dopamine, and norepinephrine. As well as being responsible for transmitting signals between nerve cells, these neurotransmitters also influence our mood. If they are deficient, we initially feel sad, and later have a high risk of becoming depressed.

Using positron emission tomography (PET) -- an imaging method that creates images of the distribution of a short-lived radioactive substance in an organism -- the researchers measured the distribution of a radioactively- marked ligand in the brain which binds specifically and with a high affinity to the enzyme monoamine oxidase A. They found that levels of MAO-A were, on average, 43 percent higher in women who had just had a baby than in a control group consisting of women who either had children a long time ago or had no children. The MAO-A increase could be shown in all brain regions investigated, with MAO-A levels being highest on day five postpartum. This result fits neatly with the fact that the mood of mothers often hits a low precisely on this day.

Severe baby blues symptoms can be viewed as a prodromal stage for postpartum depression. From this perspective, preventing depressive symptoms in the immediate postpartum period may have powerful impact for prophylaxis of postpartum depression. Attempts can be made to either lower elevated levels of MAO-A with selected antagonist drugs, or to increase the concentration of monoamine neurotransmitters that can elevate mood. Both have the goal of keeping levels of monoamine neurotransmitters in the brain balanced after birth. Given the need to develop treatments that are compatible with breastfeeding, the intake of dietary supplements of monoamine precursors in the early postpartum period would be a promising strategy to maintain a sufficient balance of monoamines during this time. This includes the administration of precursor supplements such as the amino acids tryptophan and tyrosine, which the body can convert into the neurotransmitters serotonin, norepinephrine, and dopamine, respectively.

"Our results have the exciting potential for prevention for severe postpartum blues. This could have an impact on prevention and treatment of postpartum depression in the future," says Julia Sacher, first author of the study.

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Max-Planck-Gesellschaft**.

Journal Reference:

1. J. Sacher, A. A. Wilson, S. Houle, P. Rusjan, S. Hassan, P. M. Bloomfield, D. E. Stewart, J. H. Meyer. **Elevated Brain Monoamine Oxidase A Binding in the Early Postpartum Period**. *Archives of General Psychiatry*, 2010; 67 (5): 468 DOI: 10.1001/archgenpsychiatry.2010.32

http://www.sciencedaily.com/releases/2010/06/100616102854.htm

Retooling the Ocean Conveyor Belt

The old conveyor belt model of ocean currents is no longer valid for the ocean's overturning, not because it's a gross simplification, but because it ignores crucial elements such as eddies and the wind field. (Credit: Copyright Michele Hogan)

ScienceDaily (June 20, 2010) — For decades, oceanographers have embraced the idea that Earth's ocean currents operate like a giant conveyor belt, overturning to continuously transport deep, cold polar waters toward the equator and warm equatorial surface waters back toward the poles along narrow boundary currents. The model held that the conveyor belt was driven by changes in the temperature and salinity of the surface waters at high latitudes.

In a paper in the June 18 issue of *Science*, a Duke University oceanographer reviews the growing body of evidence that suggests it's time to rethink the conveyor belt model.

"The old model is no longer valid for the ocean's overturning, not because it's a gross simplification, but because it ignores crucial elements such as eddies and the wind field. The concept of a conveyor belt for the overturning was developed decades ago, before oceanographers had measured the eddy field of the ocean and before they understood how energy from the wind impacts the overturning," says Susan Lozier, professor of physical oceanography and chair of the Division of Earth and Ocean Sciences at Duke University's Nicholas School of the Environment.

"It is important to understand that there is clear and convincing evidence that the ocean waters overturn and that this overturning impact's the Earth's climate," she says. "Recent studies, however, have cast doubt on our ability to describe this overturning as a conveyor belt. From these studies we now understand that the overturning waters are not restricted to narrow boundary currents, that the overturning may vary from one ocean basin to the next and that the winds may create variability in the amount of water that overturns and in the pathways for the upper and lower limbs of the overturning."

The *Science* article also reviews what remains unknown about the ocean's overturning. As surface waters warm and/or freshen due to climate change, how might the overturning change? Though modeling studies have addressed this question, there has been no observational study.

A new international research program in the planning stages, led by Lozier, aims to address the question of climate effects. The initiative will bring together researchers from the United States, Germany, Canada, France and the United Kingdom to study overturning in the northern North Atlantic over a five-to-10-year period.

In her *Science* article, Lozier reviews the emerging view of the overturning circulation within a historical framework that chronicles significant scientific developments in the field, from the first reported measurement of ocean overturning in 1751 through the present.

"Basically, our ability to refine our understanding of the ocean's overturning stems in large part from our ever increasing ability to measure the ocean at finer and finer scales and at depths previously unmeasured," she says. "Because the ocean waters are corrosive, at high pressure and generally inaccessible, the ocean has historically been a sparsely observed system. Recent technological advances are rapidly expanding the ocean's observational database and with it, our understanding of ocean circulation."

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Duke University**.

http://www.sciencedaily.com/releases/2010/06/100618102646.htm

Faster Employees May Indirectly Motivate Colleagues to Increase Production

You wouldn't think that there would be much similarity between a hockey line and an automobile assembly line. However, management-science researchers say that both groups can learn something about line design and human behaviour, which may help them perform better. (Credit: iStockphoto/Joseph Gareri)

ScienceDaily (June 20, 2010) — You wouldn't think that there would be much similarity between a hockey line and an automobile assembly line. However, University of Alberta management-science researcher Ken Schultz says that both groups can learn something about line design and human behaviour, which may help them perform better.

Schultz, who recently published an article in *Management Science*, analyzed production-line data from a General Motors plant and identified that there seemed to be a shift in how fast the task was completed. What he and his fellow researchers hypothesized was that these workers, who were performing similar tasks, were positively influenced by the performance on a fellow worker who completed his task more efficiently.

Schultz found that an individual's performance level may have a direct effect on what becomes "a good day's work" in that some members may change their work behaviour to match the output of their co-worker.

Schultz ties the results of their study to the principle of equity theory, or the idea that motivation comes from fair treatment -- a good day's work for a good day's pay. "The workers may think 'we're not really connected, so I have no real reason to care about how fast you are working. But I'm a human being and I do care, and I do notice,'" said Schultz, who concluded that is possible for "people [to] change based on what they see."

Part of that change, Schultz found in his analysis of the production-line data, was that, by changing up lines to introduce a higher-performing worker to an average or lower-than-average performing line, an impact can be made on efficiency or productivity.

However, Schultz notes, simple switching people on teams will not produce the desired effect. In a plant, as in hockey, knowing which players to change up will provide the most benefit.

"You'd look for the person who's a good performer but doesn't react to others around him; that's the person you want to move to the low-level team," he said, because "there's a good chance he's going to be a person who has proven to be a leader.

Schultz also noted that the design of the workspace is equally important in influencing productivity, yet is an aspect that is ignored when designing new plants or redesigning workspaces. The key is to arrange the area so that workers are facing each other when performing their tasks, rather than facing away from each other, or in same direction. Allowing the workers to observe and monitor the speed of their co-workers is the necessary catalyst for the behavioural change to occur, he says.

"You don't have to say anything, you don't have to do anything, you don't have to put a flashing light over their head, said Schultz. "Just make sure people can see each other and allow the workers to do what they would naturally do."

Thus, whether seeking to improve productivity or build a strong contender for Lord Stanley's Cup, Schultz says that, while the environments and processes are different, being mindful of the human element and its motivational properties can produce the desired effect.

"Good coaches have seen this, and we have research that shows it's being doing in the factory floor as well," said Schultz. "You want your team to have not just good or average -- or even great players -- that can play well no matter where they are.

"To get that extra bit, you want to find the good or great players who will perform better around other great players."

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **University of Alberta**, via EurekAlert!, a service of AAAS.

Journal Reference:

1. K. L. Schultz, T. Schoenherr, D. Nembhard. **An Example and a Proposal Concerning the Correlation of Worker Processing Times in Parallel Tasks**. *Management Science*, 2009; 56 (1): 176 DOI: 10.1287/mnsc.1090.1080

http://www.sciencedaily.com/releases/2010/06/100615141749.htm

Ocean Changes May Have Dire Impact on People

Scientists reveal the growing atmospheric concentrations of man-made greenhouse gases are driving irreversible and dramatic changes to the way the ocean functions, with potentially dire impacts for hundreds of millions of people across the planet. (Credit: Image courtesy of Global Change Institute)

ScienceDaily (June 19, 2010) — The first comprehensive synthesis on the effects of climate change on the world's oceans has found they are now changing at a rate not seen for several million years.

In an article published June 18 in *Science* magazine, scientists reveal the growing atmospheric concentrations of man-made greenhouse gases are driving irreversible and dramatic changes to the way the ocean functions, with potentially dire impacts for hundreds of millions of people across the planet.

The findings of the report emerged from a synthesis of recent research on the world's oceans, carried out by two of the world's leading marine scientists, one from The University of Queensland in Australia, and one from The University of North Carolina at Chapel Hill, in the USA.

Professor Ove Hoegh-Guldberg, lead author of the report and Director of The University of Queensland's Global Change Institute, says the findings have enormous implications for mankind, particularly if the trend continues.

He said that the Earth's ocean, which produces half of the oxygen we breathe and absorbs 30% of human-generated CO_2, is equivalent to its heart and lungs. "Quite plainly, the Earth cannot do without its ocean. This study, however, shows worrying signs of ill health.

"It's as if the Earth has been smoking two packs of cigarettes a day!"

He went on to say, "We are entering a period in which the very ocean services upon which humanity depends are undergoing massive change and in some cases beginning to fail," says Prof. Hoegh-Guldberg. "Further degradation will continue to create enormous challenges and costs for societies worldwide."

He warned that we may soon see "sudden, unexpected changes that have serious ramifications for the overall well-being of humans," including the capacity of the planet to support people. "This is further evidence that we are well on the way to the next great extinction event."

The "fundamental and comprehensive" changes to marine life identified in the report include rapidly warming and acidifying oceans, changes in water circulation and expansion of dead zones within the ocean depths.

These are driving major changes in marine ecosystems: less abundant coral reefs, sea grasses and mangroves (important fish nurseries); fewer, smaller fish; a breakdown in food chains; changes in the distribution of marine life; and more frequent diseases and pests among marine organisms.

Report co-author, Dr John F. Bruno, an Associate Professor at The University of North Carolina, says greenhouse gas emissions are modifying many physical and geochemical aspects of the planet's oceans, in ways "unprecedented in nearly a million years." "This is causing fundamental and comprehensive changes to the way marine ecosystems function," Dr Bruno said.

"We are becoming increasingly certain that the world's marine ecosystems are approaching tipping points. These tipping points are where change accelerates and causes unrelated impacts on other systems, the results of which we really have no power or model to foresee."

The authors conclude: "These challenges underscore the urgency with which world leaders must act to limit further growth of greenhouse gases and thereby reduce the risk of these events occurring. Ignoring the science is not an option."

In their study, the researchers sought to address a gap in previous studies that have often overlooked the affects of climate change on marine ecosystems, due to the fact that they are complex and can be logistically difficult to study.According to leading US marine scientist, the University of Maine's School of Marine Services Professor Robert S. Steneck, the study provides a valuable indicator of the ecological risk posed by climate change, particularly to coastal regions.

"While past studies have largely focused on single global threats such as 'global warming', Hoegh-Guldberg and Bruno make a compelling case for the cumulative impacts of multiple planet-scale threats," Prof. Steneck said.

Story Source:

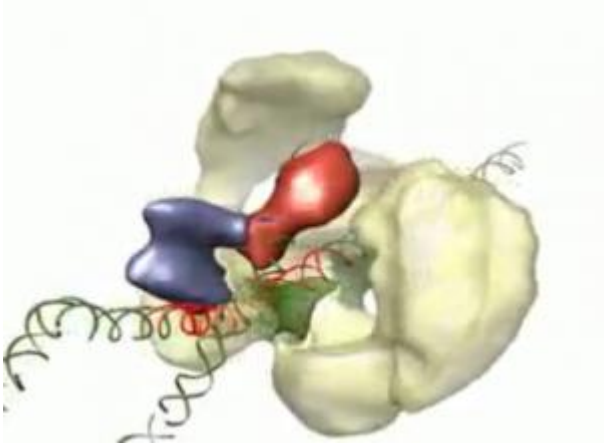
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Global Change Institute**.

Journal Reference:

1. Hoegh-Guldberg et al. **The Impact of Climate Change on the World's Marine Ecosystems**. *Science*, 2010; 328 (5985): 1523 DOI: 10.1126/science.1189930

http://www.sciencedaily.com/releases/2010/06/100618103558.htm

How DNA Is Copied Onto RNA Revealed Through Three-Dimensional Transcription Film



Gene expression takes place in two stages: the transcription of DNA to RNA by an enzyme called RNA polymerase, , followed by the translation of this RNA into proteins, whose behaviour affects the characteristics of each individual. (Credit: Image courtesy of INSERM (Institut national de la santé et de la recherche médicale))

ScienceDaily (June 19, 2010) — Gene expression takes place in two stages: the transcription of DNA to RNA by an enzyme called RNA polymerase, , followed by the translation of this RNA into proteins, whose behaviour affects the characteristics of each individual.

Transcription: a mechanism controlled in time and space

Transcription involves about fifty regulatory molecules that interact with each other to begin reading the gene at the right place and the right time. The slightest irregularity of one of these molecules disturbs the transcription. An understanding of the initiation and regulation mechanisms is essential in order to understand gene expression. The structural biology researchers at IGBMC are studying molecular structures to gain a better understanding of how they function. Patrick Schultz's team is particularly focusing on the architecture of the molecules involved in transcription and attempting to decode the mechanisms of their interactions.

An 'image-by-image' analysis

An analysis of the transcription complexes by electron cryomicroscopy allows a molecule to be observed in a hydrated state close to its natural state. Each photograph, taken using a microscope, shows thousands of specimens of the same molecule from different angles and at different instants in their reaction cycle. The statistical analysis of these images performed by Patrick Schultz's team revealed different conformations in three dimensions, which correspond to different stages of transcription initiation. 'We performed image-by-image sequencing and made a film of the initial stages of transcription,' says Schultz.

The factor TFIID, the main player in the transcription process

Patrick Schultz's team is interested in a complex protein that acts as an assembly platform in the initiation phase of transcription: the factor TFIID. Through interaction with the activator Rap1, bound upstream from

the gene to be transcribed, it is attracted to the DNA and binds onto it. Combined with another factor, TFIIA, it changes conformation and allows the RNA polymerase to initiate transcription. The original aspect of this mechanism is based on the formation of a DNA loop, which allows the RNA polymerase to be positioned exactly at the start of the sequence of the gene to be transcribed.

The structure of the transcription factor TFIID obtained after image analysis is represented in yellow on an electron cryomicroscopy image background, showing the frozen hydrated molecules in dark grey. The transcription activator Rap1 (red) interacts with the factor TFIIA (blue) and contributes to forming a DNA loop (green).

What is electron cryomicroscopy?

The biological molecules in living organisms exist in an aqueous environment, which must be preserved whilst observing the molecules. In order to be 'seen', however, molecules must be placed in an electron microscope, which operates in a vacuum and dehydrates the sample. The solution, developed in the 1980s, is to use refrigeration to keep the specimen hydrated and to examine it by electron cryomicroscopy. A very thin film (approximately 100 nm, or one ten-thousandth of a millimetre thick) of the suspension containing the sample to be analysed must be created in order to be transparent to electrons. (Thin film shown in light blue in Figure A.) This film is cooled very rapidly (at a rate of approximately 10,000°C per second) by plunging it into liquid ethane cooled to -170°C. This freezing speed prevents the formation of ice crystals, and the sample (yellow in Figure A) is trapped in a layer of vitrified water. The cold chain must be maintained throughout the observation period using a cold plate. The molecules (dark grey in Figure B) are hydrated and observed without contrast agent.

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **INSERM (Institut national de la santé et de la recherche médicale)**, via EurekAlert!, a service of AAAS.

Journal Reference:

1. Papai et al. **TFIIA and the transactivator Rap1 cooperate to commit TFIID for transcription initiation**. *Nature*, 2010; 465 (7300): 956 DOI: 10.1038/nature09080

http://www.sciencedaily.com/releases/2010/06/100617132220.htm

Converting Brownian Motion Into Work: Classical Thought Experiment Brought to Life in Granular Gas

The thought experiment is brought to life in a granular gas: the experimental setup (left) and the device in operation (right). (Credit: Image courtesy of Stichting FOM)

ScienceDaily (June 19, 2010) — Researchers from the University of Twente, the University of Patras in Greece and the Foundation for Fundamental Research on Matter (FOM) have for the first time experimentally realized, almost a century later, an idea dating from 1912. In that year the physicist Smoluchowski devised a prototype for an engine at the molecular scale in which he thought he could ingeniously convert Brownian motion into work. The team of scientists has now successfully constructed this device at the much larger scale of a granular gas.

Moreover, they have shown that an intriguing exchange takes place between the vanes of the engine and the granular gas: once the vanes have started rotating, they in turn induce a rotating motion in the gas, a so-called convection roll. This reinforces the movement of the device and allows for a virtually continuous rotation. FOM PhD student Peter Eshuis and his colleagues published their results on June 16, 2010 online in the journal *Physical Review Letters*.

Molecular motors, such as those responsible for tensing and relaxing your muscles, move in a strange manner: they propel themselves forwards despite -- or thanks to -- a continuous bombardment of the randomly moving molecules in their surroundings. This random movement is called Brownian motion, and a well-constructed motor at the nanoscale actually makes use of this to generate a directed movement (and therefore work).

The device introduced by the physicist Marian Smoluchowski in 1912, as a thought experiment, is a classical example of such a motor. It consists of a series of vanes mounted on an axis, which are set in motion under the influence of the molecular bombardment. As this motion would take place in both rotational directions, Smoluchowski devised a second element, an asymmetrical cog. This would ensure that the axis could only rotate in a single direction and could therefore perform work, for example by pulling a small weight up. However, in 1963 Richard Feynman demonstrated that the second law of thermodynamics would prevent the

device from working in a system that was in a state of thermal equilibrium, and with this, the thought experiment appeared to have been consigned to the waste bin.

Yet the objection formulated by Feynman does not apply to a system far removed from a thermal equilibrium, such as a granular gas. Researchers from the University of Twente, the University of Patras and FOM have now successfully demonstrated that Smoluchowski's thought experiment works superbly in this environment.

Brownian motion

Imagine that you are driving your car through a storm with hailstones as big as footballs. Every time that such a hailstone hits you, the impact propels you forwards, backwards or sideways, with the result that you stagger forwards across the road like a drunkard. A far-fetched example? Not on the molecular scale: there (due to the continual collisions with the surrounding molecules) all particles move in this manner, a phenomenon termed Brownian motion.

Granular gas

If a container filled with beads is vigorously vibrated on top of a shaking device, the beads move so fast that a gaseous state of rapidly moving beads arises. In many ways this state is similar to the molecular gaseous state. However, there exists one major difference with a molecular gas: when you stop shaking, the beads will lose their energy in a very short space of time and come to lie motionless on the bottom of the container. This happens because a bit of energy is lost in each collision between two beads. A constant supply of energy is therefore needed to maintain the granular gaseous state and this explains why this system remains far from thermal equilibrium.

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1. Peter Eshuis, Ko van der Weele, Detlef Lohse and Devaraj van der Meer. **Experimental Realization of a Rotational Ratchet in a Granular Gas**. *Phys. Rev. Lett.*, 104, 248001 (2010) DOI: 10.1103/PhysRevLett.104.248001

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Schrödinger's kit: Tools that are in two places at once

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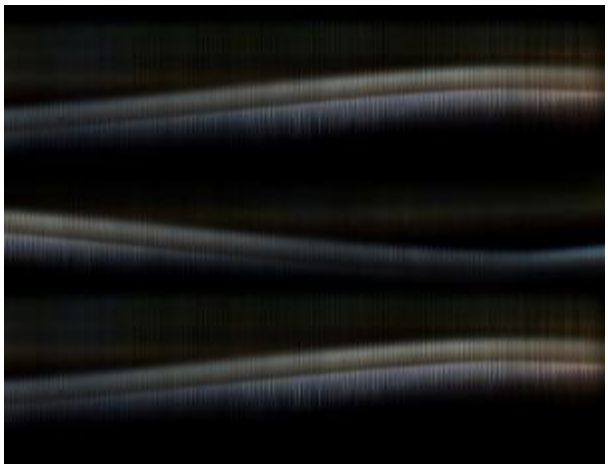

QUANTUM theory is our most successful theory of physics. There is not one shred of experimental evidence that doesn't fit with its predictions. So why, if it ain't broke, is a growing number of researchers expressing a desire to fix it?

"Everything depends on whether you believe quantum mechanics is going to go on describing the physical world perfectly to whatever level you push it," says Nobel laureate Anthony Leggett, who studies the quantum world at the University of Illinois at Urbana-Champaign.

Leggett thinks it won't, that there are too many issues with quantum theory to think it anything more than an approximation of reality. "I'm inclined to put my money on the idea that if we push quantum mechanics hard enough it will break down and something else will take over - something we can't envisage at the moment," he says.

The question is, how hard can we push it? Experiments have never had the sensitivity to pinpoint a weak spot in quantum mechanics. But thanks to a breakthrough earlier this year, that might be about to change. A new swathe of experiments is coming onto the scene that should be up to the job. Welcome to the dawn of the quantum machines.

Such machines are promising to patch a gaping hole in every experiment that has ever been used to back up our view of the quantum world. Take the simple process of measuring a photon's spin. Thanks to the strange nature of the quantum world, it can actually be spinning in two directions at once, a phenomenon known as superposition. When we use a detector to measure the spin, however, the superposition disappears and we register a spin occurring in one direction or the other.

The new breed of quantum machines promise to patch a gaping hole in every experiment ever made

Quantum theory does not explain why this happens. "We don't really understand the measurement process," admits Stephen Adler at the Institute for Advanced Study in Princeton, New Jersey.

If you want to know how little we know, ask a roomful of physicists what goes on when we measure a particle's properties. All will be able to calculate the result of the measurement, but the explanation they give will differ wildly. Some will tell you that new parallel universes necessarily sprang into being. Others will say that, before a measurement is performed, talk of particles having real properties is meaningless. Still others will say that hidden properties come into play.

Another group will tell you that they deal with physics, not philosophy, and dismiss the question without giving you an answer. It has been thus for more than 80 years. "These conceptual challenges are still not understood at all," says Markus Aspelmeyer at the University of Vienna in Austria. "We're still right at the beginning."

Experiments investigating the quantum world have traditionally focused on what are known as interferometers. Researchers fire a single quantum particle, such as a photon, towards two apertures in a screen. Common sense says the photon has to go through one aperture or the other. However, as long as you don't measure which aperture it went through, something remarkable happens.

At a screen on the far side of the twin slits, an interference pattern forms. This can only occur if the photon goes through both slits at the same time and interferes with itself. In other words, as long as nobody is watching, the photon exists in two different places at once.

A measurement changes everything, however. If you set up the experiment so you can see which slit the photon goes through, the interference pattern disappears; the photon will have gone through one slit or the other, but not both.

The situation is analogous to one of the most famous thought experiments in physics, that of Schrödinger's cat. Here, an unfortunate feline is sealed in a box with a vial of poison and a lump of radioactive metal. When the metal emits a radioactive particle, it triggers a mechanism which will break the vial, killing the cat. But because the box is sealed, there is no measurement, and the particle remains in a superposition of emitted and not emitted. According to quantum logic, the cat is therefore alive and dead at the same time.

Schrödinger came up with this bizarre scenario to show that there was something wrong with quantum theory. There's no way, he said, that something as non-quantum as a cat can be in a superposition of alive and dead - whether it is being observed or not.

Others beg to differ. Markus Arndt at the University of Vienna has demonstrated that carbon-70 molecules can go through two slits at once, too. Though these ball-shaped molecules aren't quite as substantial as cats, they can nonetheless be seen through a microscope.

Quantum tuning forks

Such interferometer experiments have been extremely useful in teaching us about what constitutes a measurement. It turns out that measurement doesn't have to be a deliberate action. Experiments have shown that if conditions allow an observer to infer which slit the photon went through - if, say, there were stray

photons in the apparatus that could bounce off the test photon and thus give away its position - the superposition will disappear. This destruction, or collapse, of the superposition is known as decoherence.

Exploring when decoherence occurs has allowed us to find out more about what makes the quantum world tick. However, there is still an enormous amount we don't know. And here we are running up against a difficult logistical problem.

Pushing at the boundary between the quantum world and that of classical physics means using ever larger molecules to see where decoherence destroys superposition. But the bigger the molecule, the harder it is to control outside forces and stop them from disrupting the molecule's delicate quantum state. For large molecules, uncontrolled decoherence effects rule, spoiling the very effect you want to measure.

This is where the quantum machines come in. At the moment, they don't look like much. The most advanced of them is little more than a sliver of aluminium about 50 micrometres in length. It functions as an oscillator, something like a quantum tuning fork. The key is its mass. Even the relatively large clusters of carbon atoms Arndt sends through his interferometer are lightweights compared with the mass that quantum machines will have (see "Mass matters"). "They operate at masses which are orders of magnitude larger than even the most massive clusters we are using," Arndt says.

This is useful because the mass of a quantum object plays an important role in several alternative explanations of how the quantum world works. For the past seven years, Dirk Bouwmeester at the University of California, Santa Barbara (UCSB), has been building a quantum machine to test an idea put forward by mathematician Roger Penrose of the University of Oxford. In 2003, Penrose suggested that gravity might cause superposition collapse. If this were so and heavy, or extremely close, objects were found to be unable to sustain being in two places at once, this could help us understand the inner workings of the quantum world and the measurement problem.

Testing such ideas, however, will require quantum machines of almost incomprehensible sensitivity. The necessary apparatus involves mirrors 10 micrometres across that weigh just a few trillionths of a kilogram. "It's a difficult experiment - it will take maybe 10 years to complete," Bouwmeester says.

His experiment calls for the mirrors themselves to be put into a superposition - in other words, in two different places at once. Verifying that, however, will mean measuring how much they are deflected by a photon that is itself in a superposition. If Bouwmeester's calculations are correct, the deflection will be less than a billionth of a millimetre.

Though Bouwmeester's machine is years away from telling us anything, another quantum machine is ready to go: the aforementioned quantum tuning fork, created by Aaron O'Connell and his colleagues at UCSB. In March they reported that they had managed to get it to rest peacefully in its ground state (*Nature*, vol 464, p 697).

This was not easy to achieve - it has taken years of painstaking work - but it means that, like an atom, the oscillator is in a state in which it will absorb energy only in distinct incremental amounts, or quanta. Its movements are so minute that adding a single quantum of energy will affect its motion or change its position. And, also like an atom, it can exist in a superposition.

Building the first quantum machine has taken years of painstaking work

O'Connell's team have managed to put their sliver of aluminium into a superposition of oscillating and not oscillating. They did this by putting the oscillator next to a tiny electric circuit that exhibits strange quantum behaviour, such as forcing current to move through it in two different directions at once. Being in the vicinity of this strange behaviour made the oscillator pick up similarly strange quantum states.

The experiment is a move towards a genuinely macroscopic case of something being in two places at once. If we can get there, it would be the mechanical analogue of a cat being alive and dead.

There is still some way to go before we are quite ready to resolve the paradox of Schrödinger's cat. Though the oscillator is large enough to see with the naked eye, the difference between its static and oscillating positions is tiny, just 10^{-16} metres. To see a meaningful deviation from standard quantum mechanics, the separations would have to be at least an order of magnitude larger - possibly a lot more, Arndt reckons.

Nevertheless, says Arndt, the breakthrough is "really stunning". He, like everyone else, is excited to see what might come of this new age of quantum machines. "The first key applications are improved tests of the foundations of quantum physics," he says.

This could be done by watching the behaviour of such oscillators under various conditions, such as different temperatures and oscillation frequency. Placing it next to different kinds of quantum circuits and using various ways of protecting it from the environment might also expose hitherto unseen quantum behaviours. Because the quantum machine is so unusually large, it is possible that it will do things that quantum theory does not predict.

O'Connell's group has not seen any deviations from the basic Schrödinger equation that describes the quantum world yet. "It seems to work just fine, from what we've seen so far," says John Martinis, who leads the team.

But these are only the first of a new wave of tests. Last year, Adler and Angelo Bassi of the University of Trieste in Italy pointed out that a quantum machine could test a proposal made by a group of physicists at Trieste more than a decade ago: that the Schrödinger equation is only an approximation of a deeper theory, and that adding a term to it that describes random noise might make it more accurate.

In this "continuous spontaneous localisation" model, the random noise is linked to the mass of the objects involved and it is this rather than the measurement process that causes the decoherence. Adler and Bassi have now shown how this could be tested - and how it might reveal something new about the universe (arxiv.org/abs/0912.2211).

What is this noise? Electromagnetic hiss? Chaotic Brownian motion of the particles? Something entirely unknown to physics? It's not clear, Adler says, but the latter possibility is the most likely if their model turns out to be right. "There could be a new cosmological field," he says. "At present it's not detectable and it's going to be very hard to detect."

The idea of a new field permeating space sounds far-fetched, but Bouwmeester reckons we shouldn't rule anything out. "We know a lot but we are far from having understood everything," he says, pointing to the surprising conclusion from astronomical observations that the universe is filled with dark energy and dark matter. "There is room for some very big surprises."

A deeper theory

And, as Adler points out, it's no more fanciful an idea than saying quantum stuff is inherently incomprehensible - that it is a matter of mysterious measurement processes or new universes forming every time a particle is detected to be doing one thing and not another. "Make the superposition collapse a real process and you don't have to explain it away through interpretations," he says.

Another test on the horizon has been devised by Charles Wang and his colleagues at Aberdeen University in the UK. This quantum machine is not a microfabricated piece of aluminium, but a gas of super-chilled atoms designed to check whether the quantum uncertainty principle is responsible for the collapse of superpositions.

First formulated by Austrian physicist Werner Heisenberg, the uncertainty principle says that empty space is fizzing with particles that pop in and out of existence due to uncertainties in the energy of the vacuum. In 2000, Ian Percival of Queen Mary, University of London, suggested that these ghostly entities could affect the way subatomic particles form superpositions and interact with each other.

Wang and colleagues plan to test this theory. They propose that the energy inherent in empty space will affect in a particular manner the movements of an ultra-cold gas of atoms, called a Bose-Einstein condensate (arxiv.org/abs/1002.2962). The result of Wang's experiment - which he hopes to carry out in the near future - might reveal a previously unconsidered influence on the quantum world.

Any, or none, of the schemes could change the way we view the quantum world and the way we interact with it. If mass and gravity turn out to be affecting quantum behaviour, that might tell us something about the elusive theory of quantum gravity that physicists are trying so hard to create. Penrose reckons we will eventually be forced to combine Schrödinger's equation describing quantum particles, an understanding of the measurement process, and the principles of Einstein's theory of gravity into one theory, and that each of these three aspects of reality will then be seen as nothing more than an approximation to a deeper fundamental truth.

Bouwmeester is excited that, while all eyes are on the high-energy potential of the Large Hadron Collider at CERN, near Geneva, Switzerland, the quantum machines might tell us something more fundamental about the universe. "Most theorists would probably not expect big things to come out of the type of experiments we are doing," he says. "They probably think we have to go to huge energies to resolve such fundamental issues."

Though the road ahead looks to be a bumpy one, everyone is excited about quantum machines opening up a new vista. It's a chance to probe the quantum world with a "new and unexplored regime", Aspelmeyer says. "This is really testing quantum physics in its extremes."

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