Infoteca's E-Journal

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UA de C Universidad Comprometida

CONTENTS

First in Man SESAME Stent Trial Demonstrates 100% Acute Success Rate

Wiley - Blackwell

Low 30-Day MACE Rate and 9-Month Patency Comparable to Balloon Expandable Stents

A new study revealed that the novel self-expanding super-elastic all-metal endoprosthesis stent (SESAME Stent™) used in patients undergoing angioplasty of degenerated saphenous vein graft (SVG) lesions has 100% acute success, low 30 day major adverse cardiac events (MACE) rates, and 9-month patency comparable to balloon expandable stents without embolic protection. Results of the study are published in the November issue of *Catheterization and Cardiovascular Intervention*, a peer-reviewed journal from The Society for Cardiovascular Angiography and Interventions.

Percutaneous coronary intervention (PCI), or angioplasty, is a procedure to alleviate plaque buildup due to atherosclerosis. A thin catheter containing a small balloon is inserted into an artery and threaded toward the heart to the blockage. The balloon is then inflated to push back the plaque and restore blood flow to the heart, and a wire mesh tube called a stent is usually put in place to prevent re-blocking.

PCI of old, degenerated saphenous vein grafts (SVGs) is a challenging and risky procedure. Diseased SVGs are complicated, thrombotic lesions associated with a higher risk of plaque and thrombus embolization, making the placement of embolic distal protection devices during PCI difficult. Up to half of patients with SVGs receiving bare metal stents have restenosis or occlusion within 6–12 months following stent implantation. There are no self-expanding stents specifically used to treat SVG disease. Prior adjunctive therapies such as antiplatelet agents and covered stents have not been effective in improving procedural outcomes of SVG PCI.

The Advanced Bioprosthetic Surfaces™ SESAME stent offers a system that limits plaque protrusion through the stent struts and limits stent strut migration into the underlying plaque. The microporous mesh of the SESAME stent is an improvement over the polymer covers used in other stents for SVG implantation because it allows improved vascular healing and tissue regrowth over the sent (endothelialization). Biocompatibility studies indicate metals are advantageous over polymers, suggesting that a metal membrane should be a good choice for a covered-stent.

The SESAME First in Man trial is a prospective, multicenter registry of 20 nonrandomized consecutive patients with 21 stenotic SVGs treated electively at two centers between February 2005 and August 2005. Patients underwent elective intervention of symptomatic SVG lesions with 50% stenosis. PCI was performed without embolic protection devices.

“The SESAME trial is the first study to prospectively demonstrate that a self-expanding microporous membrane-covered stent can be safely used with a high success rate in treating complex SVG lesions even in the absence of embolic protection devices,” comments study leader Steven R. Bailey, MD, FSCAI, from the University of Texas Health Sciences Center in San Antonio. Technical success—successful crossing of the lesion and deployment of the device—was achieved in 100% of lesions using the SESAME stent. A 100% procedural success rate, defined as a residual stenosis of less than 50% stenosis post stent and no MACE, was also achieved.

No procedural or in hospital complications occurred. Follow-up was present in 20 patients at 30 days, with clinical and angiographic evaluation at 9 months. No MACE events occurred at 30 days. At 9 months, 3 patients underwent repeat PCI. Dr. Bailey concluded, “Even in severely degenerate SVG lesions,

interventionists can safely achieve a high primary success rate with low MACE during the initial 30 days following the procedure."

For more information, please visit:

http://onlinelibrary.wiley.com/journal/10.1002/(ISSN)1522-726X..

http://www.alphagalileo.org/ViewItem.aspx?ItemId=89843&CultureCode=en

Dressing indicates infections

Fraunhofer-Gesellschaft

Wounds have to be regularly checked, to make sure any complications in the healing process are detected at an early stage. A new material will make it possible to check wounds without changing the dressing: If an infection arises, the material changes its color.

Whether a small cut with a fruit knife, a surgical wound or a major injury caused by a fall – the body's defense and repair system leaps into action and tries to close the wound as quickly as possible. Small injuries usually heal within a few days, but a gaping wound will take longer to heal, and an infection can take hold even after several days. Dressings protect the site of the injury but to check the wound they have to be removed. This can be painful for the patient and moreover it risks giving germs the chance to enter and cause infection. Scientists at the Fraunhofer Research Institution for Modular Solid State Technologies EMFT in Munich have developed dressing materials and plasters which indicate pathological changes in the skin. If an infection is present, the color of the dressing changes from yellow to purple.

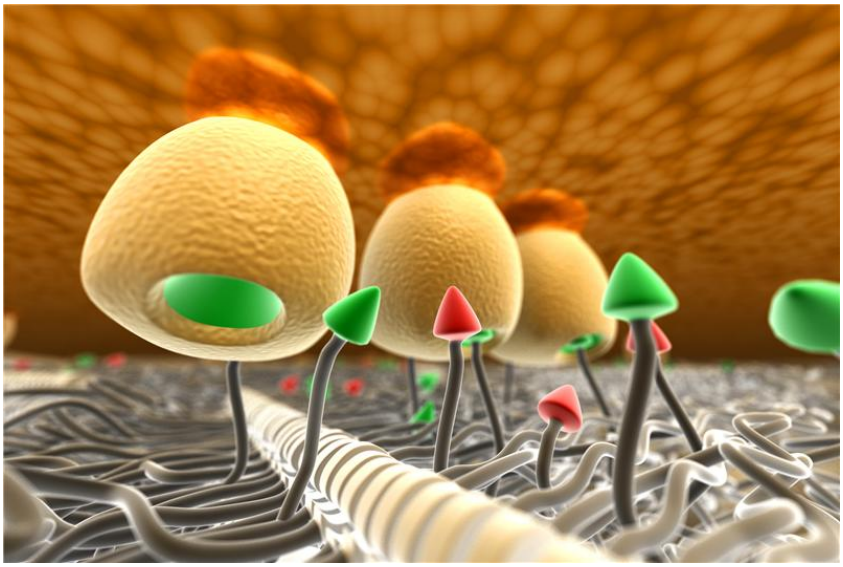
"We have developed an indicator dye which reacts to different pH values, and we have integrated it into a dressing and a plaster. Healthy skin and healed wounds usually show a pH value of below 5. If this value increases, it is shifting from the acid to the alkaline range, which indicates complications in the healing of the wound. If the pH value is between 6.5 und 8.5 an infection is frequently present and the indicator color strip turns purple," states Dr. Sabine Trupp, scientist at the EMFT, explaining the chemical reaction. In this way the intelligent dressing material makes it possible to regularly check wounds from the outside without disrupting the healing process.

Production of the color control strip posed a number of challenges for the research scientists as it had to meet several different requirements: “The dye has to remain chemically stable when bonded to the fibers of the dressing material or the plaster to ensure that it does not get into the wound. At the same time, the indicator must show a clear change in color and also react sensitively in the right pH range,” says Trupp. The experts succeeded in meeting all these requirements. A prototype of the dressing has already been produced and initial tests have proved successful. The researchers are now thinking about how to develop their innovation further. There are plans to integrate optical sensor modules into the dressing to measure the pH value and indicate the results on a reader unit. This method would allow the value to be read off precisely, providing information about how the wound is healing.

How do we go from here? The next step will be to use the dressing in a hospital environment at the University of Regensburg’s dermatology clinic. Dr. med. Philipp Babilas will be medical supervisor to the project: “Our studies of the pH value in acute as well as in chronic wounds have shown that it plays a key role in wound healing.” At present Dr. Trupp and her team are looking for an industrial partner to produce the dressing commercially.

http://www.alphagalileo.org/ViewItem.aspx?ItemId=89837&CultureCode=en

Cultured kidney cell layer is a step towards improved dialysis



Eindhoven University of Technology

Scientists succeed in growing functional kidney cells thanks to smart bioactive membrane

Researchers at Eindhoven University of Technology (TU/e) and the University Medical Center Groningen have succeeded in culturing a layer of kidney cells in the lab. These cells maintained their functional properties, and are able to purify blood. The key to this success is a new kind of bioactive synthetic membrane developed at TU/e with a structure resembling that of human basement membrane in the kidney. This is a step towards improved kidney dialysis. The ultimate aim of the scientists is to be able to grow whole biological artificial kidneys using autologous cells.

Kidney function is vitally important; for example the kidneys filter toxic metabolic waste products from the blood. Many people suffer from kidney failure, and more than 6000 people in the Netherlands (and over 350.000 in the United States) require artificial blood cleansing by kidney dialysis. Unfortunately this technique is not yet perfect: its purifying capacity is only 15 to 20% of that of healthy kidneys. Scientists are therefore looking for ways to restore kidney function using cultured kidney cells.

Nanofibers
Dr. Patricia Dankers, who has a central role in this research, explains that there are two essential characteristics of the synthetic membranes on which she cultures the kidney cells: their structure and their bioactivity. Structurally the membranes consist of nanofibers that are part of larger, micrometer-size fibers. This structure resembles that of a human kidney membrane. The kidney cells grow on this fibrous membrane, but cease to function after several days. Dankers was only able to maintain the cell function by adding bioactive signals to the synthetic membrane.

Signals
These signals enable the kidney cells to adhere and survive, and ensure that they continue to function. Dankers was able to achieve this by supramolecular attachment of bioactive peptides (small pieces of protein)

to the synthetic membranes. To do this Dankers used a kind of 'Velcro' binding, also relatively recently developed at TU/e. This allows the bioactive groups to be coupled to the membrane without the complex processes that were formerly needed.

Better dialysis

The researchers now intend to work on a biological artificial kidney to supplement the existing dialysis systems. This will increase the quality of dialysis treatment, because the kidney cells are able to filter exactly the right substances out of the blood. Dankers also hopes that the kidney cells will, in the longer term, produce hormones made by normal kidneys. These are important in making red blood cells, for example. However she is unable to say how long it may take to reach this stage. "It's difficult to predict, and we don't want to create unrealistic expectations."

After that the next step will be to develop a mobile dialysis system, so that kidney patients do not repeatedly have to visit hospitals. "Our ultimate dream is to make an implantable, living artificial kidney", says Dankers.

An animation movie on YouTube from the animation studio of ICMS (Institute for Complex Molecular Systems) shows the most important processes in this research:

http://bit.ly/cua2yT

http://www.alphagalileo.org/ViewItem.aspx?ItemId=89834&CultureCode=en

Research into the scientific potential of time of flight cameras

Universidad Carlos III de Madrid - Oficina de Información Científica

Researchers from the Group of Applied Artificial Intelligence (GIAA) on the Colmenarejo Campus of UC3M have presented this application at the latest *Salón Internacional de Material Eléctrico y Electrónico,* recently held in Madrid. The participants at the stand of Infaimon, the company which has collaborated on this project, had the opportunity to test this interface with a videogame operated simply by moving ones hands as if holding a virtual steering wheel. For this purpose, the scientists have employed a time of flight camera or TOF with which they capture in 3D user's movements to later transmit them to a computer, which then processes and transmits them to the game's car. "The most complicated part was determining the camera's characteristics to be able to optimize movement and its integration with many different applications", noted one of the GIAA researchers from UC3M, Daniel Sánchez, who has carried out his final degree project within the framework of this research study.

The great advantage of this type of camera is that it offers three-dimensional information without having to resort to the classic stereoscope systems of two lenses. "These new sensors offer in-depth information, which is of great interest when working with artificial vision systems", remarked Miguel Ángel Patricio, who coordinates this research from the Department of Informatics at UC3M. The functioning of the TOF camera is relatively simple: an infrared ring gives off a light that bounces off the body, which is then recorded and returns to the sensor. According to the time this process takes, the distance between these objects can be calculated. "Our idea", Patricio points out, "is to be able to apply this sensor to different problems on which we are currently working, such as video surveillance systems, biometric face identification, analysis of player movement in sports performance, and man-machine interfaces", he concluded.

Mutliple applications

These researchers, who work on the UC3M Campus of Colmenarejo, are now focusing their efforts on analyzing information that is obtained using this type of sensors. "I am convinced that their use will revolutionize artificial vision systems in the future, because the data obtained are much richer than that obtained through other types of traditional sensors", asserted the professor, who pointed out that we only have to wait until the economy of the market lowers their price, as they now cost close to 6,000 euros per unit.

The current challenge facing these scientists is applying this camera's potential in certain fields. In medicine, for example with this type of sensors an automatic rehabilitation system can be created which can guide patients in doing their exercises without having to leave their home. These researchers also collaborate with INEF (Spain's National Sport Institute) in the development of criteria for the analysis of childhood obesity through the TOF sensor, which up to now has been done with laser. And the applications likewise reach into the area of what is referred to as "affective computing" through the design of HCI (Human-Computer Interface) applications which attempt to examine a person's mood through the application of algorithms that analyze information provided by these three-dimensional cameras.

http://www.uc3m.es/portal/page/portal/actualidad_cientifica/noticias/flight_cam

http://www.alphagalileo.org/ViewItem.aspx?ItemId=89828&CultureCode=en

Disease tracking - is there an app for that?

martes, 16 de noviembre de 2010 Inderscience

British scientists are hoping to use the "location", or geo, information that is increasingly a part of mobile internet and phone usage, to track the spread of infectious diseases and so provide important clues about how quickly a pandemic might occur and also provide data with which epidemiologists can work. They provide details in the current issue of the International Journal of Healthcare Technology and Management.

William John Knottenbelt of Imperial College London and colleagues there and at Edinburgh Napier University, explain that the precision of location tracking technology, such as that used by GPS, global positioning system, has improved greatly over the last few decades. They have now demonstrated that by tracking the locations of individuals in a closed environment, it is possible to record the nature and frequency of interactions between them. This information could be used to predict the way in which an infection will spread throughout such a population, given parameters such as transmission and recovery rates.

From the launch of GPS system in 1978, through wireless technologies such as Wi-Fi and Bluetooth, to mobile phone network assisted GPS and radio frequency identification tags (RFID tags), and ultrawideband the accuracy of real-time location tracking has increased to better than 10 metres and beyond. Location tracking systems are already being used to keep tabs on at-risk patients, who need constant monitoring to protect their safety and to monitor the whereabouts of employees working in extreme or dangerous environments.

As such the team has developed a software package that can record and playback location data with high-precision. The software then uses SIR modelling (S (for susceptible), I (for infectious) and R (for recovered)) and the epidemiological technique of contact tracing in order to predict the spread of a disease through a network of people.

Many diseases are transmitted through intimate personal and sexual contact, others through simply being in the same space as someone space as someone carrying an airborne infection. Sexually transmitted infections (STIs) are relatively easy to track and to trace partners who may have subsequently been infected but until recently its has been almost impossible to study the route an airborne infection might take from nose to hand to door handle to hand to another nose, for instance. With location-based services in handheld devices such as smart phones it is now possible to track the path of an infected person and their contacts with one metre accuracy.

The team points out that such a system would give emergency health providers a way to prioritise those who may have come into contact with an individual exposed to a serious illness, such as influenza or a currently unknown emergent disease. During an outbreak, information about contact between individuals could be used to produce a list ordered by probability for all people in a given location depending on contact with known cases of infection. Another application might be to trace the origin of an infection in a close environment, such as a hospital."As a proof of concept, the combination of the high precision location tracking hardware and the software that we have designed is a success. Our experiments show that, in a test environment at least, the hardware is capable of producing location readings that are sufficiently accurate to monitor the movement of individuals, to the extent that a contact tracing study that provides meaningful results can be performed," the team concludes.

http://www.alphagalileo.org/ViewItem.aspx?ItemId=89819&CultureCode=en

Risø Energy Report 9: CO2-free energy can meet the world's energy needs in 2050

Risø National Laboratory for Sustainable Energy

Taken as a whole, energy sources with low or no carbon emissions could easily cover the global energy supply in 2050. This is the main conclusion of Risø Energy Report 9. The challenge for a sustainable global energy system with low carbon emissions will be to use this potential in the energy system the best way possible seen from an economic point of view.

Risø Energy Report 9 lists a wide range of energy technologies in the market with low or no emissions of greenhouse gases, describing how several of these will be made commercially available in the next decades.

However, it is not possible to make the world's energy supply CO2-free as cheaply as possible, using only technology development in the current energy systems. There must be room for technological leaps and there is a need for an integrated process to optimise the entire energy system, from energy production, through transformation into energy carriers, to energy transportation and distribution and efficient end use.

There is also a need for a smart grid, connecting production and end use at local level. End users should contribute to maintain balance in the future energy system and new technologies should be introduced to the end users, including houses with low and flexible consumption, smart electronic equipment, heat pumps, energy storage and local energy supplies such as solar cells and micro CHP. Information and communication technology (ICT) will determine how successful the integration of renewables into the grid actually will be.

Considering the security of supply in the short and long term, there is still a need for access to fossil fuels, but they must be continuously replaced with renewable energy sources. If we do not make efforts to promote renewable energy sources, coal and gas might easily be prevailing in the global energy supply for the rest of this century. For many countries, however, it could be advantageous to switch to renewable energy sources in order to reduce dependence on imported oil and gas. In addition, this transition can help the countries achieve their environmental policy goals.

Seen in isolation, Denmark has a great chance for achieving these goals and for phasing out fossil fuels at a rapid pace and thus reduce emissions of greenhouse gases at the required pace.

Danish wind and biomass resources in particular will make it possible to phase out fossil fuels in connection with power generation and heat production before 2040. It will take further 10 years to eliminate fossil fuels within the transport sector.

A future smart energy system requires that we start investments now. If we do not make these investments, future generations will look back on this period wondering how we could be satisfied with an outdated energy system, without taking advantage of the opportunities which we already were aware of.

http://www.risoe.dtu.dk/News_archives/News/2010/1110_Riso_Energy_Report_9.aspx?sc_lang=en

http://www.alphagalileo.org/ViewItem.aspx?ItemId=89792&CultureCode=en

Researchers map the way to personalised treatment for ovarian cancer

The European CanCer Organisation (ECCO)

Researchers have shown that point mutations – mis-spellings in a single letter of genetic code – that drive the onset and growth of cancer cells can be detected successfully in advanced ovarian cancer using a technique called OncoMap. The finding opens the way for personalised medicine in which every patient could have their tumour screened, specific mutations identified, and the appropriate drug chosen to target the mutation and halt the growth of their cancer.

Using mass spectrometry for identifying the genetic make-up of cancer cells, OncoMap can determine the point mutations in a large panel of over 100 known cancer-causing genes (oncogenes) in tumours. In the work to be presented today (Wednesday) at the 22nd EORTC-NCI-AACR [1] Symposium on Molecular Targets and Cancer Therapeutics in Berlin, researchers will describe how they used OncoMap to identify mutations in oncogenes in tumour samples from women with advanced high-grade serous ovarian cancer. Earlier in the year 76 mutations in 26 different genes had been found but, since then, further work in more tumour samples has found more.

Dr Ursula Matulonis, director/program leader in medical gynaecologic oncology at the Dana Farber Cancer Institute in Boston (Massachusetts, USA) and Associate Professor of Medicine at Harvard Medical School, will tell the meeting: “Epithelial ovarian cancer is the most lethal of all the gynaecologic malignancies, and new treatments are needed for both newly diagnosed patients as well as patients with recurrent cancer. The success of conventional chemotherapy has reached a plateau, and new means of characterising ovarian cancer so that treatment can be personalised are needed.

“We know that many human cancers have point mutations in certain oncogenes, and that these mutations can cause cancer cells to have a dependence on just one overactive gene or signalling pathway for the cancer cell’s growth and survival – a phenomenon known as ‘oncogene addiction’. If the mutation that causes the oncogene addiction can be inhibited, then it seems that this often halts the cancer process. Examples of mutations that are successfully inhibited by targeted drugs are HER2 (for which trastuzumab is used in breast cancer), EGFR (erlotinib in lung cancer) and c-kit (imatinib in chronic myeloid leukaemia). So if we know the status of specific genes in a tumour, then this enables us to choose specific treatments that are likely to work successfully against the cancer.”

Dr Matulonis and her colleagues used OncoMap to investigate the mutation status of high-grade serous ovarian tumours that were known not to be caused by inherited mutations in the BRCA 1/2 genes. They found mutations previously identified to be involved in ovarian cancer: KRAS, BRAF, CTNNB1 and PIK3CA. The KRAS and PIK3CA mutations were the most common, while BRAF was more rare. The researchers also identified a low frequency of mutations in many other different oncogenes.

“This study shows that it’s feasible to use OncoMap to identify whether a patient's tumour has a mutation in an oncogene for which a known drug is available to target that specific gene, so as to enable us to place her on a clinical study of that drug; for instance, XL147 or GDC0941 are inhibitors for the P13kinase mutation that are in clinical trials at present,” said Dr Matulonis. “In addition, someone's cancer could harbour a mutation (such as *ALK*) that is not known to be associated with ovarian cancer or has not yet been studied in ovarian cancer – these patients could be matched with a drug that inhibits that protein too. As new drugs get developed, this information would be used to match future drugs with patients and their cancers.”

The researchers hope that OncoMap will become a clinical test for all cancer patients at the Dana Farber Cancer Institute before long, so that the genetic information obtained can be used to choose the best treatment for them.

"At present, only a few targeted therapies are being used for newly diagnosed ovarian cancer and most are being used to treat recurrent ovarian cancer, but this will change eventually. I have already referred several of our patients who are either newly diagnosed or have recurrent cancer and who have mutations (one with *KRAS* and one with *PIK3CA*) to our phase I programme for drugs studies specific to these mutations," said Dr Matulonis.

She believes that OncoMap and other similar analytical tools will become mainstream practice in all cancer clinics before long. Tools for detecting genes with the incorrect numbers of copies or abnormal expression will also help doctors to choose the best treatment for individual patients.

"For ovarian cancer, understanding mutational analysis is one piece of the genetic puzzle. Our group will also start looking for chromosomal and gene amplifications and deletions in patients' tumours, which we know are important for ovarian cancer."

Abstract no: 35. Oral presentation in plenary session 2, Rooms A-C, 14.45-16.15 hrs CET, Wednesday 17 November.

Notes:

[1] EORTC [European Organisation for Research and Treatment of Cancer, NCI [National Cancer Institute], AACR [American Association for Cancer Research].

[2] The study was funded by the Madeline Franchi Ovarian Cancer Research Fund, twoAM Fund and the Sally Cooke Ovarian Cancer Research Fund.

http://www.alphagalileo.org/ViewItem.aspx?ItemId=89804&CultureCode=en

Smoke from fireworks is harmful to health

Plataforma SINC

The metallic particles in the smoke emitted by fireworks pose a health risk, particularly to people who suffer from asthma. This is the conclusion of a study led by researchers from the Institute of Environmental Assessment and Water Research (IDAEA-CSIC), published this week in the Journal of Hazardous Materials.

"The toxicological research has shown that many of the metallic particles in the smoke from fireworks are bio-reactive and can affect human health", Teresa Moreno, a researcher from the IDAEA (CSIC) and lead author of a study that has been published this week in the Journal of Hazardous Materials, tells SINC.

The different colours and effects produced in these displays are achieved by adding metals to the gunpowder. When a pyrotechnic display takes place it releases a lot of smoke, liberating minute metallic particles (of a few microns in size, or even less), which are small enough to be inhaled deeply into the lungs.

"This poses a risk to health, and the effects are probably more acute in people with a background of asthma or cardiovascular problems", Moreno explains. "The effects in healthy people are still unknown, but common sense tells us it cannot be good to inhale the high levels of metallic particles in this smoke, even if this only happens a few times a year".

The study focused on the San Juan fiestas (the night of 23 June through to 24 June, 2008) in the Spanish city of Girona. The researchers analysed the levels of more than 30 chemical elements and compounds in May and June in order to confirm that the levels of lead, copper, strontium, potassium and magnesium skyrocketed after the fireworks were launched.

The team found the results were similar in other towns too. During the Mascletà (18 March), for example, in the Las Fallas fiestas in Valencia, levels of these elements rose once again, as well as others such as aluminium, titanium, barium and antimony, and also concentrations of nitric oxide (NO) and sulphur dioxide (SO2).

Other studies have confirmed that the smoke from fireworks increases the presence of metallic particles in the skies over L'Alcora and Borriana (Castellón), Barcelona and even London (United Kingdom) during the Guy Fawkes' Night celebrations.

"People who live in cities already inhale significant amounts of contaminant particles stemming from traffic emissions, chimneys and cigarettes, and the dense smoke caused by fireworks only worsens this situation", points out Moreno.

Possible solutions

The researcher compares the problem with that of tobacco. "The less you expose yourself to the smoke, the fewer negative effects it will have on your health, and so the best solution is to avoid inhaling it".

According to the scientists, in the absence of a ban on fireworks, spectators should stay well back in a place not affected by the smoke and pay attention to the wind direction. They also recommend that fireworks displays should be sited in a place that ensures the plume of smoke will blow away from densely populated areas.

An added problem is the chemical mixtures in the different kinds of fireworks, since some contain extremely toxic metals such as lead. "There should be strict controls on fireworks imports so that those with the potentially most dangerous chemical composition can be avoided", concludes Moreno.

http://www.plataformasinc.es/esl/Noticias/El-humo-de-los-fuegos-artificiales-perjudica-la-salud

http://www.alphagalileo.org/ViewItem.aspx?ItemId=89813&CultureCode=en

Scientists identify potential new target for treating triple negative breast cancer

The European CanCer Organisation (ECCO)

Scientists believe they may have found a new target for treating triple negative breast cancer – one of the more difficult breast cancers to treat successfully and for which there is no targeted therapy at present.

Triple negative breast cancer (TNBC) is a cancer that does not express receptors for oestrogen (ER), progesterone (PR) or the human epidermal growth factor (HER2). It tends to be more aggressive, occurs more often in younger women, and is difficult to treat successfully as it lacks the receptors that currently available targeted therapies such as tamoxifen and trastuzumab (Herceptin) can home in on. Surgery, followed by chemotherapy, is the usual treatment.

Now researchers in Dublin (Ireland) have found that TNBC cells respond to compounds that disrupt the signalling processes of another receptor, EGFR (epidermal growth factor receptor), high levels of which are expressed in TNBC. In a presentation to the 22nd EORTC-NCI-AACR [1] Symposium on Molecular Targets and Cancer Therapeutics in Berlin today (Wednesday), Dr Patricia McGowan, a senior postdoctoral scientist at University College Dublin, said the compounds had reduced the growth of TNBC cells in the laboratory by up to 91%.

“As these cancers possess high levels of EGFR, we thought that they may be dependent on EGFR signalling,” she said. “ADAMs (a disintegrin and metalloprotease) are enzymes that are involved in the activation of EGFR binding-proteins (i.e. ligands) during the signalling process, and so we thought that inhibiting them might be a potential therapeutic option for TNBC, either alone or in combination with drugs that target EGFR, such as gefitinib.”

Dr McGowan and her colleagues tested gefitinib and a compound that specifically inhibits ADAM17 on breast cancer cell lines. The compound, known as TMI-002 (Pfizer), was similar to gefitinib in its ability to inhibit the growth of cancer cells. Gefitinib is not used in breast cancer treatment at present, but the researchers tested it to see whether inhibiting ADAM and EGFR simultaneously would work synergistically. “We did not observe any additional benefit when we combined the ADAM inhibitor with gefitinib; however, adding gefitinib 72 hours after ADAM inhibitor treatment was more effective than adding both inhibitors simultaneously, although this did not reach statistical significance.”

In addition, another, as yet un-named compound that blocks both ADAM10 and ADAM17 resulted in significant effect on a range of TNBC cell lines. “We found that it reduced the growth of these cells by up to 91%,” she said. “We have also found that treatment of TNBC cells with this compound reduced their ability to migrate, a process that is vital for the progression of cancer.

“Triple negative breast cancers comprise 10-20% of all breast cancer cases. Women with TNBC tend to present with higher grade, larger tumours, are younger at diagnosis, have a higher incidence of metastases and have a shorter time to recurrence compared to other breast cancer types. One reason for the poor prognosis for this group is the lack of targeted therapies for these women. Having found that an ADAM inhibitor can reduce the proliferation of TNBC cell lines, we hope that ADAMs may be a useful therapeutic target.”

The scientists hope that inhibiting ADAMs might also be a possible treatment for other cancers in which members of the EGFR ‘family’ are active. In addition to EGFR, the ‘family’ consists of HER2, HER3 and HER4, and these are implicated in a number of cancers such as lung, colorectal, head and neck, and pancreatic cancers.

"Theoretically, inhibiting ADAMs should block downstream signalling from all four EGFR family members and thus potentially reduce cancer progression. We are excited that we have seen an effect in this particularly aggressive subgroup of breast cancers but propose that we will see an effect in other cancer settings also," said Dr McGowan.

"We hope to expand our investigation of these compounds using a larger panel of cell lines, moving into animal models, and eventually into clinical trials."

Abstract no: 129. Poster on Wednesday 17 November in the Exhibition Hall (ground level) from 08.00/09.00 hrs to 18.00 hrs CET.

Notes:

[1] EORTC [European Organisation for Research and Treatment of Cancer, NCI [National Cancer Institute], AACR [American Association for Cancer Research].

[2] This work was funded by Science Foundation Ireland, Strategic Research Cluster Award (08/SRC/B1410) to Molecular Therapeutics for Cancer Ireland.

http://www.alphagalileo.org/ViewItem.aspx?ItemId=89807&CultureCode=en

A new search engine links biomedical articles to nucleic acid sequences

Facultad de Informática de la Universidad Politécnica de Madrid

Researchers from the Universidad Politécnica de Madrid's Biomedical Informatics Group based at the Facultad de Informática have created a tool called PubDNA Finder. This tool is the first search engine specialized in linking biomedical articles to nucleic acid sequences.

PubDNA Finder is an *on line* repository created to link documents archived at PubMed Central with the nucleic acid sequences that they contain. PubMed Central is a free digital archive maintained by the United States National Institutes of Health. Developed and administered by the National Center for Biotechnology Information (NCBI), it contains the principal documentation related to biomedicine and the life sciences published in scientific journals all over the world.

PubDNA Finder extends the capabilities of the search engine provided by PubMed Central, enabling biomedical researchers to run advanced searches on nucleic acid sequences. One of its features is to search documents that cite one or more specific nucleic acid sequences and retrieve the genetic sequences appearing in different articles.

These additional consultation facilities are provided by a search index created by archiving all 176,672 documents available at PubMed Central and the nucleic acids that they contain.

The researchers used an original method to automatically extract the genetic sequences returned by each search: an innovative system combining combines natural language processing, text mining and knowledge engineering runs unsupervised searches to retrieve genetic sequences.

The database is automatically updated every month by means of a FTP connection to the PubMed Central site to retrieve the manuscripts and new indexes. Users can query the database over the Web.

The research team that has developed this tool is led by the Facultad de Informática faculty member Miguel García-Remesal. García-Remesal is also a member of the Biomedical Informatics Group led by Prof. Víctor Maojo.

http://www.fi.upm.es/?id=tablon&acciongt=consulta1&idet=663

http://www.alphagalileo.org/ViewItem.aspx?ItemId=89795&CultureCode=en

Need for transparency on the Web

Southampton, University of

The need for more transparency in Web-based information systems has been highlighted by an academic at the University of Southampton's School of Electronics and Computer Science.

In a paper entitled *The Foundations for Provenance on the Web*, which is published in the journal, *Foundations and Trends in Web Science*, Professor Luc Moreau points out that due to the complex flows of information on the Web, it is not always clear where information originates from.

"This is a challenge since we want to be able to establish the exact source of information, we want to decide whether information has been altered, and by whom, we want to corroborate and possibly reproduce such information, and ultimately we want to decide whether the information comes from a trustworthy source," said Professor Moreau.

According to Professor Moreau, the solution lies in 'provenance', a term used in diverse areas such as art, archaeology and palaeontology, which describes the history of an object since its creation. Its main focus is to establish that the object has not been forged or altered, and the same can be done with computer-generated data.

"Understanding where data comes from will enable users to decide if it's trustworthy. This will also lead to a new generation of services over the Web, capable of producing trusted information," Professor Moreau added.

In his paper, Professor Moreau reviews several approaches that adopt provenance, allowing their actions and information flows to be audited, and their compliance or violation to rules and policies to be determined. These strong capabilities - information transparency, auditing capabilities and compliance detection - provide users with the means to decide whether they can trust systems and information.

"A powerful argument for provenance is that it can help make systems transparent," said Professor Moreau. "Our aim, with the community of researchers, is to establish a standard method to ascertain the provenance of information on the Web."

A copy of the paper: Luc Moreau (2010) *The Foundations for Provenance on the Web*, Foundations and Trends® in Web Science: Vol. 2: No 2-3, pp 99-241 can be accessed at:
http://eprints.ecs.soton.ac.uk/21691/

http://eprints.ecs.soton.ac.uk/21691/

http://www.alphagalileo.org/ViewItem.aspx?ItemId=89786&CultureCode=en
0047

Size of hippocampus may indicate early dementia

University of Gothenburg

The size of the part of the brain known as the hippocampus may be linked to future dementia, reveals a thesis from the University of Gothenburg, Sweden.Mild cognitive impairment, or MCI, is a condition where the cognitive functions are impaired – though not as severely as in dementia – and is a precursor to several types of dementia.

"One of the challenges for the healthcare is identifying which MCI patients have an underlying dementia disorder, which is why we need new tools to detect the early signs of dementia," says Carl Eckerström, a researcher at the Sahlgrenska Academy's Department of Psychiatry and Neurochemistry, and doctor at Sahlgrenska University Hospital's memory clinic.

Atrophy of the hippocampus is common in Alzheimer's disease. The thesis shows that the hippocampus may also be affected in small vessel disease (SIVD) which, along with Alzheimer's, are the two most common types of dementia. SIVD is characterised by damage to the brain's white matter and is considered to be the most important type of vascular dementia in the elderly.Researchers measured the extent of changes to white matter in 122 MCI patients, and compared this with the size of their hippocampus. The patients were divided into two categories – one group who subsequently developed dementia after two years, and a second group whose clinical status remained unchanged after two years. There was also a group of healthy controls. The results showed that there may be a link between damage to the white matter and a reduction in the size of the hippocampus, which means that damage to the white matter could play a part in a process that leads to hippocampal atrophy."I believe that measuring the hippocampus could be a useful clinical instrument for investigating whether a person is in the early stages of dementia, as our findings suggest that the size of the hippocampus is linked to a deterioration in cognitive function and dementia," says Eckerström.

THE HIPPOCAMPUS

The hippocampus is part of the limbic system and is located deep in the temporal lobe. It is vital for our ability to learn and is known as the brain's memory centre. The hippocampus also helps with spatial awareness, enabling us to navigate our way around new places.

For more information, please contact:

Carl Eckerström, researcher at the Sahlgrenska Academy's Department of Psychiatry and Neurochemistry, and doctor at Sahlgrenska University Hospital's memory clinic, mobile: +46 (0)7 0440 0725, e-mail: Carl.eckerstrom@neuro.gu.se

Title of thesis: Hippocampal volumetry in mild cognitive impairment The thesis has been successfully defended.

Link to thesis: http://hdl.handle.net/2077/22902

http://www.ncbi.nlm.nih.gov/sites/entrez?cmd=Retrieve&db=PubMed&list_uids=20389071

http://www.alphagalileo.org/ViewItem.aspx?ItemId=89780&CultureCode=en

Appearance not always enough to identify species

University of Gothenburg

Linnaean taxonomy is still a cornerstone of biology, but modern DNA techniques have erased many of the established boundaries between species. This has made identifying species difficult in practice, which can cause problems, as shown by a researcher from the University of Gothenburg, Sweden.

"If you can't recognise a species by looking at it, this can have serious consequences," says Emma Vodoti from the Department of Zoology at the University of Gothenburg. "For example, there is a species of leech that is widely used in medical studies, and it was discovered recently that sometimes a leech was being used that looks the same but has a different genetic make-up. This naturally has an effect on the results of the studies conducted. All work based on having to be able to identify species may have to change."

350 years after Linnaeus created his system for organising and categorising species of plants and animals, the system is being pulled apart. Newly discovered organisms are still categorised and named in line with his system, but there is a big difference between species described before and after the discovery of DNA. Until the 1980s, scientists had to rely entirely on appearance, anatomy and other characteristics, such as a bird's song. Since then, genetic patterns have also been taken into account when identifying new species.

"Ironically, these genetic studies have erased many of the established boundaries between species and even disproved the existence of previously described species that have turned out not to be related. Attempts have been made to establish universal boundaries between species by quantifying how much DNA needs to be different between two organisms in order for them to be viewed as separate species, but this doesn't always work."

In her thesis, Vodoti looks at the practical problems with species identification today, after having studied the relationship between the genetic relatedness and the appearance and geographical distribution of various sea creatures. The common horse mussel *Modiolus modiolus* found in the Atlantic and on the west coast of Sweden turns out to be totally different genetically from the one found on the Pacific coast of the USA, despite looking identical. Nemertean worms may have similarities in appearance but turn out to consist of a hotchpotch of different species, more or less independent of looks. Nemerteans include worms just a few millimetres in length to one of the world's longest creatures, *Lineus longissimus*, which can grow up to 15 metres.

"It's probably impossible to find a universal way of defining, identifying and delimiting species," says Vodoti. "My thesis shows that there is a need for individual assessment on a case-by-case basis when identifying species, taking account of both appearance and genes."

http://hdl.handle.net/2077/23294

http://www.alphagalileo.org/ViewItem.aspx?ItemId=89777&CultureCode=en

Newly discovered drumlin field provides answers about glaciation and climate

University of Gothenburg

The landform known as a drumlin, created when the ice advanced during the Ice Age, can also be produced by today's glaciers. This discovery, made by researchers from the University of Gothenburg, Sweden, has just been published in the scientific journal *Geology*.

Drumlins generally consist of an accumulation of glacial debris – till – and are found in areas that were covered by ice sheet. As the ice advanced, it moved rocks, gravel and sand and created tear-shaped raised ridges running parallel with the movement of the ice.

"Until now, scientists have been divided on how drumlins were created," says Mark Johnson from the Department of Earth Sciences at the University of Gothenburg. "Because they are formed under the ice, it's not an observable process. Drumlins are common almost everywhere the Ice Age ice sheets existed, but they're almost unknown with modern-day glaciers. Now, though, we've found a new drumlin field by the Múlajökull glacier on Iceland. It's quite unique."

The melting of glaciers revieles drumlins

The melting of glaciers as a result of climate change has helped the researchers to study this geological phenomenon. The drumlin discovery on Iceland has presented unique opportunities to study their structure.

"One of the drumlins we found was sliced through by erosion. This gave us an opportunity to study it layer by layer, and it was clear that it had been built up only recently. In other words, the glacier has not just retreated to reveal old drumlins, but is continuing to create new ones."

There are currently multiple theories about the origins of drumlins. The Gothenburg researchers' discovery shows that they can form within two kilometres of the edge of the ice.

"A surging glacier can move 100 metres a day, as opposed to the more normal 100 metres a year. If we can link drumlins to fast-moving glaciers, this would mean that the ice sheet advanced much more quickly than scientists currently believe."

Can effect climate research

The link between drumlins and rapid ice movements is important for climate research. When modelling climate change, we need to know how high and how cold a glacier was in order to understand the last Ice Age. A glacier that moves quickly will not be as thick. This discovery could therefore affect how scientists approach climate modelling.

Solving the riddle of the drumlin is a longstanding dream for Mark Johnson:

"We discovered the drumlin field while flying in towards the edge of the glacier to do a completely different study. It was the most exciting thing I've been involved in during my research. All geologists know about drumlins, and when I began to study geology in Wisconsin in the 1980s, many people would come there to study the drumlins in the area. Coming up with a theory for how they formed was a big question even then."

The discovery of the new drumlin field was made by Mark Johnson from the Department of Earth Sciences at the University of Gothenburg in collaboration with researchers from Iceland, Norway and the UK.

http://geology.gsapubs.org/content/38/10/943/F1.expansion.html

http://www.alphagalileo.org/ViewItem.aspx?ItemId=89774&CultureCode=en

We're used to windy conditions

University of Gothenburg

Although female business owners in the Gothenburg archipelago in Sweden are often extremely bound to their duties, they also enjoy a great degree of freedom and independence. The book "Vi är vana att det blåser" by ethnologist Ninni Trossholmen from the University of Gothenburg, Sweden, is based on interviews with about 20 women who are or have been business owners in the island community of Öckerö.

The title of the book, literally translated 'we are used to windy conditions', relates both to the often windy weather in the archipelago and to the Swedish custom of referring to hardships as windy conditions.

Women in the archipelago, especially the wives of fishermen, have traditionally been viewed as strong and independent. When the men went to sea for long periods, the women had to take care of the children and the household alone.

'I wanted to explore how self-employed women in the archipelago manage everyday life considering the double work that running both a business and a family often results in,' says Trossholmen. 'I also asked the women why they became business owners.'

Many reasons for self-employment

Accountants, shop owners, hairdressers, graphic designers and coffee shop owners are some of the professions found among the interviewed women. Some started their own business due to a lack of employment opportunities in the community; others did it out of passion. And a couple of the women were fed up with frequent re-organisations at their previous workplaces.

The women told Trossholmen about the long hours they put into their businesses, about the non-existence of 40-hour workweeks and about the constant lack of time regardless of whether they work at or away from home.

'But many women at the same time enjoy the freedom of being their own boss, of being able to do whatever they want in life and of being able to combine work with childcare.'

Fear of illness

Several of the women talked about the fear of becoming ill and about having neither the opportunity nor the money to hire a stand-in. They also talked about the difficulty of taking time off from work to be with their children and families. The reason for this is that small business owners do not have the same insurance protection that employed individuals have, although there have been some recent improvements in this respect.

'Some of the women said that this pressure was too much to handle and that they as a result became ill and/or sold their businesses,' says Trossholmen.

The interviewed women seem to share one feature: They truly love the archipelago and the opportunity to remain in the community.

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Rational family structure dominates

University of Gothenburg

Couples do not live together for traditional or romantic reasons. They do so for purely rational reasons - emotional, financial, intellectual and social. The nuclear family still holds a strong position in Sweden. Some 70 percent of the population live in a nuclear family, shows research from the University of Gothenburg, Sweden.

Many families today consist of networks of various people that include a whole host of constellations, without being a nuclear family.
Family researchers are at any rate pleased at the break up of the nuclear family, and the late 20th century is of particular interest to those who specialise in to family research.

Not giving enough

"The number of divorces in Sweden and other countries increased dramatically during the 1960s and 70s. A new form of relationship began to emerge in modern society, with people no longer forming partnerships and living together for traditional or romantic reasons. The new relationship takes a rational approach, where people ask what the relationship is giving them and what they get in exchange emotionally, financially, intellectually and socially. The answer often shows that the relationship is not giving enough in return, which explains the increase in the number of divorces in our part of the world, with reference to research carried out by the English sociologist Anthony Giddens and others," says Thomas Johansson, Professor of education specialising in child and youth studies at the Department of Education, Communication and Learning.

Studies of family structures during the 2000s are therefore about how people live together today, people's motivation for doing so and how the various, and often new, types of families organise their lives in practical terms.

Complicated business

The fact is that just under 70 percent of Sweden's population live in nuclear families today. The heterosexual nuclear family is the dominant structure.

"But there are many variations, including homosexual families and rainbow families. Thirty percent is quite a high proportion of people not living in a nuclear family," says Thomas Johansson.

Time and relationship planning among the 30 percent who live in non-nuclear families is often a complicated business.
The new paternal role is one aspect of the family that has been present since the 1970s. It is associated with the new parental insurance that was introduced in Sweden in 1974, enabling families to choose to allow dads to stay at home with young children.

"The thing that is unique to Sweden is the system of parental leave, with 390 days on 80-90 percent pay, depending on the employer. The allocation of two months of parental leave solely to one of the parents is also unique."

Major variations

"We have a tendency towards equality in Sweden, but there are also major variations when it comes to class and ethnicity, which leads to different outcomes in relation to becoming a father and equality. Parents today think along more equal lines, particularly among the middle classes," says Thomas Johansson.

The family structure of the 2000s also embraces a global aspect – everything from the unaccompanied refugee children who come to Sweden, to the rich, mobile and transnational family that perhaps lives in Australia, where someone works in Holland for example, and they have relatives in Sweden.

Thomas Johansson was appointed Professor in education specialising in child and youth studies at the Department of Education, Communication and Learning in the spring.

In October he gave a talk entitled *"The Family in Modern Society"* at an open lecture at the Faculty of Education.

Thomas Johansson has written several books on the theme of family life, including *"Den andre föräldern"* (The Other Parent), "Nätverksfamiljen" (The Network Family) - together with Margareta Bäck-Wiklund - and "Familjeliv" (Family Life). In the latter book he looks broadly at recent family research and highlights several issues, including the network family. His most recent publication is *"Nya svenska fäder"* (New Swedish Fathers) from 2010 – written together with Roger Klinth - which is a study into fathers today.

The lecture was one of a series of open lectures that were held during the autumn at the Faculty of Education.

http://www.alphagalileo.org/ViewItem.aspx?ItemId=89768&CultureCode=en

Active management of the third stage of labour reduces risk of bleeding

University of Gothenburg

Active management of the third stage of labour means that women lose less blood than with a more expectant approach, reveals a thesis from the University of Gothenburg, Sweden, in conjunction with Sahlgrenska University Hospital.

A number of studies in the West have shown that heavy bleeding following childbirth has become more common in recent years. In her thesis, midwife and researcher Elisabeth Jangsten decided to look at how heavily women bleed after giving birth in Angola and Sweden following active and expectant management. The study in Angola covered 1,590 women, while the Swedish study included 1,802. The Swedish study was conducted at two of the delivery units at Sahlgrenska University Hospital, which make use of both active and expectant management.

Active management means that the umbilical cord is clamped straight after the baby is delivered, the midwife gives the mother medication to stimulate uterine contractions, presses a hand on the lower part of the uterus, and pulls gently on the umbilical cord while the mother pushes, so delivering the placenta. With an expectant approach, the umbilical cord is also clamped straight after the baby is delivered, but the midwife then waits for signals that the placenta has separated from the wall of the uterus before encouraging the mother to bear down and push out the placenta. Uterine stimulants are always given if the need arises.

"In Angola, 7.5% of women lost more than a litre of blood in the expectantly managed group, and only 1% in the actively managed group," says Jangsten, a midwife at Sahlgrenska University Hospital/Östra Hospital and researcher at the Institute of Health and Care Sciences at the Sahlgrenska Academy. "In Sweden, the difference was bigger: almost 17% of women lost more than a litre in the expectantly managed group, and only 10% in the actively managed group."

The researchers did not find any difference between the two methods in terms of perceived afterpains in either Sweden or Angola. However, afterpains were more common the more children the women had had. They also found that first-time mothers in Sweden lost more blood and were more likely to require a blood transfusion than those who had given birth before. More women bled heavily in the Swedish study, which can be explained partly by all blood being measured carefully during the course of the study, but may also be down to other factors, such as excess weight, big babies and greater intervention during childbirth.

The recommendation in Sweden has been to give mothers uterine stimulants immediately after delivery.

"But not every element of the active management approach is always included, although the World Health Organisation, the International Confederation of Midwives and the International Federation of Gynaecology and Obstetrics have been recommending active management for a number of years, albeit with slightly later clamping of the umbilical cord," says Jangsten.

However, administering uterine stimulants routinely following all types of delivery has been questioned by those who believe that there should be as little medical intervention in childbirth as possible in order not to disrupt the natural process. They believe instead that treatment should be given only if the situation requires it.

"In the light of our results in this thesis, I think that active management should be the first choice for hospital deliveries. However, women should be informed about the different methods available so that they can be involved in decisions about the management of the third stage of labour if they so wish."

POSTPARTUM HAEMORRHAGE
Postpartum haemorrhage is the medical term for bleeding following childbirth, both before and after the placenta is delivered. Total blood loss is normally around 600 ml, but sometimes the bleeding is heavier because the placenta does not separate properly from the uterus, or because the muscles in the walls of the uterus do not contract strongly enough. If this happens, the mother is given medication to stimulate uterine contractions, and sometimes the placenta may need to be removed manually.

http://gupea.ub.gu.se/handle/2077/23833

http://www.alphagalileo.org/ViewItem.aspx?ItemId=89765&CultureCode=en

Saving our data from digital decay

Inderscience

An old-school alternative to digital storage has a modern spin that could save us from future information loss as technology changes and today's state of the art devices become tomorrow's museum pieces.

Digital objects - documents, images, databases - require specific software to open and read them, which in turn requires specific operating systems, device drivers, and hardware to run them depending on the format in which they're stored, whether magnetic, optical or some other system.

The pace of change in the world of technology is so rapid that applications as well as media technology have only short life spans and archived data has to be migrated at frequent intervals on to new data carriers and into new file formats to maintain its integrity. For instance, data that once might have been held on magnetic tape or floppy disks is unreadable on today's equipment and CD-ROMs and other media will go the same route in the future.

If the 0s and 1s of digitised information can succumb to the vagaries of technological change, one thing is certain, analogue archives will always be readable to future generations provided they retain language skills.

After all, we can read the works of modern authors almost as readily as the words of Shakespeare and Chaucer and ancient hieroglyphics bear close scrutiny once we cracked the code. With this point in mind, Steffen Schilke of the Gemeinsame IT-Stelle der hessischen Justiz in Frankfurt am Main in Germany and Andreas Rauber of the Department of Software Technology and Interactive Systems, Vienna University of Technology, in Austria discuss how e-government archives might be safely stored using an alternative to digital media - the microfilm format beloved of spy fiction.

Writing in the International Journal of Electronic Governance, the team explains how e-government applications have to archive data or documents for long retention periods of 100 years or more for legal reasons and also such materials are often worthy of storage for future historians. They and many others have recognised the problems of storing such materials in digital media and suggest that in terms of cost, stability and technology independence, microfilm offers a promising solution for "off-line" storage.

The team has carried out a feasibility study that analysed encoding techniques to allow digital data to be saved on to microfilm and then to test data recovery as well as cost issues. Aside from precluding the need for frequent technology updates, storage of documents and data on microfilm will give future generations access to the information by scanning the microfilm into whatever system they are currently using and applying optical character recognition to re-digitize und subsequently decode the data.

The team further suggests that in order to reduce the amount of microfilm used for any given repository and so cut conversion and re-digitization times it would be possible to convert a stream of text into a bar-code type system that would still be entirely analogue but would rely on knowledge of the conversion key to return the data to digital form from microfilm.

Using such a system could render a tested 170 kilobyte file that requires 191 pages of microfilm space as just 12 or so "printed as a two-dimensional barcode. Such a barcode would incorporate redundancy and be self-checking unlike a straight digital to analogue image scan of the text. Further compression is possible, if colour microfilm and barcodes were used for storage. This may provide a valuable, low-maintenance additional

back-up for the original digital objects in addition to preservation activities needed for the on-line access copies.

For microfilm data storage, no tapes, no spinning discs, no electronic devices are needed and the only precautions necessary for the storage of the microfilm is a dry, temperature-controlled and locked closet or even just a hermetically sealed box. "The advantage of such a method is clearly the 'don't care' factor for the media migration," the team asserts, "With a lifetime of more than 100 years a lot of media migration projects (which are usually necessary every 3 to 7 years) could be avoided, saving money, effort, and precluding the risk of data loss as technology diverges away from today's standards."

http://www.alphagalileo.org/ViewItem.aspx?ItemId=89747&CultureCode=en

Homecoming for Stark Record of Apartheid

By CELIA W. DUGGER

JOHANNESBURG — When he was only in his 20s Ernest Cole, a black photographer who stood barely five feet tall, created one of the most harrowing pictorial records of what it was like to be black in apartheid South Africa. He went into exile in 1966, and the next year his work was published in the United States in a book, "House of Bondage," but his photographs were banned in his homeland where he and his work have remained little known.

In exile Mr. Cole's life crumbled. For much of the late 1970s and 1980s he was homeless in New York, bereft of even his cameras. "His life had become a shadow," a friend later said. Mr. Cole died at 49 in 1990, just a week after Nelson Mandela walked free. His sister flew back to South Africa with his ashes on her lap.

Mr. Cole is at last having another kind of homecoming. The largest retrospective of his work ever mounted is now on display at the Johannesburg Art Gallery, built in the neo-Classical style almost a century ago in an era when South Africa's great mining fortunes were being made on the backs of black labor. It is a collection of images that still possesses the power to shock and anger.

"How could white people do this to us?" asked Lebogang Malebana, 14, as he stood before a photograph of nude gold-mine recruits who had been herded into a grimy room for examination. "How could they put naked black men on display like that?"

Mr. Cole conceived the idea of his own portrait of black life after seeing Henri Cartier-Bresson's book "People of Moscow." He got this particular picture by sneaking his camera into the mine in his lunch bag, under sandwiches and an apple, Struan Robertson, who shared a studio and darkroom with Mr. Cole, recounted in an essay for the book that accompanies the exhibition, "Ernest Cole: Photographer."

On a recent Saturday afternoon at the museum here in a crime-ridden downtown that long ago emptied of white people, three visitors wandered through cavernous galleries lined with Mr. Cole's work. Lebogang, an

eighth grader, had drifted in from a nearby single-room apartment that he shares with his mother, who is a maid, and his younger brother. His father is in jail. “It’s very sad,” he said as he lingered over the black-and-white images.

Jimmy Phindi Tjege, 27, who like many young black South Africans has never held a job in a society still scarred by apartheid, had come to the exhibition with his girlfriend, Nomthandazo Patience Chazo, 26, who works for the government and has a car. They had driven from their black township, Daveyton, about 30 miles away.

Ms. Chazo was struck by a photograph of four hungry children scraping porridge from a single pot set on a concrete floor. Mr. Tjege singled out another picture, one of a serious boy squatting on the floor of an unfurnished schoolroom, clutching a chalkboard, with two tears of sweat running down the side of his face.

“I feel angry,” Mr. Tjege said, as he gestured to the rest of the gallery with a sweep of his hand. “This room is full of anger.”

Mr. Cole’s captions and photographs are imbued with wrenching emotions.

Next to a photograph of a maid holding a white baby girl whose lips are pressed to the woman’s forehead, the caption says: “Servants are not forbidden to love. Woman holding child said, ‘I love this child, though she’ll grow up to treat me just like her mother does.’ ”

The caption for a picture of a hospital ward where the floor was crowded with sick children reads, “New cases have their names written on adhesive tape stuck to their foreheads.”

A series of images of tsotsis, young black gangsters, picking the pockets of white men is accompanied by a caption that reads: “Whites are angered if touched by anyone black, but a black hand under the chin is enraging. This man, distracted by his fury, does not realize his pocket is being rifled.”

The son of a washerwoman and a tailor, Mr. Cole quit high school in 1957 at 16 as the Bantu education law meant to consign blacks to menial labor went into effect.

When he was 20, the apartheid authorities deemed his family’s brick home and the black township where it sat as a “black spot” and bulldozed them into rubble.

Somehow, pretending to be an orphan, Mr. Cole had by then already managed to persuade apartheid bureaucrats to reclassify him as colored, or mixed race, despite his dark skin. His fluency in Afrikaans, the language of most coloreds, probably helped. His ability to pass as colored freed him from laws that required blacks always to carry a work permit when in “white areas,” and this mobility proved crucial to his photography.

Joseph Lelyveld, a retired executive editor of The New York Times who was The Times’s correspondent in Johannesburg in the mid-1960s and worked with Mr. Cole, then a freelancer, described the young photographer as a wry, soft-spoken man.

“His judgments could be angry, but he had an ironic, almost furtive nature, conditioned by what he was trying to pull off,” Mr. Lelyveld, who remained a friend of Mr. Cole until his death, said in a telephone interview. “It wasn’t easy to be a black man walking around Johannesburg with expensive cameras. The presumption would be you stole them.”

In the mid-1970s, when Mr. Cole was destitute and homeless in New York, Mr. Lelyveld said they went together to a cheap hotel where Mr. Cole had left his negatives and the photographs he had of his mother, only to discover they had gone to an auction of unclaimed items.

For years rumors circulated that a suitcase of Mr. Cole's prints had survived somewhere in Sweden. David Goldblatt, a renowned South African photographer, had heard they were with the Hasselblad Foundation there. When Mr. Goldblatt received the Hasselblad Award in 2006, and traveled to Gothenburg to accept it, he asked to see them. He said he was agape paging through the images, saying, "They can't lie in a vault."

Later, when he carefully studied scans of them at his home in Johannesburg, Mr. Goldblatt, now 80, said he began to realize that many of the photographs in "House of Bondage" had been cropped severely to enhance their impact in a powerful anti-apartheid polemic. But the full frames showed Mr. Cole's artistry.

"He wasn't just brave," said Mr. Goldblatt, who has been photographing this country for more than a half-century. "He wasn't just enterprising. He was a supremely fine photographer."

For example, the picture of naked mine recruits photographed in a line from behind, their arms outstretched as if they were being held up, had a water basin on the wall at the end of the line. It was almost entirely cut out in the book.

"Cole was careful to include the basin, and the basin is like the full stop or exclamation mark in a sentence," Mr. Goldblatt said. "It just brings another dimension. It makes it banal. It's not just dramatic, it's banally dramatic. This is the kind of thing photographers live by, these details."

Next year the exhibition, organized by the Hasselblad Foundation, will travel to Cape Town, Port Elizabeth, Durban and Mamelodi, the black township outside Pretoria where Mr. Cole's family still lives. The foundation is now planning an American tour that probably will include San Francisco, Detroit, Atlanta and New York.

http://www.nytimes.com/2010/11/18/arts/design/18cole.html?ref=design

'Magic number' 695 opens up new areas for Alzheimer's research

martes, 16 de noviembre de 2010 campuspr / University of Leeds

The latest findings from University of Leeds biologists open up exciting new avenues for research into Alzheimer's and may help to explain why decades of study into the causes of the disease have so far failed to lead to a cure.

Alzheimer's disease is widely believed to be caused by the gradual accumulation in the brain of amyloid-beta peptide which is toxic to nerve cells. Amyloid beta peptide is formed from a protein known as APP, which is found in three forms. Most research into APP – a key area of study for the disease – does not distinguish between the different forms of the protein.

The findings, published in the *Journal of Biological Chemistry*, show that amyloid beta peptide is actually created mainly by just one form of APP – known as APP_{695} for the number of its amino acids. APP_{695} is found at greater concentration in brain and nerve cells, but this study – funded by the Medical Research Council and the Alzheimer's Research Trust – is the first time the significance of that has been shown.

This discovery will now enable research to focus more clearly on the exact mechanism by which amyloid beta peptide accumulates in the brain.

"Research into amyloid beta peptide has been going on for more than 20 years and while treatments have made it to clinical trials, nothing has proved truly effective against this disease," says Professor Tony Turner, from Leeds' Faculty of Biological Sciences, who co-led the research. "This could be because research to date has been a bit of a blunt instrument: scientists have essentially been working on too broad a field. Our findings will allow researchers to target their work much more precisely."

The study of APP_{695} also led the scientists to identify a potential new factor in the development of Alzheimer's. When APP is broken down, it forms another protein called AICD. The researchers discovered that AICD formed from APP_{695} switches on certain genes within nerve cells that may then damage the cell. The process is unique to nerve cells and AICD formed from the other forms of APP does not have this effect.

"AICD has been detected before, but because studies haven't differentiated between the different forms of APP, there was no consensus on its role," explains co-researcher Professor Nigel Hooper. "It seems likely that AICD formed from APP_{695} is a contributing factor in the deterioration in nerve and brain cells which leads to Alzheimer's. This provides another avenue for research into a potential cure for the disease."

Professor Chris Kennard, chair of the MRC Neurosciences and Mental Health Board, said: "This is the latest study from a long-term research collaboration to significantly further our understanding of neurodegenerative diseases, such as Alzheimer's Disease. It forms part of a £4.1m investment by the MRC and is a shining example of where fundamental research, which unravels the complex biology of disease, can provide the building blocks for potential treatments in future."

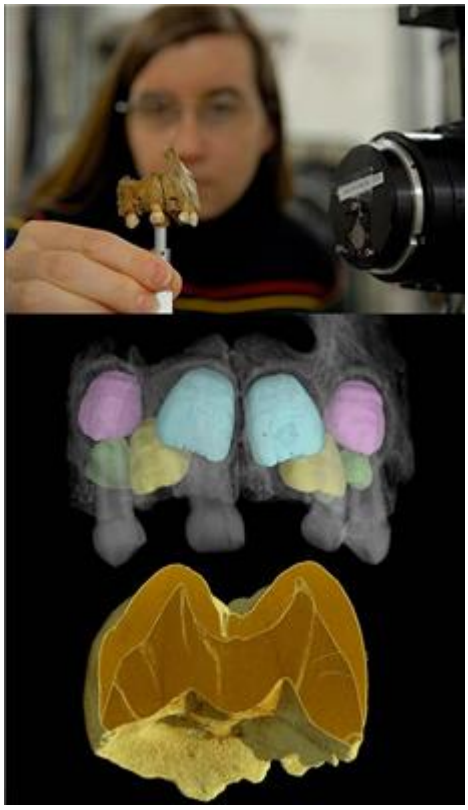
Dr Simon Ridley, Head of Research at the Alzheimer's Research Trust, said: "This study gives us important new insight into the role of APP in Alzheimer's disease, and could have significant implications for future research in this area. We must now build on these findings with more research, as this is the only way we will be able to find an effective treatment for dementia."

Over 820,000 people in the UK live with dementia and one in three over 65s will die with some form of the disease. The Alzheimer's Research Trust estimates that the annual cost to the UK economy is £23 billion.

http://www.leeds.ac.uk/news/article/1241/magic_number_695_opens_up_new_areas_for_alzheimers_research

http://www.alphagalileo.org/ViewItem.aspx?ItemId=89744&CultureCode=en

Synchrotron reveals human children outpaced Neanderthals by slowing down



European Synchrotron Radiation Facility (ESRF)

- **Embargado hasta lunes, 15 de noviembre de 2010 20:01 GMT**The website (see below) is password protected, so journalists should contact press@esrf.fr if they wish to download images or videos.

Human childhood is considerably longer than chimpanzees, our closest-living ape relatives. A multinational team of specialists, led by researchers from Harvard University, Max-Planck Institute for Evolutionary Anthropology (MPI-EVA) and the ESRF, applied cutting-edge synchrotron X-ray imaging to resolve microscopic growth in 10 young Neanderthal and /Homo sapiens /fossils. They found that despite some overlap, which is common in closely-related species, significant developmental differences exist. Modern humans are the slowest to the finish line, stretching out their maturation, which may have given them a unique evolutionary advantage.

Evolutionary biology has shown that small changes during early development may lead to differences that result in new species. These changes may take the form of modifications in the sequence or timing of developmental events; therefore, understanding developmental transformation is key to reconstructing evolutionary history. Anthropologists have documented many differences in adult characteristics among closely related species, such as humans and chimpanzees. Genomic data combined with fossil evidence indicate that these two lineages split six to seven million years ago, and have since been evolving separately.

However, we know much less about which changes led to the separate lineages, how these changes arose, and when they occurred.

One poorly understood change is our unique life history, or the way in which we time growth, development, and reproductive efforts. Compared to humans, non-human primate life history is marked by a shorter gestation period, faster post-natal maturation rates, younger age at first reproduction, shorter post-reproductive period, and a shorter overall lifespan. For example, chimpanzees reach reproductive maturity several years before humans, bearing their first offspring by age 13, in contrast to the human average of 19.

It might seem that life history is invisible in the fossil record, but it turns out that many life history variables correlate strongly with dental development. "Teeth are remarkable time recorders, capturing each day of growth much like rings in trees reveal yearly progress. Even more impressive is the fact that our first molars contain a tiny 'birth certificate and finding this birth line allows us to calculate exactly how old a juvenile was when it died" says Tanya Smith, researcher at Harvard University and MPI-EVA.

This forensic approach to the past is possible with a 'super-microscope:' extremely powerful X-ray beams produced at the European Synchrotron Radiation Facility (ESRF) in Grenoble, France, which is one of the largest synchrotron in the world. Paul Tafforeau, from the ESRF, notes: "At the ESRF, we are able to look inside invaluable fossils without damaging them by using the special properties of high energy synchrotron X-rays. We can investigate fossils at different scales and in three-dimensions, ranging from studies of overall 3D shape down to microscopic daily growth lines. This is currently the only place where these studies of fossil humans are possible." Scientists and curators have been quietly visiting the European synchrotron, often with some of the rarest hominin fossils in the world, for imaging with this state-of-the-art technique.

The study includes some of the most famous Neanderthal children, including the first hominin fossil ever discovered. This Belgian Neanderthal child, discovered in the winter of 1829-1830, was thought to be 4-5 years of age when it died. Powerful synchrotron X-rays and cutting-edge imaging software revealed that it actually died at a mere 3 years of age. Another invaluable Neanderthal discovered in Le Moustier, France in 1908, barely survived the shelling of its' German repository during the Second World War.

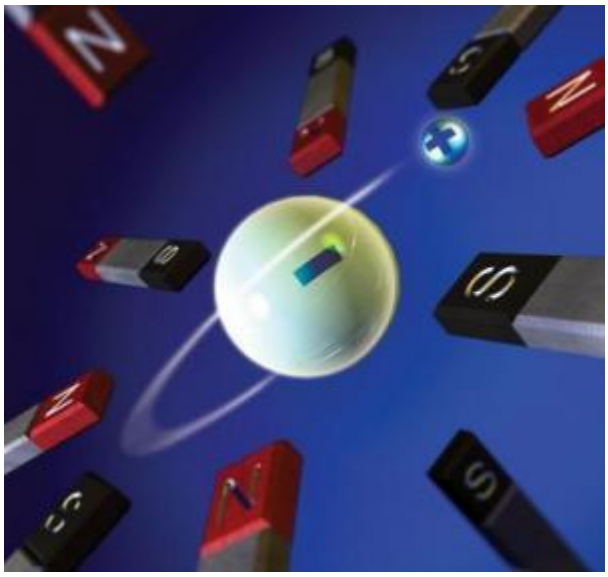
A remarkable finding of this five-year study is that Neanderthals grow their teeth significantly faster than members of our own species, including some of the earliest groups of modern humans to leave Africa between 90-100,000 years ago. The Neanderthal pattern appears to be intermediate between early members of our genus (e.g., *Homo erectus*) and living people, suggesting that the characteristically slow development and long childhood is a recent condition unique to our own species. This extended period of maturation may facilitate additional learning and complex cognition, possibly giving early *Homo sapiens* a competitive advantage over their contemporaneous Neanderthal cousins.

These new results present a unique opportunity to assess the origins of a fundamentally human condition: the costly yet advantageous shift from a primitive "live fast and die young" strategy to the "live slow and grow old" strategy that has helped to make us one of the most successful organisms on the planet.

http://www.heb.fas.harvard.edu/Press

http://www.alphagalileo.org/ViewItem.aspx?ItemId=89741&CultureCode=en

Antimatter Atoms Stored for the First Time



An artist's impression of an antihydrogen atom -- a negatively charged antiproton orbited by a positively charge anti-electron, or positron -- trapped by magnetic fields. (Credit: Graphic by Katie Bertsche)

ScienceDaily (Nov. 17, 2010) — Atoms of antimatter have been trapped and stored for the first time by the ALPHA collaboration, an international team of scientists working at CERN, the European Organization for Nuclear Research near Geneva, Switzerland. Scientists from the U.S. Department of Energy's Lawrence Berkeley National Laboratory and the University of California at Berkeley have made key contributions to the ongoing international effort.

ALPHA stored atoms of antihydrogen, consisting of a single negatively charged antiproton orbited by a single positively charged anti-electron (positron). While the number of trapped anti-atoms is far too small to fuel the Starship Enterprise's matter-antimatter reactor, this advance brings closer the day when scientists will be able to make precision tests of the fundamental symmetries of nature. Measurements of anti-atoms may reveal how the physics of antimatter differs from that of the ordinary matter that dominates the world we know today.

Large quantities of antihydrogen atoms were first made at CERN eight years ago by two other teams. Although they made antimatter they couldn't store it, because the anti-atoms touched the ordinary-matter walls of the experiments within millionths of a second after forming and were instantly annihilated -- completely destroyed by conversion to energy and other particles.

"Trapping antihydrogen proved to be much more difficult than creating antihydrogen," says ALPHA team member Joel Fajans, a scientist in Berkeley Lab's Accelerator and Fusion Research Division (AFRD) and a professor of physics at UC Berkeley. "ALPHA routinely makes thousands of antihydrogen atoms in a single second, but most are too 'hot'" -- too energetic -- "to be held in the trap. We have to be lucky to catch one."

The ALPHA collaboration succeeded by using a specially designed magnetic bottle called a Minimum Magnetic Field Trap. The main component is an octupole (eight-magnetic-pole) magnet whose fields keep anti-atoms away from the walls of the trap and thus prevent them from annihilating. Fajans and his colleagues in AFRD and at UC proposed, designed, and tested the octupole magnet, which was fabricated at

Brookhaven. ALPHA team member Jonathan Wurtele of AFRD, also a professor of physics at UC Berkeley, led a team of Berkeley Lab staff members and visiting scientists who used computer simulations to verify the advantages of the octupole trap.

In a forthcoming issue of *Nature* now online, the ALPHA team reports the results of 335 experimental trials, each lasting one second, during which the anti-atoms were created and stored. The trials were repeated at intervals never shorter than 15 minutes. To form antihydrogen during these sessions, antiprotons were mixed with positrons inside the trap. As soon as the trap's magnet was "quenched," any trapped anti-atoms were released, and their subsequent annihilation was recorded by silicon detectors. In this way the researchers recorded 38 antihydrogen atoms, which had been held in the trap for almost two-tenths of a second.

"Proof that we trapped antihydrogen rests on establishing that our signal is not due to a background," says Fajans. While many more than 38 antihydrogen atoms are likely to have been captured during the 335 trials, the researchers were careful to confirm that each candidate event was in fact an anti-atom annihilation and was not the passage of a cosmic ray or, more difficult to rule out, the annihilation of a bare antiproton.

To discriminate among real events and background, the ALPHA team used computer simulations based on theoretical calculations to show how background events would be distributed in the detector versus how real antihydrogen annihilations would appear. Fajans and Francis Robicheaux of Auburn University contributed simulations of how mirror-trapped antiprotons (those confined by magnet coils around the ends of the octupole magnet) might mimic anti-atom annihilations, and how actual antihydrogen would behave in the trap.

Learning from antimatter

Before 1928, when anti-electrons were predicted on theoretical grounds by Paul Dirac, the existence of antimatter was unsuspected. In 1932 anti-electrons (positrons) were found in cosmic ray debris by Carl Anderson. The first antiprotons were deliberately created in 1955 at Berkeley Lab's Bevatron, the highest-energy particle accelerator of its day.

At first physicists saw no reason why antimatter and matter shouldn't behave symmetrically, that is, obey the laws of physics in the same way. But if so, equal amounts of each would have been made in the big bang -- in which case they should have mutually annihilated, leaving nothing behind. And if somehow that fate were avoided, equal amounts of matter and antimatter should remain today, which is clearly not the case.

In the 1960s, physicists discovered subatomic particles that decayed in a way only possible if the symmetry known as charge conjugation and parity (CP) had been violated in the process. As a result, the researchers realized, antimatter must behave slightly differently from ordinary matter. Still, even though some antiparticles violate CP, antiparticles moving backward in time ought to obey the same laws of physics as do ordinary particles moving forward in time. CPT symmetry (T is for time) should not be violated.

One way to test this assumption would be to compare the energy levels of ordinary electrons orbiting an ordinary proton to the energy levels of positrons orbiting an antiproton, that is, compare the spectra of ordinary hydrogen and antihydrogen atoms. Testing CPT symmetry with antihydrogen atoms is a major goal of the ALPHA experiment.

How to make and store antihydrogen

To make antihydrogen, the accelerators that feed protons to the Large Hadron Collider (LHC) at CERN divert some of these to make antiprotons by slamming them into a metal target; the antiprotons that result are held in CERN's Antimatter Decelerator ring, which delivers bunches of antiprotons to ALPHA and another antimatter experiment.

Wurtele says, "It's hard to catch p-bars" -- the symbol for antiproton is a small letter p with a bar over it -- "because you have to cool them all the way down from a hundred million electron volts to fifty millionths of an electron volt."

In the ALPHA experiment the antiprotons are passed through a series of physical barriers, magnetic and electric fields, and clouds of cold electrons, to further cool them. Finally the low-energy antiprotons are introduced into ALPHA's trapping region.

Meanwhile low-energy positrons, originating from decays in a radioactive sodium source, are brought into the trap from the opposite end. Being charged particles, both positrons and antiprotons can be held in separate sections of the trap by a combination of electric and magnetic fields -- a cloud of positrons in an "up well" in the center and the antiprotons in a "down well" toward the ends of the trap.

To join the positrons in their central well, the antiprotons must be carefully nudged by an oscillating electric field, which increases their velocity in a controlled way through a phenomenon called autoresonance.

"It's like pushing a kid on a playground swing," says Fajans, who credits his former graduate student Erik Gilson and Lazar Friedland, a professor at Hebrew University and visitor at Berkeley, with early development of the technique. "How high the swing goes doesn't have as much to do with how hard you push or how heavy the kid is or how the long the chains are, but instead with the timing of your pushes."

The novel autoresonance technique turned out to be essential for adding energy to antiprotons precisely, in order to form relatively low energy anti-atoms. The newly formed anti-atoms are neutral in charge, but because of their spin and the distribution of the opposite charges of their components, they have a magnetic moment; provided their energy is low enough, they can be captured in the octupole magnetic field and mirror fields of the Minimum Magnetic Field Trap.

Of the thousands of antihydrogen atoms made in each one-second mixing session, most are too energetic to be held and annihilate themselves against the trap walls.

Setting the ALPHA 38 free

After mixing and trapping -- plus the "clearing" of the many bare antiprotons that have not formed antihydrogen -- the superconducting magnet that produces the confining field is abruptly turned off -- within a mere nine-thousandths of a second. This causes the magnet to "quench," a quick return to normal conductivity that results in fast heating and stress.

"Millisecond quenches are almost unheard of," Fajans says. "Deliberately turning off a superconducting magnet is usually done thousands of times more slowly, and not with a quench. We did a lot of experiments at Berkeley Lab to make sure the ALPHA magnet could survive multiple rapid quenches."

From the start of the quench the researchers allowed 30-thousandths of a second for any trapped antihydrogen to escape the trap, as well as any bare antiprotons that might still be in the trap. Cosmic rays might also wander through the experiment during this interval. By using electric fields to sweep the trap of charged

particles or steer them to one end of the detectors or the other, and by comparing the real data with computer simulations of candidate antihydrogen annihilations and look-alike events, the researchers were able to unambiguously identify 38 antihydrogen atoms that had survived in the trap for at least 172 milliseconds -- almost two-tenths of a second.

Says Fajans, "Our report in Nature describes ALPHA's first successes at trapping antihydrogen atoms, but we're constantly improving the number and length of time we can hold onto them. We're getting close to the point where we can do some classes of experiments on antimatter atoms. The first attempts will be crude, but no one has ever done anything like them before."

Story Source:

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

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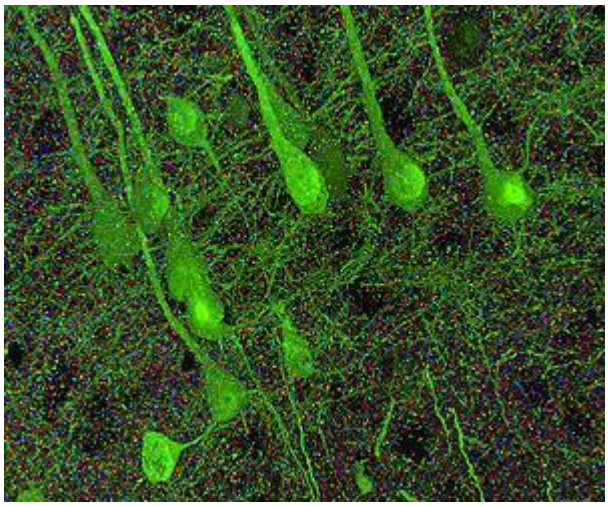
http://www.sciencedaily.com/releases/2010/11/101117141523.htm

Stunning Details of Brain Connections Revealed



Visual reconstruction (from array-tomography data) of synapses in the mouse somatosensory cortex, which is responsive to whisker stimulation. Neurons are depicted in green. Multicolored dots represent separate synapses. (Credit: Image courtesy of Stephen Smith and Stanford University Medical Center)

ScienceDaily (Nov. 17, 2010) — Researchers at the Stanford University School of Medicine, applying a state-of-the-art imaging system to brain-tissue samples from mice, have been able to quickly and accurately locate and count the myriad connections between nerve cells in unprecedented detail, as well as to capture and catalog those connections' surprising variety.

A typical healthy human brain contains about 200 billion nerve cells, or neurons, linked to one another via hundreds of trillions of tiny contacts called synapses. It is at these synapses that an electrical impulse traveling along one neuron is relayed to another, either enhancing or inhibiting the likelihood that the second nerve will fire an impulse of its own. One neuron may make as many as tens of thousands of synaptic contacts with other neurons, said Stephen Smith, PhD, professor of molecular and cellular physiology and senior author of a paper describing the study, to be published Nov. 18 in *Neuron*.

Because synapses are so minute and packed so closely together, it has been hard to get a handle on the complex neuronal circuits that do our thinking, feeling and activation of movement. But the new method may put the mapping of these connections within scientists' grasp. It works by combining high-resolution photography with specialized fluorescent molecules that bind to different proteins and glow in different colors. Massive computing power captures this information and converts it into imagery.

Examined up close, a synapse -- less than a thousandth of a millimeter in diameter -- is a specialized interface consisting of the edges of two neurons, separated by a tiny gap. Chemicals squirted out of the edge of one neuron diffuse across the gap, triggering electrical activity in the next and thus relaying a nervous signal. There are perhaps a dozen known types of synapses, categorized according to the kind of chemical employed in them. Different synaptic types differ correspondingly in the local proteins, on one abutting neuron or the other, that are associated with the packing, secretion and uptake of the different chemicals.

Synapse numbers in the brain vary over time. Periods of massive proliferation in fetal development, infancy and adolescence give way to equally massive bursts of "pruning" during which underused synapses are eliminated, and eventually to a steady, gradual decline with increasing age. The number and strength of

synaptic connections in various brain circuits also fluctuate with waking and sleeping cycles, as well as with learning. Many neurodegenerative disorders are marked by pronounced depletion of specific types of synapses in key brain regions.

In particular, the cerebral cortex -- a thin layer of tissue on the brain's surface -- is a thicket of prolifically branching neurons. "In a human, there are more than 125 trillion synapses just in the cerebral cortex alone," said Smith. That's roughly equal to the number of stars in 1,500 Milky Way galaxies, he noted.

But attempting to map the cerebral cortex's complex circuitry has been a fool's errand up to now, Smith said. "We've been guessing at it." Synapses in the brain are crowded in so close together that they cannot be reliably resolved by even the best of traditional light microscopes, he said. "Now we can actually count them and, in the bargain, catalog each of them according to its type."

Array tomography, an imaging method co-invented by Smith and Kristina Micheva, PhD, who is a senior staff scientist in Smith's lab, was used in this study as follows: A slab of tissue -- in this case, from a mouse's cerebral cortex -- was carefully sliced into sections only 70 nanometers thick. (That's the distance spanned by 700 hydrogen atoms theoretically lined up side by side.) These ultrathin sections were stained with antibodies designed to match 17 different synapse-associated proteins, and they were further modified by conjugation to molecules that respond to light by glowing in different colors.

The antibodies were applied in groups of three to the brain sections. After each application huge numbers of extremely high-resolution photographs were automatically generated to record the locations of different fluorescing colors associated with antibodies to different synaptic proteins. The antibodies were then chemically rinsed away and the procedure was repeated with the next set of three antibodies, and so forth. Each individual synapse thus acquired its own protein-composition "signature," enabling the compilation of a very fine-grained catalog of the brain's varied synaptic types.

All the information captured in the photos was recorded and processed by novel computational software, most of it designed by study co-author Brad Busse, a graduate student in Smith's lab. It virtually stitched together all the slices in the original slab into a three-dimensional image that can be rotated, penetrated and navigated by the researchers.

The Stanford team used brain samples from a mouse that had been bioengineered so that particularly large neurons that abound in the cerebral cortex express a fluorescent protein, normally found in jellyfish, that glows yellowish-green. This let them visualize synapses against the background of the neurons they linked.

The researchers were able to "travel" through the resulting 3-D mosaic and observe different colors corresponding to different synaptic types just as a voyager might transit outer space and note the different hues of the stars dotting the infinite blackness. A movie was also created by this software.

This level of detailed visualization has never been achieved before, Smith said. "The entire anatomical context of the synapses is preserved. You know right where each one is, and what kind it is," he said.

Observed in this manner, the brain's overall complexity is almost beyond belief, said Smith. "One synapse, by itself, is more like a microprocessor -- with both memory-storage and information-processing elements -- than a mere on/off switch. In fact, one synapse may contain on the order of 1,000 molecular-scale switches. A single human brain has more switches than all the computers and routers and Internet connections on Earth," he said.

In the course of the study, whose primary purpose was to showcase the new technique's application to neuroscience, Smith and his colleagues discovered some novel, fine distinctions within a class of synapses previously assumed to be identical. His group is now focused on using array tomography to tease out more such distinctions, which should accelerate neuroscientists' progress in, for example, identifying how many of which subtypes are gained or lost during the learning process, after an experience such as traumatic pain, or in neurodegenerative disorders such as Alzheimer's. With support from the National Institutes of Health, Smith's lab is using array tomography to examine tissue samples from Alzheimer's brains obtained from Stanford and the University of Pennsylvania.

"I anticipate that within a few years, array tomography will have become an important mainline clinical pathology technique, and a drug-research tool," Smith said. He and Micheva are founding a company that is now gathering investor funding for further work along these lines. Stanford's Office of Technology Licensing has obtained one U.S. patent on array tomography and filed for a second.

The *Neuron* study was funded by the NIH, the Gatsby Charitable Trust, the Howard Hughes Medical Institute, Stanford's Bio-X program and a gift from Lubert Stryer, MD, the emeritus Mrs. George A. Winzer Professor of Cell Biology in the medical school's Department of Neurobiology. Other Stanford co-authors of the paper were neuroscience graduate student Nicholas Weiler and senior research scientist Nancy O'Rourke, PhD.

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

Story Source:

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

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Language May Help Create, Not Just Convey, Thoughts and Feelings

Study participants who took a test in Spanish showed a greater preference for other Hispanics. In English, that preference disappeared. (Credit: iStockphoto/Flavia Morlachetti)

ScienceDaily (Nov. 17, 2010) — The language we speak may influence not only our thoughts, but our implicit preferences as well. That's the finding of a study by psychologists at Harvard University, who found that bilingual individuals' opinions of different ethnic groups were affected by the language in which they took a test examining their biases and predilections.

The paper appears in the *Journal of Experimental Social Psychology*.

"Charlemagne is reputed to have said that to speak another language is to possess another soul," says co-author Oludamini Ogunnaike, a graduate student at Harvard. "This study suggests that language is much more than a medium for expressing thoughts and feelings. Our work hints that language creates and shapes our thoughts and feelings as well."

Implicit attitudes, positive or negative associations people may be unaware they possess, have been shown to predict behavior towards members of social groups. Recent research has shown that these attitudes are quite malleable, susceptible to factors such as the weather, popular culture -- or, now, by the language people speak.

"Can we shift something as fundamental as what we like and dislike by changing the language in which our preferences are elicited?" asks co-author Mahzarin R. Banaji, the Richard Clarke Cabot Professor of Social Ethics at Harvard. "If the answer is yes, that gives more support to the idea that language is an important shaper of attitudes."

Ogunnaike, Banaji, and Yarrow Dunham, now at the University of California, Merced, used the well-known Implicit Association Test (IAT), where participants rapidly categorize words that flash on a computer screen or are played through headphones. The test gives participants only a fraction of a second to categorize words, not enough to think about their answers.

"The IAT bypasses a large part of conscious cognition and taps into something we're not aware of and can't easily control," Banaji says.

The researchers administered the IAT in two different settings: once in Morocco, with bilinguals in Arabic and French, and again in the U.S. with Latinos who speak both English and Spanish.

In Morocco, participants who took the IAT in Arabic showed greater preference for other Moroccans. When they took the test in French, that difference disappeared. Similarly, in the U.S., participants who took the test in Spanish showed a greater preference for other Hispanics. But again, in English, that preference disappeared.

"It was quite shocking to see that a person could take the same test, within a brief period of time, and show such different results," Ogunnaike says. "It's like asking your friend if he likes ice cream in English, and then turning around and asking him again in French and getting a different answer."

In the Moroccan test, participants saw "Moroccan" names (such as Hassan or Fatimah) or "French" names (such as Jean or Marie) flash on a monitor, along with words that are "good" (such as happy or nice) or "bad" (such as hate or mean). Participants might press one key when they see a Moroccan name or a good word, and press another when they see a French name or a bad word. Then the key assignments are switched so that "Moroccan" and "bad" share the same key and "French" and "good" share the other.

Linguist Benjamin Lee Whorf first posited in the 1930s that language is so powerful that it can determine thought. Mainstream psychology has taken the more skeptical view that while language may affect thought processes, it doesn't influence thought itself. This new study suggests that Whorf's idea, when not caricatured, may generate interesting hypotheses that researchers can continue to test.

"These results challenge our views of attitudes as stable," Banaji says. "There still remain big questions about just how fixed or flexible they are, and language may provide a window through which we will learn about their nature."

Ogunnaike, Dunham, and Banaji's work was supported by Harvard's Weatherhead Center for International Affairs and the Mellon Mays Foundation.

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

Story Source:

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

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Length of Pregnancy Influenced by Placenta Structure

Newborn puppies. New findings help to explain why humans, whose placentas do not form the complex web-like structure seen in animals such as dogs and leopards, have relatively lengthy pregnancies. (Credit: iStockphoto/Nikola Miljkovic)

ScienceDaily (Nov. 17, 2010) — The nine-month pregnancy in humans is influenced by the structure of the placenta, according to new research into the evolution of reproduction in mammals which ends a 100-year mystery.

The study, by Durham and Reading universities, shows that babies grow twice as fast in the wombs of some mammals compared to others. The difference in growth rates appears to be due to the structure of the placenta and the way it connects mother and baby.

The research has found that the more intimate the connection is between the tissues of the mother and the fetus, the faster the growth of the baby and the shorter the pregnancy. The findings help to explain why humans, whose placentas do not form the complex web-like structure seen in animals such as dogs and leopards, have relatively lengthy pregnancies.

The structure of the placenta is surprisingly different amongst mammal species although it serves the same basic function in all of them. The scientists say that, despite speculation, the reasons for this variation have been a mystery for more than 100 years, until now.

The researchers, whose findings are published in the academic journal *American Naturalist* this week, analyzed data on 109 mammal species showing for the first time that the structure of the placenta influences pregnancy duration in mammals. The scientists say that the placenta in some mammals is highly 'folded' creating a larger surface area, increasing the rate at which nutrients are passed from mother to baby.

This sort of folding is a common way in which evolution has solved the problem of increasing surface area in animal bodies. It is seen in many tissues where a large surface area needs to be packed into a small space, including the lungs, intestines and cortex of the brain.

Females of all mammal species develop placentas when they conceive, including bats, whales, and elephants. The placenta connects the developing fetus to the lining of the womb to allow nutrient uptake, waste elimination, and gas exchange via the mother's blood supply.

The research team studied the length of pregnancy, structure of placenta, and size of offspring in mammals, and examined how these characteristics have changed during the evolution of mammals. They found that, despite the placenta essentially having the same function in all mammals, there were some striking structural differences.

Previously, the extent to which there is direct contact between the mother's blood and the placenta was thought to reflect an evolutionary arms-race between mother and baby with both battling for 'control' over how much food is given and received. In this conflict, it is believed that the mother needs to reserve some of her resources for her other offspring but the fetus 'demands' more to fuel its growth.

Lead author, Dr Isabella Capellini, says "This study shows that it is not necessarily the contact with maternal blood which determines speed of growth, but the extent to which the tissues of mother and baby are "interlocked," or folded, with one another.

"In humans, the placenta has simple finger-like branches with a relatively limited connection between the mother's tissues and those of the fetus, whereas in leopards, for example, it forms a complex web of interconnections that create a larger surface area for the exchange of nutrients."

Co-author Professor Robert Barton from Durham University explained: "Parent-offspring conflict is universal. From the moment of conception, the physiologies of mother and baby are adapted to achieve slightly different goals in terms of how fast the baby grows.

"Because we found no differences in the size of the babies when they are born, it seems that the outcome of this conflict is a kind of equilibrium in which faster growth is offset by a shorter pregnancy."

Understanding how differences between species evolve and what combination of pressures and conflicts gives rise to certain physiological features can help us to appreciate issues as diverse as economics, farming and biodiversity.

The research was funded by the Biotechnology and Biological Sciences Research Council (BBSRC), Natural Environment Research Council (NERC) and the Leverhulme Trust.

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

Story Source:

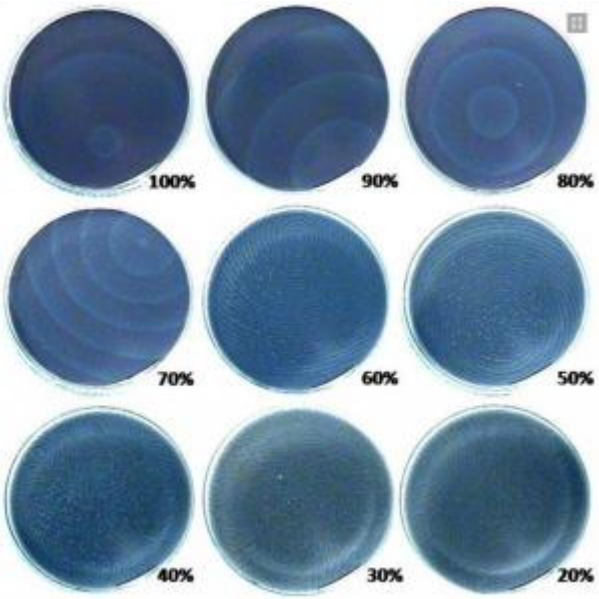
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Durham University**, via EurekAlert!, a service of AAAS.

Journal Reference:

1. Isabella Capellini, Chris Venditti, and Robert A. Barton. **Placentation and Maternal Investment in Mammals**. *American Naturalist*, 177: January 2011

http://www.sciencedaily.com/releases/2010/11/101116203438.htm

Damaged Organs Linked to Change in Biochemical Wave Patterns



Wave patterns change from targets to spirals as "active" beads decrease and "inactive" beads increase. (Credit: Image courtesy of Texas A&M University)

ScienceDaily (Nov. 17, 2010) — By examining the distinct wave patterns formed from complex biochemical reactions within the human body, diseased organs may be more effectively identified, says Zhengdong Cheng, associate professor in the Artie McFerrin Department of Chemical Engineering at Texas A&M University, who has developed a model that simulates how these wave patterns are generated.

His findings, which appear in the October issue of the journal *Physical Review E,* detail Cheng's work with a system designed to model cells in a biochemical environment, similar to what occurs inside the human body.

His system utilizes two types of resin beads to represent cells. Those beads loaded with a catalyst are referred to as active and represent living cells. Those beads that are not loaded with a catalyst are referred to as inactive and represent diseased or dead cells.

In contrast to previous experiments that have only focused on the effects of active beads, Cheng's system is the first to examine the effects of inactive beads, particularly the effects of significant increases in the inactive bead population within a system.

Because the beads within the sample represent cells, the increase in inactive beads, Cheng explains, simulates a higher percentage of dead or diseased cells within an organ, such as the heart.

What Cheng found is that as the population of inactive beads increases, the resulting wave patterns transform from target-shaped to spiral-shaped. The inference, Cheng notes, is that as tissue of an organ becomes more diseased and greater numbers of cells die, the biochemical reactions involving that organ will produce spiral wavelets instead of target wavelets.

This corresponds, Cheng notes, to observations made with electrocardiograms that reveal a change from pane-wave to spiral wavelets accompanying the procession from normal sinus rhythm to ventricular fibrillation, a cause of cardiac arrest.

Recognizing these wave patterns and what they represent, Cheng says, may lead to a better and more timely understanding of the structure of a diseased organ. This knowledge, he adds, could help determine whether an organ is becoming diseased as well as the extent of damage to an organ once it is diseased.

"For example, fibrotic nonexcitable 'dead' tissue normally presents as a small percentage of normal heart tissue," Cheng says. "As a result of aging, after a heart attack, or in the case of cardiac myopathies, the percentage of fibrotic tissue increases dramatically, up to 30 or 40 percent.

"In a scenario such as this, given our findings, we would expect to see more spiral-shaped wavelets when examining an organ that has incurred structural damage. A further increase in spiral wavelets could potentially signal an even greater percentage of structural damage to the heart," Cheng says.

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

Story Source:

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

Journal Reference:

1. Guanqun Wang, Qingsheng Wang, Peng He, Srinivasa Pullela, Manuel Marquez, Zhengdong Cheng. **Target-wave to spiral-wave pattern transition in a discrete Belousov-Zhabotinsky reaction driven by inactive resin beads**. *Physical Review E*, 2010; 82 (4): 045201 DOI: 10.1103/PhysRevE.82.045201

http://www.sciencedaily.com/releases/2010/11/101116150041.htm

Putting the Chinese in 'Made in China'
By ALICE RAWSTHORN

BEIJING — If Hollywood location scouts were searching for a place to convey the style-crazed consumerism of the new Beijing, the shiny new Sanlitun Village North shopping center would be a strong contender.

What would they hope to find there? Soon-to-open stores for French fashion houses like Balenciaga and Lanvin? Check. More new stores for Japanese brands like Comme des Garçons and Bathing Ape? Check. A boutique hotel designed by a foreign starchitect? Check. (This one, the Opposite House, is by the Japanese architect Kengo Kuma.) A contemporary art gallery? Check. A cafe selling stratospherically expensive (though very yummy) cupcakes? Check again.

The Village North has all of the above. Only a few years ago Sanlitun was best known for drinking dens; it is now one of the places that — or so its developers hope — is becoming Beijing's answer to cool shopping districts like Omotesando in Tokyo. But amid the glossy global branding, an unexpectedly homely tone is struck by a store selling the work of young Chinese designers. A white neon frieze is suspended beside the entrance depicting three things that you'd expect to find in an old-fashioned Chinese kitchen — a sprig of mint, grains of sticky rice and a leek.

Each of the three ingredients was chosen because of the first letter of its Chinese name: B for bo he, or mint; N for nuomi, or sticky rice; and C for cong, or leek. They are also the first letters of the three words in the name of the store Brand New China, which is owned by Hong Huang, a Chinese publisher and blogger. She entrusted the visual identity to the graphic designer Liu Zhizhi, who has abbreviated the name to BNC, and chosen the three ingredients as symbols of each letter. As well as being depicted on the neon frieze, they also appear on all of its packaging in the form of traditional botanical drawings.

Sitting in the Colibri Cafe (home of those pricey cupcakes) Mr. Liu seems to be as perfectly cast to represent the new Beijing as Sanlitun Village North is to act as its set. A lithe 35-year-old with a wispy goatee and oversized spectacles, he is in the forefront of a new generation of graphic designers who are trying to define a visual language for contemporary China.

One way he does so is by using vernacular motifs familiar from daily life in China or its recent past. The mint, rice and leek in BNC's identity are typical. An earlier design was based on the ubiquitous logo of CCTV,

China's state broadcaster. Another was a map of Shanghai made from neon lights, which glowed across the city before the 1949 Chinese Revolution. He is also fond of using traditional Chinese printing techniques and paper treatments.

You can see similar allusions to everyday life in the work of contemporary Chinese architects, fashion designers and filmmakers, but Mr. Liu identifies other, subtler qualities that, he believes, make his designs "Chinese."

"An important difference between China and the West is that we respond to things instinctively," he said. "Westerners often want to understand things by rationalizing them, whereas we just feel and know. Our relationship to visual culture is intuitive and fluid."

"You can see that in the BNC identity, but there are other very obvious Chinese elements in it," he continued. "Not so much if you look at the symbols individually, but when you see them together. For example, the two main images, the mint and leek, are facing you flat on the page. The way the space is filled up is very Chinese, too. You can see both of those elements in traditional Chinese painting."

When Mr. Liu was growing up, graphic design didn't exist in China beyond the visual propaganda of government information campaigns. He discovered it as a teenager when the country's first-ever graphic design exhibition opened in Shenzhen in 1992. "It was the first time I'd heard of such a thing," he recalled. "And I knew at once that it was what I wanted to do."

After high school, he studied graphics at the prestigious Central Academy of Fine Arts in Beijing, and in 2002 opened a studio, the MEWE Design Alliance, with two fellow students, Guang Yu and He Jun. Most of their early work was for artists, architects and designers they had known at the academy and, like them, were based in 798, the labyrinth of studios and galleries on the site of an old electronics factory in the east of Beijing. MEWE folded this year, and Mr. Liu set up on his own, but the three have remained friends.

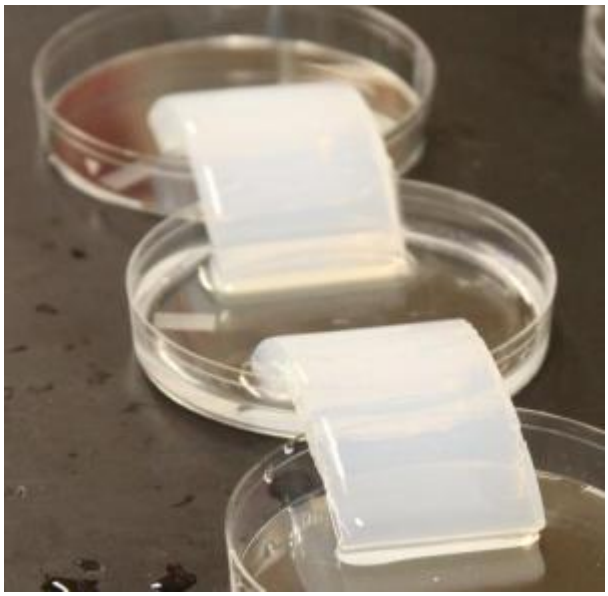
Still based in 798, he now works with three assistants and a partner. His business model is similar to that of the European independent design groups he admires, such as M/M (Paris), which adapt a distinctive approach to all of their work. "One of the challenges I enjoy is reflecting the client's needs and spirit in projects like the BNC identity," he said. "But I also see graphic design as a medium of self-expression."

Mr. Liu, like many of his peers, feels that design is still in its infancy in China. "There's a lot of talk about the transition from 'Made in China' to 'Designed in China,"' he said. "We're only a quarter of the way along that road, though we are moving in the right direction."

One frustration is that his commissions still come from the niche band of artists, designers, architects and creative entrepreneurs, like Ms. Hong, rather than from mass-market Chinese brands. "I want to reach a mass audience," he said. "It isn't possible yet, because those companies are too unsophisticated in their approach to graphic design. But it will change."

http://www.nytimes.com/2010/11/15/arts/15iht-design15.html?ref=design

Bioengineers Provide Adult Stem Cells With Simultaneous Chemical, Electrical and Mechanical Cues



The translucent materials bridging the dishes in the photo are "agarose salt bridges" -- part of the electrochemical cell used to subject hydrogels to an electric field. (Credit: Image courtesy of University of California - San Diego)

ScienceDaily (Nov. 17, 2010) — Bioengineers from the University of California, San Diego have achieved the "Triple Crown" of stem cell culture -- they created an artificial environment for stem cells that simultaneously provides the chemical, mechanical and electrical cues necessary for stem cell growth and differentiation. Building better microenvironments for nurturing stem cells is critical for realizing the promises of stem-cell-based regenerative medicine, including cartilage for joint repair, cardiac cells for damaged hearts, and healthy skeletal myoblasts for muscular dystrophy patients. The advance could also lead to better model systems for fundamental stem cell research.

This work appears in a paper published online in *Advanced Functional Materials* on November 13.

While researchers have already created artificial environments for stem cells that provide chemical cues combined with either mechanical or electrical cues, the UC San Diego bioengineers say this is the first material reported in the scientific literature, to the best of their knowledge, that simultaneously provides all three cues to stem cells in a three dimensional supportive environment. Remarkably, the development of the new material was led entirely by bioengineering undergraduate students at UC San Diego.

In nature, stem cells communicate with other cells and with the extracellular matrix through chemical, electrical, and mechanical cues. "We mimicked all these cues that the native environment provides to the cells. This work is therefore fundamental to creating more life-like environments for stem cells in order to steer stem cells toward specific cell types such as chondrocytes, osteoblasts, myoblasts or cardiomyocytes," said Shyni Varghese, the bioengineering professor who advised the student researchers working in her Biomimetic Polymers and Stem Cell Engineering laboratory at the UC San Diego Jacobs School of Engineering.

Realistic *in vitro* microenvironments for stem cells would also serve as excellent model systems for systematically studying cell function, signaling pathways, disease progression, and tissue growth and development.

Multifunctional Gel Matrix

The stem cells are embedded in a gelatin-like hydrogel bathed in an electrolyte solution compatible for cell growth. When an electric potential passes through the hydrogel, the gel bends and exerts mechanical strain on the cells that is designed to mimic the mechanical cues stem cells experience in natural microenvironments.

"Our hydrogel provides the chemical cues, and when you expose them to an electric field, the hydrogel surrounding the stem cells bends, which provides mechanical strain to the cells," said Varghese.

In the new paper, the bioengineers report results of human bone marrow derived mesenchymal stem cells growing in the new microenvironment. The chemical, electrical, and mechanical cues steered the embedded cells to differentiate into cartilage cells.

The researchers continue to improve their system, with the goal of coaxing healthy tissue from stem cells. "The ultimate goal of regenerative medicine is to make healthy tissues and differentiated cells with regenerating ability that can save lives. We are not there yet, but this work takes us one step closer," said Varghese, who is a faculty member of the UC San Diego Institute of Engineering in Medicine.

In addition, the work will be useful to researchers involved in basic stem cell research as well as stem-cell-based clinical trials. For example, in current clinical trials involving human stem cells, the cells are often conditioned in an artificial environment so that when they are implanted into humans, they are more apt to differentiate into the right kinds of cells. Additional control over the cues the cells receive during this conditioning phase could be critical to future regenerative therapy successes.

Crucial Undergraduate Input

"A significant portion of the credit goes to Han Lim, who did this work as an undergraduate bioengineering student. A lot of ideas bounced back and forth between he and I," said Varghese. "Han also sought out collaboration with NanoEngineering professor Gaurav Arya in order to incorporate mathematical modeling into the project. Han and the other undergraduates on this project were very active. They were coming to me and saying, 'Why don't we do this, why don't we do that? Let us do this, let us do that!'," said Varghese.

"I feel really excited and privileged to be given this opportunity to work independently with my colleagues, all of them being undergraduates except Professors Arya and Varghese. I must say initially it was very daunting, but I received a lot of help along the way," said Han Lim, the first author on the paper who performed this work as a bioengineering undergraduate, including a 2008 stint at a Calit2 Summer Undergraduate Research Scholar.

"I'd like to thank all my collaborators for their contributions, and especially Dr. Varghese for believing in our potential. With this research, I hope that somewhere in the future we will be able to manipulate chemical, mechanical, and electrical cues such that one can create better biomimicking materials for applications in tissue engineering. As for myself, it would be great if I can further my studies in this field by looking at other ways of studying and manipulating cell behavior. After my studies, I aim to pursue a career in academia and continue to work for the advancement of the field as well as improve the quality of medicine and life," said Lim.

Varghese's bioengineering research projects span the continuum from basic research to translational work aimed at bridging the bench-to-bed divide. The lab, however, is united by one overarching goal: to treat dysfunctional tissues or organs using stem cells and healthy tissues derived from stem cells.

"I strongly believe that if we don't fundamentally understand the science, then the translational work cannot happen. We need to know what is happening in nature before we can successfully mimic it," said Varghese.

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

Story Source:

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

Journal Reference:

1. Han L. Lim, Jessica C. Chuang, Tuan Tran, Aereas Aung, Gaurav Arya, Shyni Varghese. **Dynamic Electromechanical Hydrogel Matrices for Stem Cell Culture**. *Advanced Functional Materials*, 2010; DOI: 10.1002/adfm.201001519

http://www.sciencedaily.com/releases/2010/11/101116182049.htm

Heat Stress to Caribbean Corals in 2005 Worst on Record; Caribbean Reef Ecosystems May Not Survive Repeated Stress

NOAA diver with a one square meter quadrat examining a bleached reef (Montastraea) colony in St. Croix, USVI in Oct., 2005. (Credit: NOAA)

ScienceDaily (Nov. 16, 2010) — Coral reefs suffered record losses as a consequence of high ocean temperatures in the tropical Atlantic and Caribbean in 2005 according to the most comprehensive documentation of basin-scale bleaching to date. Collaborators from 22 countries report that more than 80 percent of surveyed corals bleached and over 40 percent of the total surveyed died, making this the most severe bleaching event ever recorded in the basin.

The study appears in *PLoS ONE,* an international, peer-reviewed, open-access, online publication.

Satellite-based tools from NOAA's Coral Reef Watch Program guided site selection for field observations conducted across the greater Caribbean region from June to October 2005. Field surveys of bleaching and mortality in this study surpass prior efforts in both detail and extent.

This study also substantially raised the standards for documenting the effects of bleaching and for testing satellite and forecast products. Coral bleaching occurs when stress causes corals to expel their symbiotic algae, or zooxanthellae. If prolonged or particularly severe, it may result in coral death.

"Heat stress during the 2005 event exceeded any observed in the Caribbean in the prior 20 years, and regionally-averaged temperatures were the warmest in at least 150 years," said C. Mark Eakin, Ph.D., coordinator of NOAA's Coral Reef Watch Program. "This severe, widespread bleaching and mortality will undoubtedly have long-term consequences for reef ecosystems, and events like this are likely to become more common as the climate warms."

Through this survey, several species and localities reported bleaching for the first time, including the first known bleaching of any kind in Saba, the first documented mass bleaching at the Flower Garden Banks National Marine Sanctuary, and the first reported mass bleaching in Virgin Islands National Park of *Acropora palmata*, a species listed as threatened under the U.S. Endangered Species Act in 2006.

The Caribbean is suffering severe bleaching again this year, and in some locations, this bleaching event is worse than the event in 2005. Not only are temperatures causing further damage to reefs hit hard during the 2005 event, but new locations have also been impacted.

The decline and loss of coral reefs has significant social, cultural, economic and ecological impacts on people and communities throughout the world. As the "rainforests of the sea," coral reefs provide economic services -- jobs, food and tourism -- estimated to be worth as much as $375 billion each year.

This research was supported by the NOAA Coral Reef Conservation Program. Its research and monitoring program covers all shallow-water and deep-water coral reef ecosystems under the jurisdiction of the United States and is intended to inform resource managers, scientists, policymakers and the public.

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **National Oceanic and Atmospheric Administration**.

Journal Reference:

1. C. Mark Eakin, Jessica A. Morgan, Scott F. Heron, Tyler B. Smith, Gang Liu, Lorenzo Alvarez-Filip, Bart Baca, Erich Bartels, Carolina Bastidas, Claude Bouchon, Marilyn Brandt, Andrew W. Bruckner, Lucy Bunkley-Williams, Andrew Cameron, Billy D. Causey, Mark Chiappone, Tyler R. L. Christensen, M. James C Crabbe, Owen Day, Elena de la Guardia, Guillermo Díaz-Pulido, Daniel DiResta, Diego L. Gil-Agudelo, David S. Gilliam, Robert N. Ginsburg, Shannon Gore, Héctor M. Guzmán, James C. Hendee, Edwin A. Hernández-Delgado, Ellen Husain, Christopher F. G. Jeffrey, Ross J. Jones, Eric Jordán-Dahlgren, Les S. Kaufman, David I. Kline, Philip A. Kramer, Judith C. Lang, Diego Lirman, Jennie Mallela, Carrie Manfrino, Jean-Philippe Maréchal, Ken Marks, Jennifer Mihaly, W. Jeff Miller, Erich M. Mueller, Erinn M. Muller, Carlos A. Orozco Toro, Hazel A. Oxenford, Daniel Ponce-Taylor, Norman Quinn, Kim B. Ritchie, Sebastián Rodríguez, Alberto Rodríguez Ramírez, Sandra Romano, Jameal F. Samhouri, Juan A. Sánchez, George P. Schmahl, Burton V. Shank, William J. Skirving, Sascha C. C. Steiner, Estrella Villamizar, Sheila M. Walsh, Cory Walter, Ernesto Weil, Ernest H. Williams, Kimberly Woody Roberson, Yusri Yusuf, Tamara Natasha Romanuk. **Caribbean Corals in Crisis: Record Thermal Stress, Bleaching, and Mortality in 2005**. *PLoS ONE*, 2010; 5 (11): e13969 DOI: 10.1371/journal.pone.0013969

http://www.sciencedaily.com/releases/2010/11/101116080407.htm

Astronomers Discover Merging Star Systems That Might Explode

The binary star system J0923+3028 consists of two white dwarfs: a visible star weighing 23 percent as much as our Sun and about four times the diameter of Earth, and an unseen companion weighing 44 percent of the Sun and about one Earth-diameter in size. The stars are currently separated by about 220,000 miles and orbit each other once per hour. The stars will spiral in toward each other and merge in about 100 million years. (Credit: Clayton Ellis (CfA))

ScienceDaily (Nov. 16, 2010) — Sometimes when you're looking for one thing, you find something completely different and unexpected. In the scientific endeavor, such serendipity can lead to new discoveries. Now, researchers who found the first hypervelocity stars escaping the Milky Way announced that their search also turned up a dozen double-star systems. Half of those are merging and might explode as supernovae in the astronomically near future.

All of the newfound binary stars consist of two white dwarfs. A white dwarf is the hot, dead core left over when a sun-like star gently puffs off its outer layers as it dies. A white dwarf is incredibly dense, packing as much as a sun's worth of material into a sphere the size of Earth. A teaspoon of it would weigh more than a ton.

"These are weird systems -- objects the size of the Earth orbiting each other at a distance less than the radius of the Sun," said Smithsonian astronomer Warren Brown, lead author of the two papers reporting the find.

The white dwarfs found in this survey are lightweight among white dwarfs, holding only about one-fifth as much mass as the Sun. They are made almost entirely of helium, unlike normal white dwarfs made of carbon and oxygen.

"These white dwarfs have gone through a dramatic weight loss program," said Carlos Allende Prieto, an astronomer at the Instituto de Astrofisica de Canarias in Spain and a co-author of the study. "These stars are in such close orbits that tidal forces, like those swaying the oceans on Earth, led to huge mass losses."

Remarkably, because they whirl around so close to each other, the white dwarfs stir the space-time continuum, creating expanding ripples known as gravitational waves. Those waves carry away orbital energy, causing the stars to spiral closer together. Half of the systems are expected to merge eventually. The tightest binary, orbiting once every hour, will merge in about 100 million years.

"We have tripled the number of known, merging white-dwarf systems," said Smithsonian astronomer and co-author Mukremin Kilic. "Now, we can begin to understand how these systems form and what they may become in the near future."

When two white dwarfs merge, their combined mass can exceed a tipping point, causing them to detonate and explode as a Type Ia supernova. Brown and his colleagues suggest that the merging binaries they have discovered might be one source of underluminous supernovae -- a rare type of supernova explosion 100 times fainter than a normal Type Ia supernova, which ejects only one-fifth as much matter.

"The rate at which our white dwarfs are merging is the same as the rate of underluminous supernovae -- about one every 2,000 years," explained Brown. "While we can't know for sure whether our merging white dwarfs will explode as underluminous supernovae, the fact that the rates are the same is highly suggestive."

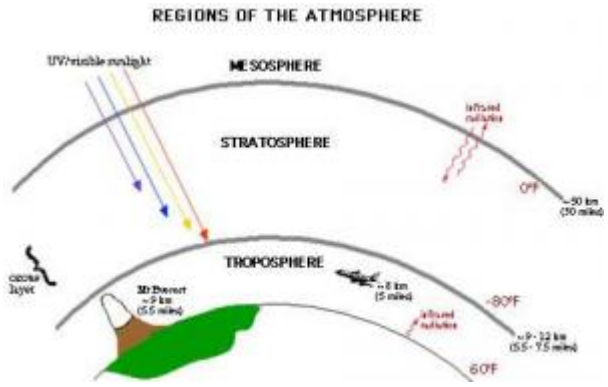
Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Harvard-Smithsonian Center for Astrophysics**.

Journal References:

1. Warren R. Brown, Mukremin Kilic, Carlos Allende Prieto, Scott J. Kenyon. **The ELM Survey. I. A Complete Sample of Extremely Low Mass White Dwarfs**. *The Astrophysical Journal*, ApJ, 2010, 723, 1072 DOI: 10.1088/0004-637X/723/2/1072
2. Warren R. Brown, Mukremin Kilic, Carlos Allende Prieto, Scott J. Kenyon. **The Merger Rate of Extremely Low Mass White Dwarf Binaries: Links to the Formation of AM CVn Stars and Underluminous Supernovae**. *Monthly Notices of the Royal Astronomical Society: Letters*, (in press) [link]

Earth's Lower Atmosphere Is Warming, Review of Four Decades of Scientific Literature Concludes



Regions of the atmosphere. (Credit: NOAA)

ScienceDaily (Nov. 16, 2010) — The troposphere, the lower part of the atmosphere closest to the Earth, is warming and this warming is broadly consistent with both theoretical expectations and climate models, according to a new scientific study that reviews the history of understanding of temperature changes and their causes in this key atmospheric layer.

Scientists at NOAA, the NOAA-funded Cooperative Institute for Climate and Satellites (CICS), the United Kingdom Met Office, and the University of Reading in the United Kingdom contributed to the paper, "Tropospheric Temperature Trends: History of an Ongoing Controversy," a review of four decades of data and scientific papers to be published by *Wiley Interdisciplinary Reviews: Climate Change*, a peer-reviewed journal.

The paper documents how, since the development of the very first climate models in the early 1960s, the troposphere has been projected to warm along with the Earth's surface because of the increasing amounts of greenhouse gases in the atmosphere. This expectation has not significantly changed even with major advances in climate models and is in accord with our basic physical understanding of atmospheric processes.

In the 1990s, observations did not show the troposphere, particularly in the tropics, to be warming, even though surface temperatures were rapidly warming. This lack of tropospheric warming was used by some to question both the reality of the surface warming trend and the reliability of climate models as tools. This new paper extensively reviews the relevant scientific analyses -- 195 cited papers, model results and atmospheric data sets -- and finds that there is no longer evidence for a fundamental discrepancy and that the troposphere is warming.

"Looking at observed changes in tropospheric temperature and climate model expectations over time, the current evidence indicates that no fundamental discrepancy exists, after accounting for uncertainties in both the models and observations," said Peter Thorne, a senior scientist with CICS in Asheville, N.C., and a senior researcher at North Carolina State University. CICS is a consortium jointly led by the University of Maryland and North Carolina State University.

This paper demonstrates the value of having various types of measurements -- from surface stations to weather balloons to satellites -- as well as multiple independent analyses of data from these observation systems.

"There is an old saying that a person with one watch always knows what time it is, but with two watches one is never sure," said Thomas Peterson, lead scientist at NOAA's National Climatic Data Center. "The controversy started with the production of the first upper-air temperature 'watch' in 1990, and it was only later when multiple additional 'watches' were made by different 'manufacturers' that we learned that they were each a few minutes off. Although researchers all agree the temperature is increasing, they disagree how much."

And while this is the first comprehensive review of the scientific literature on this topic, it is not the last word on the tropospheric temperature trend.

"Looking to the future, it is only through robust and varied observations and data analyses that we can hope to adequately understand the tropospheric temperature trend," said Dian Seidel, a NOAA scientist at the Air Resources Laboratory, in Silver Spring, Md.

The study was funded by UK Department of Energy and Climate Change, the UK Department of Environment, Food and Rural Affairs and NOAA.

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **National Oceanic and Atmospheric Administration**.

Journal Reference:

1. Peter W. Thorne, John R. Lanzante, Thomas C. Peterson, Dian J. Seidel, Keith P. Shine. **Tropospheric temperature trends: history of an ongoing controversy**. *Wiley Interdisciplinary Reviews: Climate Change*, 2010; DOI: 10.1002/wcc.80

http://www.sciencedaily.com/releases/2010/11/101116080321.htm

Global Warming Could Cool Down Northern Temperatures in Winter

New research suggests that the shrinking of sea-ice in the eastern Arctic causes some regional heating of the lower levels of air -- which may lead to strong anomalies in atmospheric airstreams, triggering an overall cooling of the northern continents. (Credit: iStockphoto/Vladimir Piskunov)

ScienceDaily (Nov. 17, 2010) — The overall warming of Earth's northern half could result in cold winters, new research shows. The shrinking of sea-ice in the eastern Arctic causes some regional heating of the lower levels of air -- which may lead to strong anomalies in atmospheric airstreams, triggering an overall cooling of the northern continents, according to a study recently published in the *Journal of Geophysical Research.*

"These anomalies could triple the probability of cold winter extremes in Europe and northern Asia," says Vladimir Petoukhov, lead author of the study and climate scientist at the Potsdam Institute for Climate Impact Research. "Recent severe winters like last year's or the one of 2005-06 do not conflict with the global warming picture, but rather supplement it."

The researchers base their assumptions on simulations with an elaborate computer model of general circulation, ECHAM5, focusing on the Barents-Kara Sea north of Norway and Russia where a drastic reduction of ice was observed in the cold European winter of 2005-06. Those surfaces of the sea lacking the ice cover lose a lot of warmth to the normally cold and windy arctic atmosphere. What the researchers did was to feed the computer with data, gradually reducing the sea ice cover in the eastern Arctic from 100 percent to 1 percent in order to analyse the relative sensitivity of wintertime atmospheric circulation.

"Our simulations reveal a rather pronounced nonlinear response of air temperatures and winds to the changes of sea-ice cover," Petoukhov, a physicist, says. "It ranges from warming to cooling to warming again, as sea ice decreases." An abrupt transition between different regimes of the atmospheric circulation in the sub-polar and polar regions may be very likely. Warming of the air over the Barents-Kara Sea seems to bring cold winter winds to Europe. "This is not what one would expect," Petoukhov says. "Whoever thinks that the shrinking of some far away sea-ice won't bother him could be wrong. There are complex teleconnections in the climate system, and in the Barents-Kara Sea we might have discovered a powerful feedback mechanism."

Other approaches to the issue of cold winters and global warming referring to reduced sun activity or most recently the gulf stream "tend to exaggerate the effects," Petoukhov says. The correlation between these phenomena and cold winters is relatively weak, compared to the new findings referring to the processes in the Barents-Kara Sea. Petoukhov also points out that during the cold winter of 2005-06 with temperatures of ten degrees below the normal level in Siberia, no anomalies in the north Atlantic oscillation have been observed. These are fluctuations in the difference of atmospheric pressure between the Icelandic low and the Azores

high which are commonly associated with temperature anomalies over Europe. But temperatures in the eastern arctic were up to 14 degrees above normal level. However, distinct anomalies in the north Atlantic oscillation could interact with sea-ice decrease, the study concludes. One could amplify the other and more anomalies would be the result.

Petoukhov's study is not about tomorrow's weather forecast but about longtime probabilities of climate change. "I suppose nobody knows," he says, "how harsh this year's winter will be."

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Potsdam Institute for Climate Impact Research**.

Journal Reference:

1. Vladimir Petoukhov, Vladimir A. Semenov. **A link between reduced Barents-Kara sea ice and cold winter extremes over northern continents**. *Journal of Geophysical Research*, 2010; 115 (D21): D21111 DOI: 10.1029/2009JD013568

http://www.sciencedaily.com/releases/2010/11/101117114028.htm

Small Clumps of Tau Protein Disrupt Memory; Animal Study Suggests Possible Target for Alzheimer's Disease Therapies

ScienceDaily (Nov. 16, 2010) — Too many small aggregates of a protein called tau in the brain can directly interfere with memory, according to new animal research presented at Neuroscience 2010, the annual meeting of the Society for Neuroscience, held in San Diego.

"Our findings are important because they suggest that tau may be a good target for developing therapies against Alzheimer's and related diseases," said senior author Ottavio Arancio, PhD, of Columbia University.

Many neurodegenerative diseases are marked by an accumulation of protein aggregates in the brain, and Alzheimer's disease is no exception. The two most common aggregating proteins associated with Alzheimer's disease are amyloid- beta and tau, which form the neural plaques and tangles that are hallmarks of the disease. Recently, scientists have begun to focus on some of the smaller, still-soluble forms of these protein aggregates, called oligomers, which may be especially toxic to neurons.

Arancio and his colleagues found that tau oligomers impaired fearful memories in mice. Tau oligomers also disrupted synaptic plasticity -- cellular events important for memory formation.

"Our findings suggest that tau is critically involved in the development of Alzheimer's disease -- and that reducing the abnormal aggregation of the protein may prove to be an effective treatment approach," Arancio said.

Research was supported by the Alzheimer's Drug Discovery Foundation, the National Institutes of Health, and Oligomerix, Inc.

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

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Society for Neuroscience**.
http://www.sciencedaily.com/releases/2010/11/101116204837.htm

Low-Allergenic Wines Could Stifle Sniffles and Sneezes in Millions of Wine Drinkers

Scientists have identified a mysterious culprit that threatens headaches, stuffy noses, skin rash and other allergy symptoms when more than 500 million people worldwide drink wine. The discovery could help winemakers in developing the first low allergenic vintages -- reds and whites with less potential to trigger allergy symptoms, they say. (Credit: iStockphoto/Igor Dutina)

ScienceDaily (Nov. 17, 2010) — Scientists have identified a mysterious culprit that threatens headaches, stuffy noses, skin rash and other allergy symptoms when more than 500 million people worldwide drink wine. The discovery could help winemakers in developing the first low allergenic vintages -- reds and whites with less potential to trigger allergy symptoms, they say.

The new study appears in ACS' *Journal of Proteome Research*.

Giuseppe Palmisano and colleagues note growing concern about the potential of certain ingredients in red and white to cause allergy-like symptoms that range from stuffed up noses to headaches to difficulty breathing. So-called wine allergies occur in an estimated 8 percent of people worldwide. Only 1 percent of those involve sulfites, sulfur-containing substances that winemakers add to wine to prevent spoilage and also occur naturally. But the wine components that trigger allergies in the remaining 7 percent are unclear. Studies suggest that glycoproteins -- proteins coated with sugars produced naturally as grapes ferment -- may be a culprit. However, scientists knew little about the structure and function of these substances in wine.

Their analysis of Italian Chardonnay uncovered 28 glycoproteins, some identified for the first time. The scientists found that many of the grape glycoproteins had structures similar to known allergens, including proteins that trigger allergic reactions to ragweed and latex. The discovery opens to door to development of wine-making processes that minimize formation of the culprit glycoproteins and offer consumers low-allergenic wines.

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

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **American Chemical Society**.

Journal Reference:

1. Giuseppe Palmisano, Donato Antonacci, Martin R. Larsen. **Glycoproteomic profile in wine: a 'sweet' molecular renaissance**. *Journal of Proteome Research*, 2010; : 101005203841006 DOI: 10.1021/pr100298j

http://www.sciencedaily.com/releases/2010/11/101117121807.htm

Development of a Safer Vaccine for Alzheimer's Disease; Mouse Study Suggests New Vaccine Approach That May Avoid Side Effects

ScienceDaily (Nov. 16, 2010) — A new vaccine protects against memory problems associated with Alzheimer's disease, but without potentially dangerous side effects, a new animal study reports.

The research was presented at Neuroscience 2010, the annual meeting of the Society for Neuroscience, held in San Diego.

Vaccines against amyloid-beta accumulation in the brain, one of the hallmarks of Alzheimer's disease, have long been considered a promising approach to developing a treatment. But finding a vaccine that is both safe and effective has been challenging. Previous research in mice showed that a vaccine that targets the human version of amyloid-beta reduces learning and memory loss associated with the disease. However, the vaccine caused dangerous autoimmune inflammation of the brain during human clinical trials.

In the current study, researchers at the University of California, Irvine tested a vaccine developed against a non-human protein that had the same shape as amyloid-beta, but a different sequence of amino acid building blocks. The Alzheimer's mice that received the vaccine showed improved performance on memory and other cognitive tests. The vaccine also reduced the clumps of amyloid-beta and tau protein that may be toxic to brain cells.

"This finding is important because it shows that you don't need a human protein to get an immune response that will neutralize the toxic amyloid oligomers associated with Alzheimer's disease," said senior author Charles Glabe, PhD. Because the protein was not human, Glabe and his colleagues believe it is unlikely to cause the dangerous autoimmune response.

"We've demonstrated a promising approach to developing a safe, active vaccine -- and one potentially cheaper and easier to distribute than the manufactured vaccines currently in human trials," Glabe said.

Research was supported by Cure Alzheimer's Fund and the Larry L. Hillblom Foundation.

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

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Society for Neuroscience**.

http://www.sciencedaily.com/releases/2010/11/101116204730.htm

Deepwater Horizon: Not Managing Danger, Not Learning from 'Near Misses'

Image of Oil Slick, Mississippi River Delta, Gulf of Mexico. The International Space Station (ISS) observed the Gulf of Mexico oil spill in late July 2010. When this image was taken, three months after the explosion on the Deepwater Horizon oil rig, the leak had been plugged for eight days. (Credit: NASA)

ScienceDaily (Nov. 17, 2010) — The numerous technical and operational breakdowns that contributed to the Deepwater Horizon oil rig explosion and spill from the Macondo well in the Gulf of Mexico suggest the lack of a suitable approach for managing the inherent risks, uncertainties, and dangers associated with deepwater drilling operations and a failure to learn from previous "near misses," says an interim report of preliminary findings from a committee of the National Academy of Engineering and National Research Council. The events also suggest insufficient checks and balances for critical decisions impacting the schedule for "abandoning" the exploratory well -- or sealing it in transition to production -- and for considering well safety.

"Important decisions made to proceed toward well abandonment despite several indications of potential hazard suggest an insufficient consideration of risks," said Donald Winter, former secretary of the Navy, professor of engineering practice at the University of Michigan, and chair of the study committee. "It's also important to note that these flawed decisions were not identified or corrected by BP and its service contractors, or by the oversight process employed by the U.S. Minerals Management Service and other regulatory agencies."

It may not be possible to definitively establish which mechanisms caused the blowout and explosion, given the deaths of 11 witnesses on board, the loss of the oil rig and important records, and the difficulty in obtaining reliable forensics information from the Macondo well, the report says. Nevertheless, the committee believes it has been able to develop a good understanding of a number of key factors and decisions that may have contributed to the blowout of the well.

The report cites numerous decisions that apparently contributed to the accident, beginning with continuing abandonment operations at the Macondo site despite several tests that indicated that the cement put in place after the installation of a long-string production casing was not an effective barrier to prevent gases from entering the well. The decision to accept the test results as satisfactory without review by adequately trained shore-based engineering or management personnel suggests a lack of discipline and clearly defined responsibilities. In addition, several clear failures in monitoring of the well appear to have contributed to its blowout; available data show hydrocarbons entered the well undetected for almost an hour before the first explosion. Timely and aggressive action to control the well was not taken, and for unknown reasons,

hydrocarbons were funneled through equipment that vented them directly above the rig floor rather than overboard. These conditions made ignition "most likely," the report says. Finally, the blowout preventer did not seal the well once activated.

Of particular concern is the lack of a systems approach to integrate the multiple factors impacting well safety, to monitor the overall margins of safety, and to assess various decisions from a well integrity and safety perspective. The report also notes that a previous loss of hydrocarbon circulation in the Macondo well more than a month before the accident presented an opportunity to take actions to mitigate future risks.

Several questionable decisions also were made about the cementing process prior to the accident, including attempting to cement across multiple hydrocarbon and brine zones in the deepest part of the well in a single operational step, making a hydraulic fracture in a low-pressure zone more likely; using a long-string production casing instead of a liner over the uncased section of the well; and deciding that only six centralizers were needed to ensure an even spacing between the formation rock and the casing, even though modeling results suggested that more centralizers would have been necessary. The type and volume of cement used to prepare for well abandonment and the time provided for the cement to cure may also have impacted the well's integrity.

For its final report, due in the summer of 2011, the committee will examine ways to establish practices and standards to foster a culture of safety and methods to ensure that schedule and cost decisions do not compromise safety. The committee will assess the extent to which there are gaps, redundancies, and uncertainties in responsibilities of multiple agencies and professional societies overseeing deepwater drilling operations, and it will consider the merits of an independent technical review to provide operation checks and balances by enforcing standards and reviewing deviations.

The Macondo well's blowout preventer was only recently recovered and is undergoing forensic analyses. The committee will evaluate possible causes for the failure of the blowout preventer once key data are made available. Data on maintenance, testing, operating procedures, and reliability of alarms and other safety systems on the Deepwater Horizon rig will also be examined; testimony at other hearings indicate that various alarms and safety systems failed to operate as intended.

The study is being sponsored by the U.S. Department of the Interior. The National Academy of Sciences, National Academy of Engineering, Institute of Medicine, and National Research Council make up the National Academies.

Interim Report on Causes of the Deepwater Horizon Oil Rig Blowout and Ways to Prevent Such Events

http://download.nap.edu/cart/deliver.cgi?record_id=13047

Story Source:

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

http://www.sciencedaily.com/releases/2010/11/101117104458.htm

How Anthrax Bacteria Impair Immune Response

ScienceDaily (Nov. 17, 2010) — Researchers from the National Institute of Allergy and Infectious Diseases (NIAID), part of the National Institutes of Health, have determined a key mechanism by which *Bacillus anthracis* bacteria initiate anthrax infection despite being greatly outnumbered by immune system scavenger cells. The finding, made by studying genetically modified mice, adds new detail to the picture of early-stage anthrax infection and supports efforts to develop vaccines and drugs that would block this part of the cycle.

To start an infection, anthrax bacteria release a toxin that binds to immune cells through two receptors, TEM8 and CMG2, found on the cell surface. The binding allows two additional bacterial toxins to enter the cells, setting off a chain of events that impairs their ability to ingest and kill the bacteria.

In the new research, NIAID investigators Stephen Leppla, Ph.D., Shihui Liu, M.D., Ph.D., and colleagues bred mice that lacked CMG2 receptors on two kinds of immune cells, neutrophils and macrophages. These usually are the first cells to arrive at the site of an anthrax infection, where they engulf the invading bacteria and try to prevent the spread of infection.

Mice without CMG2 receptors on these immune cells were completely resistant to infection by B. anthracis bacteria, experiencing only a temporary swelling at the site of infection, and fully clearing the infection within two weeks. In contrast, in normal mice, the level of anthrax bacteria increased rapidly in the 48 hours following infection, and all the mice died within six days.

The researchers concluded that B. anthracis uses CMG2 receptors to impair the scavenging action of neutrophils and macrophages during early infection, giving the bacteria time to multiply to levels sufficient to overwhelm the body's defenses. Developing drugs and vaccines that block B. anthracis from establishing early infection via binding to the CMG2 receptor, say the study authors, may be crucial to success in treating and preventing anthrax disease.

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

Story Source:

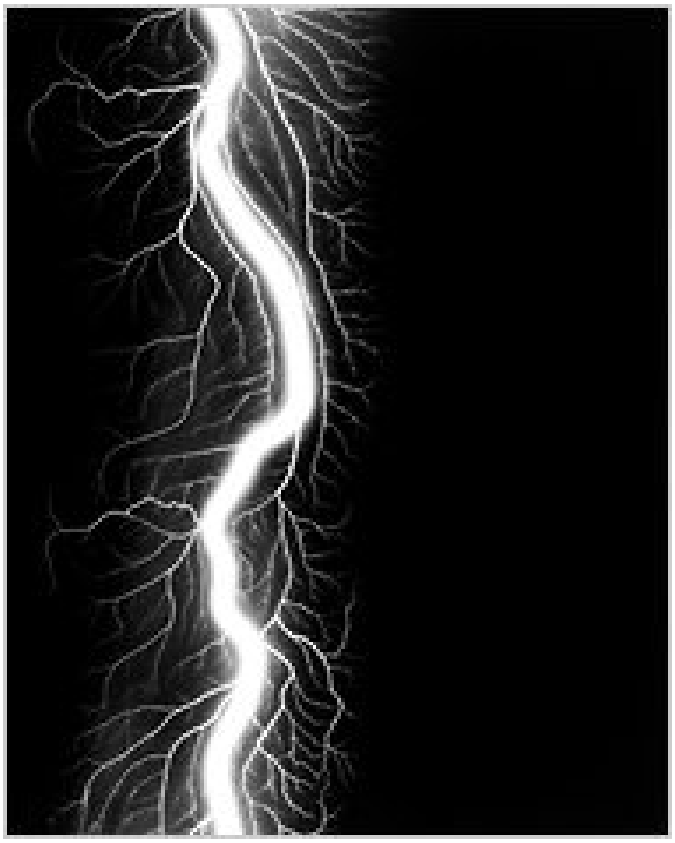
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **NIH/National Institute of Allergy and Infectious Diseases**.

Journal Reference:

1. S Liu et al. **Anthrax toxin targeting of myeloid cells through the CMG2 receptor is essential for establishment of Bacillus anthracis infections in mice**. *Cell Host and Microbe*, 2010 DOI: 10.1016/j.chom.2010.10.004

http://www.sciencedaily.com/releases/2010/11/101117121759.htm

Stealing Mother Nature's Thunder
By CAROL KINO



HIROSHI SUGIMOTO is often venerated as a Zen master of film photography. But in "The Day After," an exhibition that opened Nov. 6 at the Pace Gallery in Chelsea, he has assumed a new persona — that of a wild and visionary scientist.

The show focuses on Mr. Sugimoto's latest work: a series of monumental "Lightning Field" photographs, all from last year, that seem to sizzle with majestic lightning bolts. Marked by incandescent whites, velvety blacks and subtle textural detail, they suggest the birth of stars and planets.

These photographs are the largest that Mr. Sugimoto has ever made, and they took him some four years of intensive research to perfect. "I have always been curious about science," he said in a recent interview at his Chelsea studio. "But now it's getting very serious."

He generates his lightning photographs without a camera, rather like a photogram. But instead of placing an object on photo-sensitive paper, then exposing it to light, he produces the image by causing electrical sparks to erupt over the film's surface. The process "creates a similar situation to the first meteorite hitting the Earth," he said, before embarking on a discussion about the panspermia hypothesis, which holds that life was created when meteorites laced with amino acids plunged into the primordial seas. "That's the theory that's most believable now," Mr. Sugimoto observed wryly. "But it sounds like a fairy tale to me."

He has conceived of "The Day After" as a spectacular sound-and-light installation focused on the origins of life and the intersection of art and science. Along with pieces from his own fossil and meteorite collections

the show includes a sculpture that emits miniature purple lightning bolts. There are also photographs from his "Diorama" and "Seascape" series.

Mr. Sugimoto said he considers his entire oeuvre, including his pictures of movie theaters and wax dummies, to be "a construction of human and life history." Now, he added, "I'm using my photography methods to go back into time, to the beginning of life formation."

Lightning Field Photographs

Mr. Sugimoto said that forging a "Lightning Field" photograph can be a bit risky, involving a 7-by-2.5-foot sheet of film laid on a metal plate, a 400,000-volt Van de Graaff generator and an electrical-discharge device that he calls a wand. (He has several, each one made from a metal kitchen utensil taped to a plexiglass handle.)

To start Gregg Stanger, who manages Mr. Sugimoto's studio, connects the wand to the generator with an insulated wire. Then he and Mr. Sugimoto sequester themselves inside a pitch-black darkroom. (Although they wear rubber-soled shoes, they have both been shocked many times.) Mr. Stanger flips the generator switch, and Mr. Sugimoto waves the wand until the air crackles with static electricity.

Mustering the right dose of charge is a matter of intuition, but Mr. Sugimoto knows he's near the jackpot when "all the hair on my arms stands up," he explained. As things start "getting into the danger zone," and he senses that "it's ready to spark," he lowers the wand toward the film. Then "Bam!" he said. "It's a big bang. It's a miniature lightning field." But he doesn't know exactly what pattern the electricity has wrought until he has developed the film.

Then Mr. Sugimoto searches for the perfect 8-by-10 portion of the film to enlarge. By this point he has scores of negatives to choose from. "It's like trying to cut the center out of the entire sky," he said, joking. "I tell people that I hired a god to do it for me. Gods are not so expensive anymore."

Faraday Cage

Using an antique birdcage, a Tesla coil and other found objects, this assemblage pays homage to three of Mr. Sugimoto's mentors from history: Marcel Duchamp, who invented the mechanical readymade; William Henry Fox Talbot, who invented negative-positive photography; and Michael Faraday, the 19th-century English physicist and chemist who discovered the basic laws of electromagnetism.

At first the Faraday cage evokes Duchamp: it's based on his drawing for the Bachelor Machine, the contraption that occupies the lower half of "The Bride Stripped Bare by Her Bachelors, Even" (1915-23). But the Tesla coil, which sputters with purple electrical arcs, is a nod to the moment Mr. Sugimoto decided to make a serious study of electricity.

While visiting the Fox Talbot Museum in Britain some years back Mr. Sugimoto was stunned to discover that Fox Talbot had once conducted joint research into static electricity with his friend and colleague Faraday.

"All the books mentioned his photography activities only," Mr. Sugimoto said. Since he was already pursuing similar research, Mr. Sugimoto decided to plunge in where Fox Talbot left off.

He said he has learned that it takes many years to transform scientific discoveries into art. But "if I keep practicing," he added, "then maybe I will find the secret of the universe."

Seascapes and Dioramas

Mr. Sugimoto finished his first "Diorama" photograph in 1976, soon after moving to New York. Back then, like Timothy Leary and other pharmacological experimentalists before him, he was using hallucinogenic drugs to explore his consciousness.

"I ingest a hallucinogenic substance," he said excitedly, recalling those days, "and then all of a sudden this small piece of material gets into my body and changes my sight and sounds and vision and memory. Then I lose my sense of time. I can speak to anybody in history."

One day, without drugs, he had a similar sensation on a visit to the American Museum of Natural History. He was familiar with the dioramas there, full of "dead stuffed animals, posing for me," he said, but the fusty scenes suddenly seemed to spring to life.

"If I can photograph them as I see them," he remembered thinking, "maybe people will share the same vision." The rest is photographic history.

Similarly he conceived of his "Seascape" series as a way to evoke the birth of human consciousness. As he traveled the world, photographing vast expanses of water, he decided to take the perspective of "the first human who appeared on this planet," he said.

He was also driven by a potent childhood memory: the moment he caught his first glimpse of the ocean and "became aware of myself."

http://www.nytimes.com/2010/11/14/arts/design/14sugimoto.html?ref=design

Baking Soda Dramatically Boosts Oil Production in Algae

MSU researchers Keith Cooksey, Brent Peyton and Rob Gardner (from left) discovered that baking soda, added at a specific time in the growth cycle of algae, dramatically increases the production of oil. (Credit: MSU photo by Kelly Gorham)

ScienceDaily (Nov. 12, 2010) — Montana State University researchers have discovered that baking soda can dramatically increase algae's production of the key oil precursors for biodiesel.

The same ingredient that causes cookies to rise in the oven, the same agent that calms upset stomachs and removes odors from refrigerators is the elusive chemical trigger that scientists have sought since the early 1990s, said Rob Gardner, an MSU graduate student in chemical and biological engineering and a native of Afton, Wyo.

When added at a particular time in the growing cycle, baking soda more than doubled the amount of oil produced in half the time in three different types of algae.

"It took a lot of work. I was pretty thrilled when it all came together," Gardner said. "I'm still kind of in shock about it."

Gardner is part of the team that developed the algal biofuel technology that MSU is now offering for licensing. Other members are longtime algae experts -- Keith Cooksey, research professor emeritus in microbiology, and Brent Peyton, professor in chemical and biological engineering and associate director of MSU's Thermal Biology Institute. Representing the College of Engineering and College of Letters and Science, all three belong to MSU's Algal Biofuels Group, "one of the best cooperative research groups on campus," according to Cooksey.

The Algal Biofuels Group is part of MSU's MSU's Energy Research Institute, an umbrella for roughly 35 faculty working in a variety of disciplines. About $15 million in sponsored energy research is conducted at MSU annually.

"We are looking at everything from biofuels, to fuel cells, to wind, to carbon sequestration," said Lee Spangler, Energy Research Institute director. "This work by the algal group is an exciting example of how we take university research and make it available to the private sector through licensing."

The algal group also belong to the Algal Biomass Organization, the world's largest group devoted to algal biofuel. Peyton presented MSU's discovery to that group in late September. It was one of four presentations on biofuel from MSU.

The search for a chemical trigger to boost oil production in algae was a long, sometimes torturous, journey, according to the three MSU scientists. Not only did they have to find a chemical that would work, but they had to figure out the best time to add it to the algae. Cooksey taught Gardner how to grow the algae they used in their experiments. Gardner grew the algae in beakers and tubes in three labs across campus. He then conducted experiments and shared his progress with Cooksey and Peyton. Gardner worked for about 1 1/2 years before the trio confirmed that baking soda was the chemical trigger they'd been seeking. They made their initial discovery in two kinds of brown algae and one type of green.

"It was a lot of trial and error and failure," Gardner said. "We finally came across the right combination."

Cooksey said baking soda may work because it gives algae extra carbon dioxide necessary for its metabolism at a key point in its life cycle. If the baking soda is added too early or too late, the algae don't respond. But when added at just the right time in the growth cycle, algae produce two to three times the oil in half the time of conventional growth models. The oil, or lipid, is composed of triacylglycerides, the key precursors to biodiesel and biojet fuel.

"For industry, if you double your output in half the time, that's a big deal," Cooksey said.

Reducing the amount of time needed to produce oil is also good because algal-producing ponds are prone to contamination, he added. If growers can produce oil faster, they can reduce the opportunity for contamination to ruin the product.

Peyton said the three types of algae used in the MSU study were not closely related, so the MSU discovery should have broad application.

"We are working on demonstrating this in other varieties," he said.

Peyton and Cooksey said the baking soda discovery demonstrated the value of interdisciplinary work on campus.

"The ties between the chemical and biological engineering and microbiology departments have never been stronger," Peyton said. "We work so closely with so many of the microbiologists that it's a very good collaboration, very fruitful."

He added that algal biofuel is the "fastest moving area I have ever been involved with. It's hard to keep up with all the new developments."

Cooksey, 75, researched algal biofuel 20 years ago and published more than 40 papers in the general area, but said the government eventually lost interest and withdrew its funding. The trend has reversed itself, however, and the field is exploding. Cooksey doesn't think the interest will disappear this time because some of the biggest energy users in the world -- members of the defense and commercial airline industries -- have thrown their support behind pursuing the idea.

Cooksey is now in demand for his expertise, but he is still miffed about the lost years.

"It's great, but it's frustrating," Cooksey said. "Why the hell didn't we do this 20 years ago because we would be where we'd like to be by now."

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Montana State University**. The original article was written by Evelyn Boswell, MSU News Service.

http://www.sciencedaily.com/releases/2010/11/101115091902.htm

Infant Estrogen Levels Tracked Through Diaper Research

Transport coolers containing materials for parents, including fresh diapers, plastic bags and tagging materials. Freezer blocks were laid on top. (Credit: Image courtesy of Emory University)

ScienceDaily (Nov. 17, 2010) — With the help of babies and more than 5,000 of their diapers, Emory University researchers have developed an accurate, noninvasive method to determine estrogen levels in infants.

The method, previously used in nonhuman primates, will allow researchers to learn more about the association between estrogen levels in human infants and their long-term reproductive development as well as the development of sex-specific behaviors, such as toy preference or cognitive differences. What's more, the method will also allow researchers to look at how early disruption of the endocrine system affects long-term maturation, a growing concern among researchers and physicians.

Surprisingly little is known about hormone levels during human infancy. Previous human research has focused on the measurement of hormones in blood, urine and saliva. The new data are the result of using fecal samples collected from cotton diapers. With this novel approach, the researchers successfully measured the fecal levels of estradiol, a type of estrogen.

The well-known importance of estradiol's role in postnatal development of the body, brain and behavior has in recent years raised specific concerns about how exogenous estrogens, or environmental estrogens, such as those found in soy, fruits and vegetables, plastics and common household items, affect lifelong health.

"The development of robust, noninvasive methods to measure these hormones in infants allows us to further investigate the association between postnatal hormone production and the development of sex-specific biology and behavior," says Michelle Lampl, PhD, MD, Emory University Samuel Candler Dobbs professor of anthropology, and senior author of a paper in Frontiers in Systems Biology describing the new method. The study, conducted by researchers at Emory, the University of North Carolina at Chapel Hill and the University of Virginia Health System, Charlottesville, appears online and in the current issue of Frontiers in Systems Biology.

"The development of an assay to measure estrogen from diapers might initially strike one as unnecessary or strange, but the need is real," says Sara Berga, MD, James Robert McCord professor and chairman, Department of Gynecology and Obstetrics, Emory University School of Medicine.

"We understand very little about the hormonal dynamics that occur during early development precisely because we lack a reliable way to track hormones in neonates and very young children. Having a way to track this critical hormone that influences behavior and the development of many important tissues, including the brain, will allow us to understand normal. This really is a great leap forward, and the investigators should be congratulated on this advance."

The paper's lead author is Amanda L. Thompson, PhD, who conducted the research at Emory and is now assistant professor of anthropology at the University of North Carolina, Chapel Hill. Other authors are corresponding author Michael L. Johnson, PhD, University of Virginia Health System, and Patricia L. Whitten, Emory University.

Because of the ethical and practical difficulties of repeatedly taking blood samples from healthy infants, little data are currently available for charting the developmental pathways of estradiol. As such, existing data describe only the range of variability in hormonal levels--not developmental trends or what that variability might mean when it comes to individual physical and behavioral development.

The study included 32 infants, 15 male and 17 female, aged 7 days to 15 months. The infants' parents retained soiled diapers after each diaper change during a 24-hour period. Bagged diapers were collected and then frozen and stored at -- 80°C and analyzed 24 hours to 12 months after collection. In preparation for analysis, diapers were thawed overnight at 2 to 8°C.

Previous studies in primates have shown a close parallel between fecal levels of estradiol and serum values. Likewise, a comparison of fecal steroid levels between the study infants and previous studies of human adults shows an overlapping pattern, a pattern that is also seen in infant serum when compared with adult serum.

"These observations are the first report of human infant fecal estradiol levels and they provide a new tool for investigating early human development," says Lampl. "Because infant diapers are plentiful, fecal samples can be collected frequently and over a long period of time. Future longitudinal studies will allow the association between fecal levels of steroids and physiological measures to be assessed, and expand our understanding independent of serum measures."

At Emory, Lampl also serves as associate director of the Emory/Georgia Tech Predictive Health Institute.

Lampl's research centers on human growth spurts, with a focus on fetal and infant stages of life. Her current work investigates the relationship between nutrition, immunological and hormonal networks that interact with behavior to influence developmental processes.

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

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Emory University**. The original article was written by Robin Tricoles.

Journal Reference:

1. Thompson AL, Whitten PL, Johnson ML and Lampl ML. **Noninvasive methods for estradiol recovery from infant fecal samples**. *Front. Physio.*, July 11, 2010 DOI: 10.3389/fphys.2010.00148

http://www.sciencedaily.com/releases/2010/11/101116150400.htm

Artificial Black Holes Made With Metamaterials: Design for Human-Made Light Trapping Device Could Help Harvest Light for Solar Cells

ScienceDaily (Nov. 17, 2010) — While our direct knowledge of black holes in the universe is limited to what we can observe from thousands or millions of light years away, a team of Chinese physicists has proposed a simple way to design an artificial electromagnetic (EM) black hole in the laboratory.

In the *Journal of Applied Physics*, Huanyang Chen at Soochow University and colleagues have presented a design of an artificial EM black hole designed using five types of composite isotropic materials, layered so that their transverse magnetic modes capture EM waves to which the object is subjected. The artificial EM black hole does not let EM waves escape, analogous to a black hole trapping light. In this case, the trapped EM waves are in the microwave region of the spectrum.

The so-called metamaterials used in the experiment are artificially engineered materials designed to have unusual properties not seen in nature. Metamaterials have also been used in studies of invisibility cloaking and negative-refraction superlenses. The group suggests the same method might be adaptable to higher frequencies, even those of visible light.

"Development of artificial black holes would enable us to measure how incident light is absorbed when passing through them," says Chen. "They can also be applied to harvesting light in a solar-cell system."

Story Source:

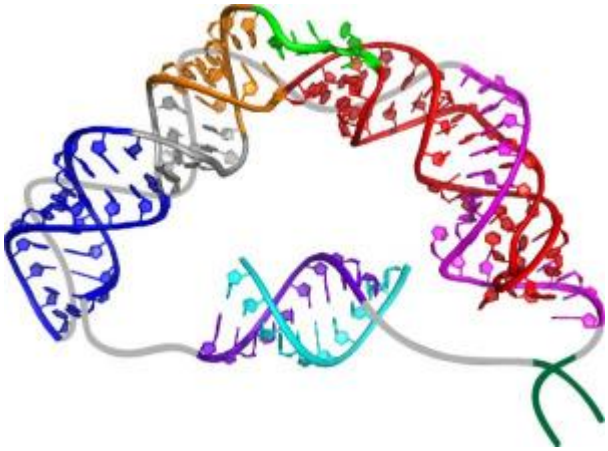
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **American Institute of Physics**, via EurekAlert!, a service of AAAS.

Journal Reference:

1. Wanli Lu, JunFeng Jin, Zhifang Lin, Huanyang Chen. **A simple design of an artificial electromagnetic black hole**. *Journal of Applied Physics*, 2010; 108 (6): 064517 DOI: 10.1063/1.3485819

http://www.sciencedaily.com/releases/2010/11/101116093534.htm

New 3-D Model of RNA 'Core Domain' of Enzyme Telomerase May Offer Clues to Cancer, Aging



A model representation of telomerase's RNA "core domain," determined by Juli Feigon, Qi Zhang and colleagues in Feigon's UCLA laboratory. (Credit: Juli Feigon, UCLA Chemistry and Biochemistry/PNAS))

ScienceDaily (Nov. 3, 2010) — Telomerase is an enzyme that maintains the DNA at the ends of our chromosomes, known as telomeres. In the absence of telomerase activity, every time our cells divide, our telomeres get shorter. This is part of the natural aging process, as most cells in the human body do not have much active telomerase. Eventually, these DNA-containing telomeres, which act as protective caps at the ends of chromosomes, become so short that the cells die.

But in some cells, such as cancer cells, telomerase, which is composed of RNA and proteins, is highly active and adds telomere DNA, preventing telomere shortening and extending the life of the cell.

UCLA biochemists have now produced a three-dimensional structural model of the RNA "core domain" of the telomerase enzyme. Because telomerase plays a surprisingly important role in cancer and aging, understanding its structure could lead to new approaches for treating disease, the researchers say.

"We still do not know how the RNA and the proteins cooperate to do this magical thing -- extend the ends of our telomeres -- but we are now one step closer to understanding that," said Juli Feigon, a UCLA professor of chemistry and biochemistry and senior author of the research, which was published Nov. 2 in the print edition of the *Proceedings of the National Academy of Sciences* (*PNAS*).

The critical telomerase RNA core domain is essential for telomerase to add telomere repeats onto the ends of chromosomes, the structures that hold our genes. The core domain contains the template that is used to code for the ends of the chromosomes.

"Telomerase is the most amazing complex," said Feigon, who began studying telomere DNA structure in the early 1990s, which led to her interest in telomerase. "Some people think if we activate telomerase, we can live forever. However, we don't want our cells to be able to divide indefinitely. As they get older and older, they accumulate all kinds of DNA damage and defects; that is why we don't want to have a high level of telomerase activity in most of our cells."

Because cancer cells divide rapidly, their telomeres should get shorter more quickly than normal cells. But while telomerase has low activity in most types of healthy cells in our bodies, the high level of telomerase

activity in cancer cells helps rebuild the telomeres, Feigon said. These cancer cells, she said, "become immortal" because of their telomerase, which enables the cancer to progress.

"There is so much potential for treating disease if we understand how telomerase works," Feigon said.

She and members of her laboratory are studying its structure at a very detailed level, which provides insights into how telomerase functions. However, Feigon emphasized that her laboratory conducts basic scientific research and is not involved in cancer treatment.

The research was federally funded by the National Institutes of Health, with American Recovery and Reinvestment Act funds, and the National Science Foundation.

The core domain consists of three pieces: a "pseudoknot" required for telomerase activity, at whose core three strands of RNA come together to form a triple helix; an "internal bulge loop," which had been largely ignored but turns out to be quite significant; and a "helical extension" -- all of which Feigon and her colleagues modeled using a new method they developed.

"We have the first useful model of the core domain of telomerase RNA," said Feigon, who was elected to the National Academy of Sciences in 2009. "We have put the three pieces together to produce a three-dimensional model of the core domain, the first time this has ever been done at a high resolution. This is exciting in terms of learning how telomerase works because it is the first time we have had a useful picture of the shape of this critical part of the RNA."

The new research, she said, could lead to targets for drug intervention.

"If you want to target drugs to telomerase, you need to know what it's doing at every stage of the cell cycle," Feigon said "If you know the three-dimensional structure of any protein or nucleic acid that is involved in essential activities in the cell, then the ability to target it with small molecules or other pharmaceuticals to either inhibit or activate it is helped tremendously."

There are diseases in which a mutation in telomerase RNA or in a telomerase protein results in inactivation of telomerase.

"We try to see the global picture with structural biology, including learning how telomerase functions and how to make it dysfunctional," said Qi Zhang, a UCLA postdoctoral scholar in Feigon's laboratory and lead author of the *PNAS* paper. "This is a very large piece that we are reporting."

The scientists who discovered how chromosomes are protected by telomerase won the 2009 Nobel Prize in physiology or medicine. Yet there is still very little known about the structural biology of the enzyme; its overall three-dimensional structure is not known. Almost all of the three-dimensional structural information about vertebrate telomerase's RNA component has come from Feigon's laboratory.

"While much is known of telomerase's biochemistry, little is known about how the RNA component and the protein component interact in the three-dimensional structure," Feigon said.

Feigon and her colleagues put together the three pieces -- the pseudoknot, the internal bulge loop and the helical extension -- to create a three-dimensional model. They determined the structures using state-of-the-art nuclear magnetic resonance (NMR) spectroscopy.

"We decided to study the internal bulge loop's structure and its dynamics," Feigon said. "What we found when we determined the structure was, first, it is quite unusual, with an unexpected fold that causes a large bend in the RNA. We then did biochemical studies that showed that the bend and its flexibility is important for telomerase activity. The internal bulge loop turns out to be really important in determining the topology of this domain, which was unpredicted."

"We are learning how the internal bulge loop functions, and we have characterized its role in the catalytic activity," said Zhang, who holds a Baltimore Family Fellowship from the Life Sciences Research Foundation.

The structure and dynamics of the internal bulge loop are important for catalytic activity.

"We have found a rare structure," Feigon said. "We studied the database of all the structures of RNA that have been solved, and it turns out that one other structure has the same type of five-nucleotide bulge. The other one is from an RNA domain of the hepatitis C virus. That was a huge surprise for us. And the bigger surprise is that the nucleotide sequence of that bulge is completely different, but the structure is almost identical. That particular bulge is also critical to the function of the virus; if you disrupt that bulge, the hepatitis C virus becomes less infectious."

For telomerase to be active, it needs the telomerase RNA and a protein called human telomerase reverse transcriptase. Chromosomes are composed of strings of bases -- nucleotides-- represented by the letters A, C, G and T. The 'C' base always binds to 'G,' while 'A' binds to 'T.' The bases combine to make three-letter codes that specify an amino acid; the corresponding amino acids combine to make proteins.

"Within telomerase, there is an RNA template that is used to code for the telomere DNA repeats," Feigon said. "If you have the letter 'A,' it puts in the letter 'T,' and if you have a 'G,' it puts in a 'C.' This method of copying, from RNA to DNA instead of copying DNA to RNA, is called reverse transcription. The core domain includes the template which does this. HIV also has a reverse transcriptase that copies from RNA to DNA.

"Reverse transcriptases normally copy RNA to DNA but do not contain RNA; in this enzyme, the protein requires the RNA component to function.

"Telomerase is unique because the template is part of the enzyme, and it is used to copy one telomere repeat and then starts over and makes another, and another, all attached to one another. That is how telomerase extends the telomeres," she said. "Telomerase has its own internal piece of RNA that is used to copy the DNA, but this 'template' is only approximately 10 of the 451 nucleotides."

Telomerase has been extremely difficult to characterize structurally because of its size and complexity and its low level in normal cells.

Other co-authors on the *PNAS* paper are Nak-Kyoon Kim, a postdoctoral scholar in Feigon's laboratory; Robert Peterson, a research scientist in Feigon's laboratory; and Zhonghua Wang, a postdoctoral scholar in Feigon's laboratory. This *PNAS* research is Feigon's inaugural article as a member of the National Academy of Sciences.

Feigon's laboratory studies the 3D structures of DNA and RNA and how proteins and DNA and RNA recognize one another to switch genes on and off in cells. A member of UCLA's faculty since 1985, Feigon was the first UCLA scientist to use NMR to determine DNA and RNA structures. She and her colleagues utilize a range of molecular biological, biochemical and biophysical techniques.

Serendipity often plays a prominent role in science, and this is another example. When Feigon began her research on telomeres and telomerase in the early 1990s, she was not even thinking about cancer. Instead, she was interested in studying DNA structure.

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

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **University of California - Los Angeles**. The original article was written by Stuart Wolpert.

Journal Reference:

1. Q. Zhang, N.-K. Kim, R. D. Peterson, Z. Wang, J. Feigon. **Structurally conserved five nucleotide bulge determines the overall topology of the core domain of human telomerase RNA**. *Proceedings of the National Academy of Sciences*, 2010; 107 (44): 18761 DOI: 10.1073/pnas.1013269107

http://www.sciencedaily.com/releases/2010/11/101104111026.htm

Landing Lights for Bumblebees

Gardeners could help maintain bumblebee populations by growing plants with red flowers or flowers with stripes along the veins, according to field observations of the common snapdragon, Antirrhinum majus, at the John Innes Centre in the UK. (Credit: John Innes Centre)

ScienceDaily (Nov. 17, 2010) — Gardeners could help maintain bumblebee populations by growing plants with red flowers or flowers with stripes along the veins, according to field observations of the common snapdragon, *Antirrhinum majus*, at the John Innes Centre in the UK.

Bees are important pollinators of crops as well as the plants in our gardens.

"Stripes following the veins of flowers are one of the most common floral pigmentation patterns so we thought there must be some advantage for pollination," said Professor Cathie Martin from the John Innes Centre, an institute of the BBSRC.

Nuffield scholars spent successive summers observing the foraging patterns of bumblebees on snapdragon plants grown on a plot near Norwich. The students compared the number of visits by bumblebees to various cultivars of the common snapdragon and the number of flowers visited per plant. Red flowers and those with venation patterning were visited significantly more frequently than white or pink. More flowers were visited per plant too.

"Stripes provide a visual guide for pollinators, directing them to the central landing platform and the entrance to the flower where the nectar and pollen can be found," said Professor Martin.

"We examined the origin of this trait and found that it has been retained through snapdragon ancestry. The selection pressure for this trait is only relaxed when full red pigmentation evolves in a species."

Bumblebees are the main pollinators for snapdragon because the of the bee is needed to open the closed flower. Pollinators learn and memorize floral signals, such as flower shape, scent, colour and patterns of pigmentation. They return to flowers from which they have previously found food. Simple changes due to single gene changes can have dramatic effects on which pollinators visit and how often.

Collaborators on the project from New Zealand also analysed how the stripy patterns are formed along the veins of the common snapdragon. They showed that two signals interact to create the stripes.

"Complex colour patterns such as spots and stripes are common in nature but the way they are formed is poorly understood," said author Dr Kathy Schwinn from the New Zealand Institute for Plant & Food Research.

"We found that one signal comes from the veins of the petals and one from the skin of the petals, the epidermis. Where these signals intersect, the production of red anthocyanin pigments is induced."

Professor Douglas Kell, Chief Executive of BBSRC, which part-funded this research through strategic funding to JIC, said: "Pollinator insects, such as honeybees, have a highly significant role in agriculture and any reduction in numbers is economically damaging and risks our food security. Much of the food on our plates is reliant on insect pollination. BBSRC is investing in research to understand how we can arrest pollinator decline and this study shows how horticulturalists and gardeners can encourage bumblebee populations."

Story Source:

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

http://www.sciencedaily.com/releases/2010/10/101011210027.htm

New Device Detects Insects in Stored Wheat

ARS researchers and industry cooperators have developed the "insect-o-graph," a new device that can detect insects such as the lesser grain borer in wheat that are not visible to the eye or that cannot be detected by usual grading methods. (Credit: Photo courtesy of Clemson University - USDA Cooperative Extension Slide Series, Bugwood.org)

ScienceDaily (Nov. 17, 2010) — A laboratory milling device for improving stored grain management has been developed by Agricultural Research Service (ARS) scientists and an industry cooperator.

The system, called the "insect-o-graph," can detect internal insects in wheat that are not visible to the eye or that cannot be detected by usual grading methods. The device, built by National Manufacturing, Inc. (NMI), of Lincoln, Neb., was based on ARS-developed technology.

ARS engineers Tom Pearson and Dan Brabec, in the Engineering and Wind Erosion Research Unit of the agency's Center for Grain and Animal Health Research at Manhattan, Kan., developed the device, which uses electrical conductance signals to monitor wheat as it's milled. If a seed containing an insect is crushed, an electrical spike occurs. The software counts the number of insects in a kilogram sample. This system can detect low levels of infestations such as five to 10 infested seeds out of 30,000 good seeds.

Tracking insect infestations in stored grain is important to ensure grain quality because insect colonies can multiply rapidly over weeks or months, and consume and damage grain as the colonies grow. Insect damage reduces the grain's value, and the grain also requires additional cleaning to remove the insects and damaged kernels.

Grain companies inspect grain as it comes into their facilities and before storage. Before unloading a truck or railcar of grain, a few minutes are taken to sample the load and inspect the grain. The insect-o-graph can estimate the number of live insects hidden in a one-kilogram grain sample in about one minute.

The device was developed under a formal Cooperative Research and Development Agreement (CRADA) with NMI, and in collaboration with the food manufacturing company General Mills, as part of efforts by ARS to transfer its technology from the laboratory to the marketplace for the benefit of consumers.

A paper describing this work was accepted for publication in the *Journal of Stored Product Research* in 2010 and will be published soon.

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 Sharon Durham.

http://www.sciencedaily.com/releases/2010/06/100624122054.htm

Critically Endangered Tree Frog Bred for First Time

La loma tree frog (Hyloscirtus colymba). (Credit: Image courtesy of Smithsonian)

ScienceDaily (Nov. 17, 2010) — As frogs around the world continue to disappear -- many killed by a rapidly spreading disease called chytridiomycosis, which attacks the skin cells of amphibians -- one critically endangered species has received an encouraging boost. Although the La Loma tree frog, *Hyloscirtus colymba*, is notoriously difficult to care for in captivity, the Panama Amphibian Rescue and Conservation Project is the first to successfully breed this species.

"We are some of the first researchers to attempt to breed these animals into captivity and we have very little information about how to care for them," said Brian Gratwicke, international coordinator for the project and a research biologist at the Smithsonian's National Zoo, one of nine project partners. "We were warned that we might not be able to keep these frogs alive, but through a little bit of guesswork, attention to detail and collaboration with other husbandry experts -- we've managed to breed them. The lessons we're learning have put us on target to save this incredible species and our other priority species in Panama."

The rescue project currently has 28 adult La Loma tree frogs and four tadpoles at the Summit Municipal Park outside of Panama City, Panama. In addition to the La Loma tree frog, the project also has successfully bred the endangered Limosa harlequin frog, *Atelopus limosus*. Keepers will continue to carefully monitor the tadpoles of both species.

Nearly one-third of the world's amphibian species are at risk of extinction. The rescue project aims to save more than 20 species of frogs in Panama, one of the world's last strongholds for amphibian biodiversity. While the global amphibian crisis is the result of habitat loss, climate change and pollution, chytridiomycosis is likely at least partly responsible for the disappearances of 94 of the 120 frog species thought to have gone extinct since 1980.

"Although the outlook for amphibians is grim, the rescue project's recent developments give us hope for these unique Panamanian species," said Roberto Ibáñez, local director of the project and a scientist at the Smithsonian Tropical Research Institute, one of the project's partners. "We are creating what amounts to an ark for these animals so that their species may survive this deadly disease. We're also looking for a cure so that someday we can safely release the frogs back into the wild."

Of Panama's six harlequin frog species, five are in collections at the Summit Zoological Park and the El Valle Amphibian Conservation Center in El Valle, Panama. One species, the Chiriqui harlequin frog, *A. chiriquiensis*, from western Panama, is likely extinct. The other species range from being extinct in the wild -- the Panamanian golden frog, *A. zeteki* -- to being endangered.

Story Source:

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

http://www.sciencedaily.com/releases/2010/11/101117141520.htm

Playing the Renegade With Eroticism or Rage

By ROBERTA SMITH

Sanctified art movements aside, most artists worthy of the name are loners and renegades. They operate without licenses — or Ph.D.'s — striving to be themselves as only they can, as clearly and intensely as possible.

This is very hard work, and when they succeed, especially over time, we are the beneficiaries. We get what we tend to look for in art: something that to some degree we haven't quite seen before, that is, the sight of a unique individual exploring his or her uniqueness to the hilt.

At the moment two New York galleries reveal this very act, in solo shows of renegade painters known for being satisfyingly obstreperous visually, badly behaved in terms of subject matter and completely devoid of do-gooder ideology.

I refer to the uproariously erotic (if predominantly heterosexual) display of William N. Copley's "X-Rated" paintings from 1973-74 at the Paul Kasmin Gallery in Chelsea, and the take-no-prisoners, fluorescent-hued canvases of Peter Saul, seen in a brisk 50-year survey at Haunch of Venison in Midtown.

Despite many significant, mutually illuminating differences, the Copley and Saul exhibitions belong together. They don't exactly finish each other's sentences, but they exude the same free-wheeling, devil-take-the-hindmost attitude. What's more, a shared penchant for comic-based figuration qualify Copley (1919-96) and Mr. Saul, who was born in 1934, as painters that Pop Art forgot. (Copley's painting in particular — which he usually signed CPLY — are proto-Pop, as Pop knew. The show's excellent catalog quotes Roy Lichtenstein: "Cply cmpltly cptvts me.")

Along with Robert Colescott, Copley and Saul can also be described as important points of origin of a lively political incorrectness that has since flourished under artists as diverse as Sue Williams, Kara Walker, Robert Melee and Carroll Dunham.

A congenitally wry and ribald man who was privately wealthy and married six times, Copley was briefly a dealer of Surrealist art (in 1946 in Los Angeles), then a respected collector of it and a philanthropist of the visual arts. (Through his Cassandra Foundation, Copley made one of 20th-century art's great gifts:

Duchamp's "Étant Donné" to the Philadelphia Museum of Art.) And in the late 1940s Copley also took up painting, spending most of the 1950s and '60s in Paris, evolving a style that was more irreverent School of Paris than Surrealist, contaminated as it was by American popular culture and folk art.

The 23 canvases at Kasmin reconstitute to a large degree "CPLY: X-Rated," a show that Copley had at the New York Cultural Center in 1974, at the height of the women's movement. That show of lusty, curvaceous females and entwined couples splayed against brightly patterned bedspreads, upholstery and wallpaper, seems to have been poorly received, when it was noticed at all. (Almost nothing sold; all of the paintings here are still in the Copley estate. He gave one to the Whitney, which was last exhibited in 1995.)

Today, at a moment when the figure and high color are attracting artists in all mediums, these works seem extremely lively and up to date. They confirm the obvious, which was that Copley loved women, sex and painting, and that he was alert to most of the currents of modernism, which he used as he saw fit.

The contorted and entwined figures suggest a keen familiarity with Matisse's early, wonderfully clunky bronze nude sculptures. The rigorous balancing of the erotic and the decorative — the carryings-on of the tangled bodies constantly offset by various tartans, checks, stripes and floral prints in saturated colors — could be said to revel in Clement Greenberg's vaunted principle of pictorial flatness, if only as a way of further pressing flesh to flesh.

The paintings have wonderful details, whether the rather colorful tattoo of a fly on the buttock of a woman on all fours on a brass bed with lavender sheets in "Fly Tattoo Lady," or such recurring devices as curved, zigzag lines that denote eyes squeezed shut with pleasure and off-hand impastos and mixes of color that seem reserved mostly for skin tones.

Over all these paintings don't shock, but their frankness is definitely energizing and oddly wise. Despite the cartoonish, abstracting tendencies that give them such visual juice, they also convey the comforting imperfections, desires and pleasures of real people, in fact consenting adults. And they put the fun back in sex — offering a useful antidote to the overzealous artifice of Jeff Koons's sex paintings at Luxembourg & Dayan uptown.

At Haunch of Venison, Mr. Saul's paintings dwell on a different human intensity: his rage against a hopelessly evil world. This jaundiced view is spelled out in fiery colors, repellently exaggerated bodies and acts of comical, if still horrible, violence. Fittingly, in a recent interview that plays on a monitor in a small gallery, Mr. Saul speaks of his lifelong interest in making "unfriendly" paintings.

The earliest paintings ridicule consumer excess with images of overflowing iceboxes embellished with intimations of sex and violence. "Icebox," from 1960, includes a wedge of brightly colored pie or cake that is something of a Saul leitmotif; outlines of frozen meats that mutate into thought balloons, boots and penises; and a little sledgehammer in a blank space that may be a television.

By 1964 Mr. Saul's disdain for society — and his love of color — have come into focus in works like "Sickroom," with its bed-ridden dentures being brushed by an attendant smoking a cigarette, and especially "Killer," which depicts a muscle-bound thug with a gun and a knife looking for trouble. His head culminates in a lighted fuse, and a red button sprouts from one shoulder; a large green hand is about to press it.

Basically Mr. Saul is a closet formalist who believes that every form tells a story, and that a surface covered with such forms can coalesce into a consuming onslaught of motif and meaning — a new type of history painting. Canvases like "Typical Saigon" (1968) assault the eye with their bulging or spurting shapes, ricocheting lines (usually speeding bullets) and acid colors. It is a feral version of Abstract Expressionist all-overness that gradually starts making excruciating narrative sense.

"Typical Saigon," for example, is a kind of Calvary in which American soldiers in diapers assault what appear to be three crucified Vietnamese prostitutes. The distinction between victim and perpetrator is lost in a general morass of human turpitude.

Mr. Saul needs big subjects to vent his rage and his chaotic schemes. Custer's Last Stand, Columbus discovering America and the fantasized execution of O. J. Simpson served him fairly well over the last 20 years. But in several recent paintings the chaos becomes general and benign, as indicated by titles like "Vacation Anxiety" and "Frequent Flyer," both from 2010.

"Beckmann's 'The Night,' " from 2009, reinterprets Max Beckmann's orgy of torture with a more Saulian version, which seems to include a ghostlike self-portrait on the right and, on the left, a strikingly realistic portrait of Beckmann that puts Mr. Saul's stippled painting style to new use. This portrait doesn't quite look like a Peter Saul, but it might be something to think about. That's the thing about the self that an artist must so diligently cultivate: It's bottomless.

IN THE GALLERIES

WILLIAM N. COPLEY: X-RATED Through Dec. 11 at the Paul Kasmin Gallery, 293 10th Avenue, at 27th Street, Chelsea; (212) 563-4474; paulkasmingallery.com.

PETER SAUL: 50 YEARS OF PAINTING Through Jan. 8 at Haunch of Venison, 1230 Avenue of the Americas, at 48th Street; (212) 259-0000; haunchofvenison.com.

http://www.nytimes.com/2010/11/12/arts/design/12copley.html

Hearing Loss Study Reveals Role of Bone Hardness in Tissue Function

The polar bear's ear bone is believed to be the hardest in its body, possibly helping the animal hear underwater. The finding has immediate implications for understanding several rare hearing disorders, they said, and ultimately could offer insight into such conditions as osteoporosis, arthritis, cardiovascular disease and cancer. (Credit: iStockphoto)

ScienceDaily (Nov. 17, 2010) — Scientists are reporting the first direct evidence that a subtle change in the physical properties of a tissue can affect its function. The finding has immediate implications for understanding several rare hearing disorders, they said, and ultimately could offer insight into such conditions as osteoporosis, arthritis, cardiovascular disease and cancer.

In their study, the scientists discovered that blocking the function of a particular molecule in the ear bone of mice decreased the hardness of the bone, causing hearing loss. Reactivating the molecule restored the bone's hardness -- and the animals' hearing.

The research likely explains the previously unknown cause of hearing loss in the human disease cleidocranial dysplasia, a genetic bone syndrome,said co-author Lawrence Lustig, MD, UCSF professor of otolaryngology, and may explain hearing loss associated with some other bone diseases.

More broadly, the finding reveals the molecular pathway that regulates the physical properties of extracellular matrix -- the interlocking mesh of molecules between cells -- in the ear's cochlear bone. The matrix is responsible for the hardness of human tissues, ranging from stiff bone and enamel to compliant brain and skin.

Perhaps most intriguing is the discovery that variations in the physical properties of extracellular matrix affect tissue function. This finding should lead to insights into abnormal matrix properties in the tissues of diseases throughout the body, the researchers said, including osteoporosis and arthritis.

The polar bear's ear bone is believed to be the hardest in its body, possibly helping the animal hear under water.

"Our finding demonstrates that establishing and maintaining the proper calibration of physical properties is essential for healthy tissue function," said the senior author of the study, Tamara Alliston, PhD, assistant professor of orthopaedic surgery and a member of the Eli and Edythe Broad Center of Regeneration Medicine and Stem Cell Research at UCSF.

Scientists have known that physical cues, such as extracellular matrix stiffness, direct the differentiation of stem cells into specific cell types, such as heart, liver and brain cells. They also have known that disruption of these cues underlies a wide range of diseases, such as osteoarthritis, cardiovascular disease and cancer.

However, they have not known the molecular mechanisms that establish the physical properties of extracellular matrix, nor the link between these properties and tissue function.

In the current study, recently reported in *EMBO* (online Sept. 17, 2010), the team, led by Jolie L. Chang, MD, a resident in the UCSF Department of Otolaryngology and Head and Neck Surgery, set out to investigate the mechanisms involved.

Earlier studies, conducted at UCSF, showed that a molecule known as transforming growth factor beta (TGF-**β**) regulates the turnover of bone cells known as osteoblasts, by inhibiting a molecule known as Runx2. Disrupting TGF-**β**'s regulation of Runx2 causes dysplastic clavicles and open cranial sutures.

These skeletal deformities, seen in the human genetic bone disease cleidocranial dysplasia, result from a defective copy of the Runx2 gene. Patients with CCD experience "sensorineural" hearing loss -- caused by damage to the cochlear bone or nerve damage.

Given these conditions, the teams used two mouse models of CCD to study the regulation and role of bone matrix properties in the cochlear bone.

They focused on this bone in part because of anecdotal evidence in patients, and research in whales, flamingos and polar bears, indicating that the bone is the hardest in the body, possibly helping the animals hear under water. The required stiffness, the team suspected, likely would be precisely calibrated.

They first conducted a nanoscale analysis of several mouse bones in the head and ear, establishing that the cochlea bone was by far the stiffest.

Then, in what they considered a major insight, they discovered that TGF-**β** regulates Runx2 to establish the physical property of the extracellular matrix of the cochlea bone. "This told us," said Chang, "that Runx2 -- a key transcriptional regulator that helps the cell selects its cell fate -- also controls the physical properties of the matrix."

Finally, by manipulating Runx2 activity through TGF-**β**, the team determined that the physical quality of the bone matrix affects hearing.

Now, the team is investigating the molecules "downstream" of Runx2, to gain further insight into the mechanism regulating the physical properties of bone. They also are studying if these mechanisms define the stiffness of matrices in other skeletal tissues.

"We want to see if TGF-**β** targets the cartilage transcription factor to make cartilage more or less stiff," Alliston said. "We think that the stiffness is degraded in arthritis and that this further disrupts chondrocyte cells, exacerbating the disease."

Other co-authors of the study are Delia S. Brauer, Jacob Johns, Carol Chen, Omar Akil, Emily N. Chin, Kristen Butcher, Richard A. Schneider, Anil Lalwani, Rik Derynck, Grayson W. Marshall, and Sally J. Marshall, of UCSF, Guive Balooch, at the time a postdoctoral fellow in the lab of co-author Robert O. Ritchie, of UC Lawrence Berkeley National Laboratories, Mary Beth Humphrey, of University of Oklahoma Health Science Center, and Alexandra E Porter, of Imperial College London.

The study was funded primarily by the National Institutes of Health, the Deafness Research Foundation, The Arthritis Foundation, UCSF School of Dentistry Creativity Fund, Arthritis Foundation, Deafness Research Foundation and Department of Energy.

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

Story Source:

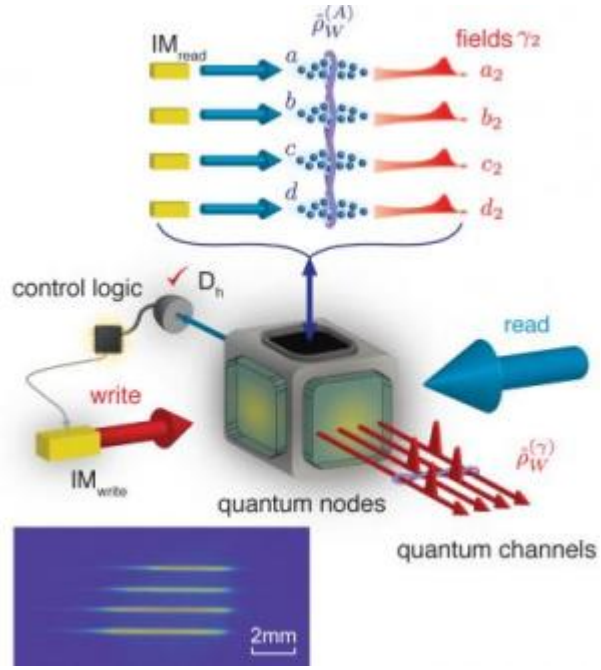
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **University of California - San Francisco**.

Journal Reference:

1. Jolie L Chang, Delia S Brauer, Jacob Johnson, Carol G Chen, Omar Akil, Guive Balooch, Mary Beth Humphrey, Emily N Chin, Alexandra E Porter, Kristin Butcher, Robert O Ritchie, Richard A Schneider, Anil Lalwani, Rik Derynck, Grayson W Marshall, Sally J Marshall, Lawrence Lustig, Tamara Alliston. **Tissue-specific calibration of extracellular matrix material properties by transforming growth factor-β and Runx2 in bone is required for hearing**. *EMBO reports*, 2010; 11 (10): 765 DOI: 10.1038/embor.2010.135

http://www.sciencedaily.com/releases/2010/11/101117141518.htm

Physicists Demonstrate a Four-Fold Quantum Memory



Writing laser pulses are switched on by the intensity modulator (IM_write) and generate correlated light scattering from four collections of atoms (atomic ensembles which serve as quantum memories). Detection of a single photon at Dh for the light scattered from the atoms creates the entangled state rho^(A)_w with one spin excitation shared collectively among the ensembles (as illustrated at the top of the figure). At later times, the intensity modulator (IM_read) switches on read laser pulses that read out the quantum information stored in the atoms, thereby creating four entangled beams of light in the state rho^(gamma)_w illustrated in the lower right corner of the figure. The inset is a fluorescence image of the laser-cooled atomic ensembles a, b, c and d that become entangled. (Credit: Akihisa Goban/Nature)

ScienceDaily (Nov. 17, 2010) — Researchers at the California Institute of Technology (Caltech) have demonstrated quantum entanglement for a quantum state stored in four spatially distinct atomic memories.

Their work, described in the November 18 issue of the journal *Nature,* also demonstrated a quantum interface between the atomic memories -- which represent something akin to a computer "hard drive" for entanglement -- and four beams of light, thereby enabling the four-fold entanglement to be distributed by photons across quantum networks. The research represents an important achievement in quantum information science by extending the coherent control of entanglement from two to multiple (four) spatially separated physical systems of matter and light.

The proof-of-principle experiment, led by William L. Valentine Professor and professor of physics H. Jeff Kimble, helps to pave the way toward quantum networks. Similar to the Internet in our daily life, a quantum network is a quantum "web" composed of many interconnected quantum nodes, each of which is capable of rudimentary quantum logic operations (similar to the "AND" and "OR" gates in computers) utilizing "quantum transistors" and of storing the resulting quantum states in quantum memories. The quantum nodes are "wired" together by quantum channels that carry, for example, beams of photons to deliver quantum information from node to node. Such an interconnected quantum system could function as a quantum

computer, or, as proposed by the late Caltech physicist Richard Feynman in the 1980s, as a "quantum simulator" for studying complex problems in physics.

Quantum entanglement is a quintessential feature of the quantum realm and involves correlations among components of the overall physical system that cannot be described by classical physics. Strangely, for an entangled quantum system, there exists no objective physical reality for the system's properties. Instead, an entangled system contains simultaneously multiple possibilities for its properties. Such an entangled system has been created and stored by the Caltech researchers.

Previously, Kimble's group entangled a pair of atomic quantum memories and coherently transferred the entangled photons into and out of the quantum memories. For such two-component -- or bipartite -- entanglement, the subsystems are either entangled or not. But for multi-component entanglement with more than two subsystems -- or multipartite entanglement -- there are many possible ways to entangle the subsystems. For example, with four subsystems, all of the possible pair combinations could be bipartite entangled but not be entangled over all four components; alternatively, they could share a "global" quadripartite (four-part) entanglement.

Hence, multipartite entanglement is accompanied by increased complexity in the system. While this makes the creation and characterization of these quantum states substantially more difficult, it also makes the entangled states more valuable for tasks in quantum information science.

To achieve multipartite entanglement, the Caltech team used lasers to cool four collections (or ensembles) of about one million Cesium atoms, separated by 1 millimeter and trapped in a magnetic field, to within a few hundred millionths of a degree above absolute zero. Each ensemble can have atoms with internal spins that are "up" or "down" (analogous to spinning tops) and that are collectively described by a "spin wave" for the respective ensemble. It is these spin waves that the Caltech researchers succeeded in entangling among the four atomic ensembles.

The technique employed by the Caltech team for creating quadripartite entanglement is an extension of the theoretical work of Luming Duan, Mikhail Lukin, Ignacio Cirac, and Peter Zoller in 2001 for the generation of bipartite entanglement by the act of quantum measurement. This kind of "measurement-induced" entanglement for two atomic ensembles was first achieved by the Caltech group in 2005.

In the current experiment, entanglement was "stored" in the four atomic ensembles for a variable time, and then "read out" -- essentially, transferred -- to four beams of light. To do this, the researchers shot four "read" lasers into the four, now-entangled, ensembles. The coherent arrangement of excitation amplitudes for the atoms in the ensembles, described by spin waves, enhances the matter-light interaction through a phenomenon known as superradiant emission.

"The emitted light from each atom in an ensemble constructively interferes with the light from other atoms in the forward direction, allowing us to transfer the spin wave excitations of the ensembles to single photons," says Akihisa Goban, a Caltech graduate student and coauthor of the paper. The researchers were therefore able to coherently move the quantum information from the individual sets of multipartite entangled atoms to four entangled beams of light, forming the bridge between matter and light that is necessary for quantum networks.

The Caltech team investigated the dynamics by which the multipartite entanglement decayed while stored in the atomic memories. "In the zoology of entangled states, our experiment illustrates how multipartite entangled spin waves can evolve into various subsets of the entangled systems over time, and sheds light on

the intricacy and fragility of quantum entanglement in open quantum systems," says Caltech graduate student Kyung Soo Choi, the lead author of the Nature paper. The researchers suggest that the theoretical tools developed for their studies of the dynamics of entanglement decay could be applied for studying the entangled spin waves in quantum magnets.

Further possibilities of their experiment include the expansion of multipartite entanglement across quantum networks and quantum metrology. "Our work introduces new sets of experimental capabilities to generate, store, and transfer multipartite entanglement from matter to light in quantum networks," Choi explains. "It signifies the ever-increasing degree of exquisite quantum control to study and manipulate entangled states of matter and light."

In addition to Kimble, Choi, and Goban, the other authors of the paper are Scott Papp, a former postdoctoral scholar in the Caltech Center for the Physics of Information now at the National Institute of Standards and Technology in Boulder, Colorado, and Steven van Enk, a theoretical collaborator and professor of physics at the University of Oregon, and an associate of the Institute for Quantum Information at Caltech.

This research was funded by the National Science Foundation, the National Security Science and Engineering Faculty Fellowship program at the U.S. Department of Defense (DOD), the Northrop Grumman Corporation, and the Intelligence Advanced Research Projects Activity.

Story Source:

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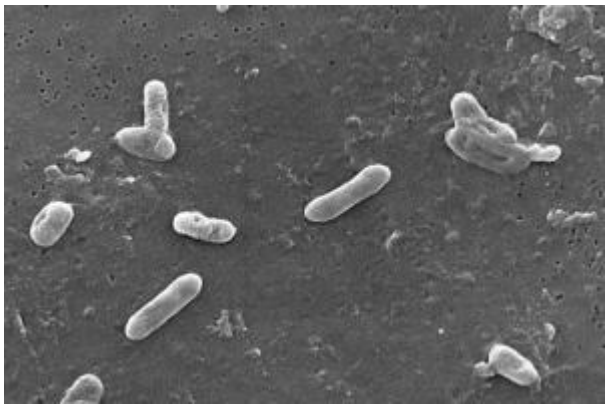
Journal Reference:

1. K. S. Choi, A. Goban, S. B. Papp, S. J. van Enk, H. J. Kimble. **Entanglement of spin waves among four quantum memories**. *Nature*, 2010; 468 (7322): 412 DOI: 10.1038/nature09568

http://www.sciencedaily.com/releases/2010/11/101117141432.htm

Mortal Chemical Combat Typifies the World of Bacteria



Gram-negative Bordetella bronchiseptica coccobacilli bacteria. (Credit: Janice Haney Carr)

ScienceDaily (Nov. 17, 2010) — Like all organisms, bacteria must compete for resources to survive, even if it means a fight to the death.

New research led by scientists from the University of North Carolina at Chapel Hill School of Medicine and the University of California, Santa Barbara, describes new complexities in the close chemical combat waged among bacteria.

And the findings from this microscopic war zone may have implications for human health and survival.

"It has been known for a long time that bacteria can produce toxins that they release into their surroundings that can kill other bacteria, sort of like throwing hand grenades at enemies," said Peggy A. Cotter, PhD, associate professor in the microbiology and immunology department at UNC. "Our data suggests that the situation is far more complex that we thought."

Cotter points out that it was in David A. Low's lab at U.C. Santa Barbara, where the discovery was made that bacteria can also produce proteins on their surface that inhibit the growth and end the life of other bacteria upon contact.

"So it appears that some bacteria participate in 'man to man' (or 'bacteria to bacteria') combat using poison-tipped swords," Cotter said. "What we have discovered is that each bacterium can have a different poison at the tip of their sword. For each poison, there is a specific protective (immunity) protein that the bacteria also make so that they don't kill themselves and are not killed by other members of their same 'family'."

The new research by senior co-authors Cotter and Low and others appear on-line November 18, 2010 in the journal *Nature*.

As to "swords," the metaphor lives close to reality. Bacteria use proteins to interact with a host, including disease-causing bacteria, such as *Bordetella pertussis*, the cause of whooping cough and *Burkholderia pseudomallei,* found in soil throughout Southeast Asia and a cause of a frequently fatal tropic disease.

In these and other gram-negative bacteria, large proteins appear as rods on the surface of cells. "In the soil or in humans, different bacteria bump into each other all the time and bump into their own 'family,' too. They

have to touch each other and recognize each other and then one can inhibit the growth of the other, non-family, bacteria." Cotter said.

According to the UNC scientist, this system may represent a primitive form of kin selection, whereby organisms kill organisms that are genetically different but not those that are closely related.

"As an additional twist, we have found that some bacteria can have two or three (or possibly more) systems. Our data suggest that these bacteria will be protected from killing by bacteria that produce any of three types of poison swords and they will be able to kill other bacteria that lack at least one of those types of immunity proteins."

Moreover, there's evidence here that these bacteria acquire these additional systems by horizontal gene transfer from other bacteria. "In other words, it seems that they may be able to kill their enemy and then steal the poison-tipped sword and protective (immunity) protein from the dead enemy, increasing their own repertoire of weapons."

By teasing out the genetics of these bacterial close combat mysteries, it may someday be possible to "engineer an organism, a non-pathogenic variant, and by putting it out in the environment, such as soil, you can potentially get rid of other pathogens, "Cotter said. "Or you could decontaminate an area, if the new knowledge is applied to biodefense."

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

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Story Source:

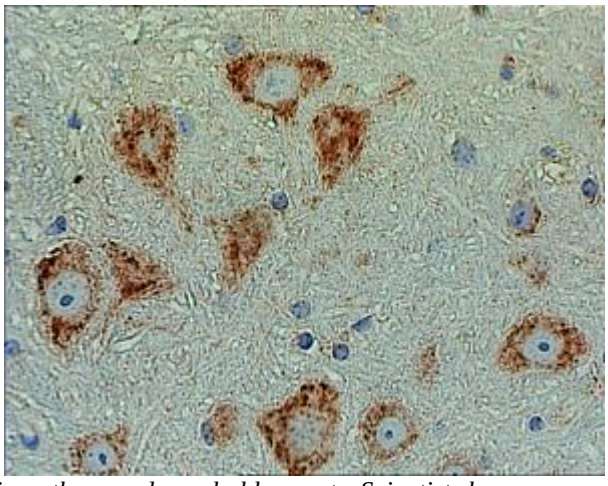
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **University of North Carolina School of Medicine**, via EurekAlert!, a service of AAAS.

Journal Reference:

1. Stephanie K. Aoki, Elie J. Diner, Claire t'Kint de Roodenbeke, Brandt R. Burgess, Stephen J. Poole, Bruce A. Braaten, Allison M. Jones, Julia S. Webb, Christopher S. Hayes, Peggy A. Cotter, David A. Low. **A widespread family of polymorphic contact-dependent toxin delivery systems in bacteria**. *Nature*, 2010; 468 (7322): 439 DOI: 10.1038/nature09490

http://www.sciencedaily.com/releases/2010/11/101117141430.htm

Scientists Identify Antivirus System



West Nile virus (brown) infects neurons, whose nuclei are the round purple-blue spots. Scientists have discovered a new anti-virus system in host cells by studying how viruses like West Nile defeated the system. It may one day be possible to use pharmaceuticals to bring this security system back online in the fight against diseases such as West Nile, sudden acute respiratory syndrome (SARS), dengue and yellow fever. (Credit: Michael Diamond, MD, PhD)

ScienceDaily (Nov. 17, 2010) — Viruses have led scientists at Washington University School of Medicine in St. Louis to the discovery of a security system in host cells. Viruses that cause disease in animals beat the security system millennia ago. But now that researchers are aware of it, they can explore the possibility of bringing the system back into play in the fight against diseases such as sudden acute respiratory syndrome (SARS), West Nile virus, dengue and yellow fever.

The findings, published in *Nature,* solve a 35-year-old mystery that began when National Institutes of Health researcher Bernard Moss, MD, PhD, noticed that poxviruses put chemical "caps" on particular spots in every piece of genetic material transcribed from their DNA. That transcribed material is RNA; to reproduce, viruses need to trick the host cell into making viral proteins from this RNA.

Noting evidence that the host cell puts caps on its own RNA in identical positions, Moss theorized that the caps might be a way for cells to distinguish between their RNA and that of an invader. He guessed the caps might serve as a sort of fake identification badge for the virus' RNA, allowing it to bypass host cell security systems primed to attack any RNA lacking the caps.

Since Moss's study, scientists have learned that some viruses have strategies for stealing RNA caps from host cells and putting them on their own RNA. Several disease-causing viruses have to make their own caps, including:

- poxviruses, which cause smallpox
- flaviviruses, which cause West Nile encephalitis, yellow fever and dengue;
- rhabdoviruses, which cause rabies;
- coronaviruses, which cause SARS;
- reoviruses, which cause mild respiratory distress or diarrhea.

Scientists also learned that one of the chemical caps added to RNA helps stabilize it, preventing the RNA from breaking down. However, despite years of research, the purpose of another cap, added near the beginning of every RNA strand in a position scientists refer to as 2' (two prime), was a persistent mystery.

The new paper from the laboratory of senior author Michael S. Diamond, MD, PhD, solves that puzzle and confirms Moss' speculation. The study used a mutant form of the West Nile virus created by Pei-Yong Shi, PhD, now a researcher at the Novartis Institute for Tropical Diseases. The mutant strain can attach the cap that keeps RNA stable but is unable to add the 2' cap. When Diamond, professor of medicine, pathology and immunology, and molecular microbiology at Washington University School of Medicine, infected mice with this mutant virus, it could not cause disease.

Next, scientists injected the mutant virus into mice lacking the receptors for interferons. These proteins are important players in defensive reactions to invading viruses within the cell, a branch of the immune system known as intrinsic immunity. The mutant virus made these mice sick, suggesting that intrinsic immunity stops the mutant viruses in normal mice, and that the 2' cap was helping normal viruses evade this part of the immune system.

Researchers recently identified a gene, IFIT2, that is activated by interferons, has mild antiviral effects against West Nile virus and seems to have potential connections to translation of RNA into proteins. When Diamond turned IFIT2 levels up in cell culture and exposed it to the mutant West Nile virus, the mutant virus could barely replicate. Tests of a mutant poxvirus and a mutant coronavirus that could not attach the 2' cap produced similar results. Knocking out a related gene in mice, IFIT1, allowed the mutant virus to evade intrinsic immunity and cause infection when it was injected into the brain.

"Now that we know what this cap is used for, we can look at the question of whether the human and viral enzymes that put the cap on are sufficiently different," says Diamond. "If they are, we may be able to design inhibitors that prevent viruses from capping their RNA and make it much harder for them to replicate once the intrinsic immune system is activated."

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

Story Source:

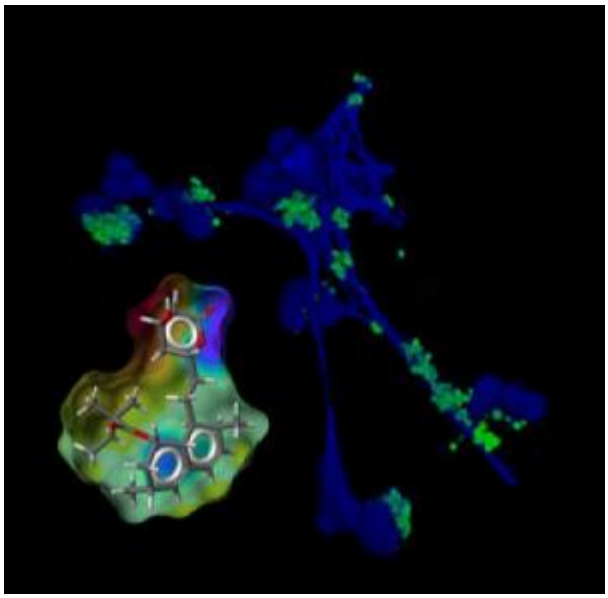
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Washington University School of Medicine**. The original article was written by Michael C. Purdy.

Journal Reference:

1. Stephane Daffis, Kristy J. Szretter, Jill Schriewer, Jianqing Li, Soonjeon Youn, John Errett, Tsai-Yu Lin, Stewart Schneller, Roland Zust, Hongping Dong, Volker Thiel, Ganes C. Sen, Volker Fensterl, William B. Klimstra, Theodore C. Pierson, R. Mark Buller, Michael Gale Jr, Pei-Yong Shi, Michael S. Diamond. **2′-O methylation of the viral mRNA cap evades host restriction by IFIT family members**. *Nature*, 2010; 468 (7322): 452 DOI: 10.1038/nature09489

http://www.sciencedaily.com/releases/2010/11/101117141428.htm

Cholesterol-Lowering Statins Boost Bacteria-Killing Cells



A human neutrophil producing DNA-based extracellular traps (stained blue), entrapping the human pathogen bacterium Staphylococcus aureus (green). This is a three-dimensional structural rendering of Simvastin, a statin. (Credit: UC San Diego School of Medicine)

ScienceDaily (Nov. 17, 2010) — Widely prescribed for their cholesterol-lowering properties, recent clinical research indicates that statins can produce a second, significant health benefit: lowering the risk of severe bacterial infections such as pneumonia and sepsis. A new explanation for these findings has been discovered by researchers at the University of California, San Diego School of Medicine and Skaggs School of Pharmacy & Pharmaceutical Sciences, who describe for the first time how statins activate the bacterial killing properties of white blood cells.

The research is published in the November 18, 2010 issue of *Cell Host & Microbe*.

Led by Victor Nizet, MD, professor of pediatrics and pharmacy, and Christopher Glass, MD, PhD, professor of medicine and cellular & molecular medicine, the UC San Diego team found that phagocytes (white blood cells that kill and ingest harmful bacteria, foreign particles and dead or dying cells) became more effective after being exposed to statins.

Surprisingly, the statin-induced improvement in bacterial killing did not correspond to increased uptake of bacteria by these specialized white blood cells. Rather, the researchers found that statins stimulated the phagocytes to release "extracellular traps" -- specialized webs of DNA-based filaments embedded with anti-microbial peptides and enzymes capable of ensnaring and killing bacteria before they spread in the body.

The findings have broad ramifications, said Glass, given the popularity of statins for controlling high cholesterol levels. Statins are the world's most-prescribed class of medication. An estimated 30 million Americans alone take the drug under commercial names like Lipitor, Zocor and Crestor. "Clinical research indicates that perhaps 100 million Americans have elevated cholesterol levels that could benefit from statin therapy," said Glass. "Thus any statin-associated changes to immune system function are certain to impact millions of people."

Prior research had described various anti-inflammatory properties of statins, suggesting that these effects could contribute to a reduction in disease severity during severe infections. Nizet and Glass explored a different hypothesis: That statins might actually aid the body in clearing itself of infectious microbes. The researchers focused on Staphyloccocus aureus, more commonly called "staph," a frequently antibiotic-resistant human pathogen responsible for everything from minor skin infections to life-threatening meningitis and sepsis. Mice treated with statins were more resistant to staph infections, and phagocytes isolated from these mice were more effective at killing staph bacteria. Simple exposure of freshly isolated human white blood cells to statins in a test tube markedly increased their ability to kill staph and other important disease causing bacteria. In each case, the increased killing correlated with greater release of the DNA-based extracellular traps by the phagocytes.

The UCSD findings demonstrate that statins have important pharmacological effects beyond inhibiting cholesterol production. "We found these drugs fundamentally alter how white blood cells behave upon encountering bacteria," Nizet said. "In our studies with staph bacteria, the net effect of statin treatment was to improve bacterial killing and extracellular trap formation. These same changes might not be so consequential for defense against less virulent bacteria that are easily susceptible to uptake and killing within phagocytes."

The research also sheds important new light on the clinical phenomenon of reduced infection severity in patients receiving statins, the scientists said. It indicates that levels of cholesterol or related lipid molecules can be sensed by white blood cells and used as signals to control their inflammatory and antibacterial activities. Nizet and Glass recommend that future research explore whether the potential of cholesterol-lowering agents combined with antibiotics can be harnessed to optimize the treatment of certain difficult infectious disease conditions.

Lead authors of the study were Ohn A. Chow of the Departments of Pediatrics, Cellular and Molecular Medicine and the Biomedical Sciences Graduate Program at UCSD and Maren von Köckritz-Blickwede of the UCSD Department of Pediatrics, now at the University of Hannover. Additional contributors include A. Taylor Bright of the UCSD Biomedical Sciences Graduate Program; Mary E. Hensler and Annelies S. Zinkernagel of the Department of Pediatrics at UCSD; Anna L. Cogen of the UCSD Department of Medicine; Richard L. Gallo of the UCSD Departments of Pediatrics and Medicine and the Veterans Administration San Diego Health Care System; Marc Monestier of the Department of Microbiology and Immunology and Temple Autoimmunity Center at the Temple University School of Medicine; and Yanming Wang at the Department of Biochemistry and Molecular Biology at Pennsylvania State University.

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

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

Journal Reference:

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http://www.sciencedaily.com/releases/2010/11/101117121755.htm

The Controversial Whitney Museum

By CHRISTOPHER GRAY

WHITHER the Whitney? Yes, it's got a swell building designed by Renzo Piano under way in the meatpacking district, to be finished in 2015. But what about its structure at 75th and Madison, where Jacqueline Kennedy attended the ribbon-cutting in 1966? Ornery and menacing, it may be New York's most bellicose work of architecture.

The artist, heiress and collector Gertrude Vanderbilt Whitney established the Whitney Museum of American Art in 1931 in back of her studio in some row houses at 10-14 West Eighth Street. In the 1950s the Whitney jumped to a small structure behind the Museum of Modern Art. In 1961 the museum enlarged its board — to include, for instance, Mrs. Kennedy — and began seeking a site for a larger building.

The board found just the spot at the southeast corner of Madison and 75th Street, which was owned by the developer and art collector Ian Woodner. He had cleared it of a lovely little group of houses, including a brick-and-brownstone Queen Anne, an Edwardian limestone and a demure neo-Federal. Mr. Woodner, who had intended to erect an apartment house, agreed to sell the property to the Whitney.

The board, despite a mission to encourage American art, hired the architect Marcel Breuer, who was Hungarian-born and Bauhaus-trained, to design a building.

A 1963 rendering of the museum shows it almost as it stands, projecting out over Madison Avenue like a medieval fortress, with oddly shaped windows reminiscent of the gun ports of the Maginot Line. But in the rendering the panels of granite are variegated in tone, giving the building a life it does not have today with its more uniform masonry.

In an article Dec. 12, 1963, Ada Louise Huxtable, the architecture critic for The New York Times, praised the initial design, finding it "serious and somber," and "sympathetic to its neighbors." But harmony was not, apparently, Breuer's intent, since in 1966 Newsweek quoted him as saying that the neighboring brownstones and town houses "aren't any good."
By this point the elite had accepted modernist architecture, and anyone who protested risked denunciation as a hayseed. But the art critic Emily Genauer, writing in The New York Herald Tribune, also on Dec. 12, cautiously ventured that the new building seemed "oppressively heavy."

A fortnight later Mrs. Huxtable backtracked slightly, saying that "it might be too somber and severe for many tastes," but was still "careful" and "conscientious." Her description, however, used the words bulky, sunken, gloomy, stygian and Alcatraz within three sentences.

The Whitney opened in 1966, and the hayseed lobby had apparently made itself known to Mrs. Huxtable; while acknowledging that it was "the most disliked building in New York," she still admired Breuer's design.

But Miss Genauer called it "the Madison Avenue Monster." And Thomas B. Hess, writing in Art News, was of the opinion that the granite gave the museum "a mineral, prison look." However, the stark concrete interiors received wide praise.

In 1967 the brash new "A. I. A. Guide to New York City," by the architects Norval White and Elliot Willensky, quipped that passers-by should "beware of boiling oil," but also called Breuer's work a must-see. It was as if, as Olga Gueft put it in Interiors Magazine, the high-culture stamp of the Whitney and its trustees made it "completely invulnerable."

Most writers at the time expressed skepticism about the Whitney's choice of a cramped site. And only a little more than a decade after opening there was talk of a critical need to expand. In the 1980s the architect Michael Graves proposed demolishing the flanking brownstones down to the 74th Street corner for a complementary addition.

But in 1980 the Whitney had been included in the Upper East Side Historic District, designed to preserve just those buildings that Breuer had deprecated to Newsweek. The landmark designation caught up good and bad alike, and Mr. Graves's proposal was not the only one that failed on the grounds of either the loss of the brownstones, or the changes to the Whitney. It is easy to imagine the conniption fits the Whitney of 1966 would meet if it were being built today; its threatening character spears every tenet of people-friendly cities now held dear. In comparison the reviled white brick apartment houses of the 1960s are absolutely benign.

Even in an age where traditionalism has triumphed, Breuer's granite bunker is still aesthetically bombproof. If its architecture is like a horror movie, it is like a Stephen King horror movie, unimpeachably literate.

The Whitney hasn't said what it intends to do with the old museum after it completes its downtown structure, and perhaps it will operate the two in tandem. If it decides to sell, it will be offering a monument that is probably unexpandable, even unchangeable, and unmistakably the brand of a single famous institution. Even if Breuer's building comes into other hands, the name Whitney will never be far removed from this singular edifice.

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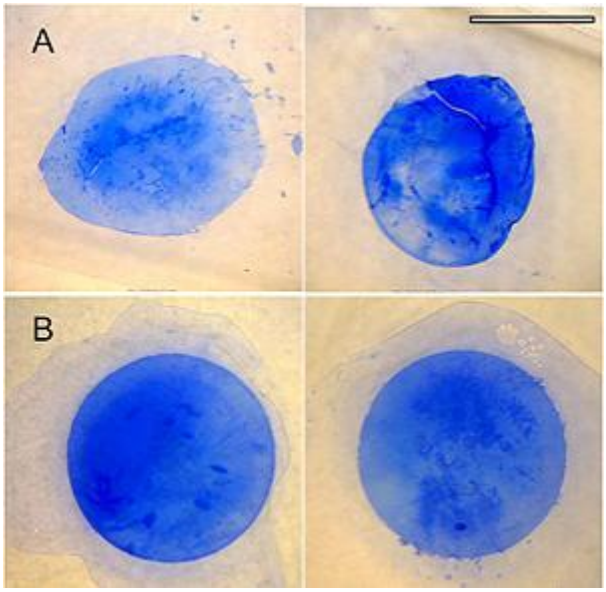
http://www.nytimes.com/2010/11/14/realestate/14Scapes.html?ref=design

Laser System Shows Promise for Cataract Surgery



Representative examples of lens capsule extraction by manual capsulorhexis (Row A) are not as close to being perfect circles and less uniform than those from laser capsulotomy (Row B). (Credit: Courtesy of Daniel Palanker)

ScienceDaily (Nov. 17, 2010) — Imagine trying to cut by hand a perfect circle roughly one-third the size of a penny. Then consider that instead of a sheet of paper, you're working with a scalpel and a thin, elastic, transparent layer of tissue, which both offers resistance and tears easily. And, by the way, you're doing it inside someone's eye, and a slip could result in a serious impairment to vision.

This standard step in cataract surgery -- the removal of a disc from the capsule surrounding the eye's lens, a procedure known as capsulorhexis -- is one of the few aspects of the operation that has yet to be enhanced by technology, but new developments in guided lasers could soon eliminate the need for such manual dexterity. A paper from Stanford University School of Medicine, to be published Nov. 17 in *Science Translational Medicine*, presents clinical findings about how one new system for femtosecond laser-assisted cataract surgery is not only safe but also cuts circles in lens capsules that are 12 times more precise than those achieved by the traditional method, as well as leaving edges that are twice as strong in the remaining capsule, which serves as a pocket in which the surgeon places the plastic replacement lens.

"The results were much better in a number of ways -- increasing safety, improving precision and reproducibility, and standardizing the procedure," said Daniel Palanker, PhD, associate professor of ophthalmology, who is the lead author of the paper. "Many medical residents are fearful of doing capsulorhexis, and it can be challenging to learn. This new approach could make this procedure less dependent on surgical skill and allow for greater consistency." The senior author is William Culbertson, MD, professor of ophthalmology at the Bascom Palmer Eye Institute at the University of Miami.

While the technology to perform this new approach -- called a capsulotomy instead of capsulorhexis -- is being developed by a number of private companies, this paper focuses on a specific system being produced by OpticaMedica Corp. of Santa Clara, Calif., which funded the study. Palanker, Culbertson and five other co-authors have equity stakes in the company; the remaining seven co-authors are company employees.

Cataract surgery is the most commonly performed surgery in the nation, with more than 1.5 million of these procedures done annually. The operation is necessary when a cloud forms in the eye's lens, causing blurred and double vision and sensitivity to light and glare, among other symptoms.

The current procedure involves making an incision in the eye and then performing capsulorhexis: in that step, the paper explains, "The size, shape and position of the anterior capsular opening ... is controlled by a freehand pulling and tearing the capsular tissue." After that, the lens is broken up with an ultrasound probe and suctioned out. The surgery culminates with the placement -- as snugly as possible -- of an artificial intraocular lens in the empty pocket created in the capsule. Before closing the eye, the surgeon may make additional incisions in the cornea to prevent or lessen astigmatism.

With the new system, a laser can pass through the outer tissue -- without the eye being opened -- to cut the hole in the capsule and to slice up the cataract and lens, all of which occurs just before the patient enters the operating suite. The laser also creates a multi-planar incision through the cornea that stops just below the outermost surface, which means that the surgeon needs to cut less once the operation begins, as well as decreasing the risk of infection. Because of the laser work, once the operation is under way, the removal of the cut section of the capsule and the sliced-up lens can be done relatively easily, with much less need for the ultrasound energy.

Femtosecond lasers, which deliver pulses of energy per quadrillionths of a second, were already being widely and successfully used to reshape the cornea of the eye to correct nearsightedness, farsightedness and astigmatisms. For use in cataract surgery, however, the laser would need to cut tissue deep inside the eye. While the laser would need to reach a level of intensity strong enough to ionize tissue at a selected focal point, it would also have to have pulse energy and average power low enough to avoid collateral damage to the surrounding tissue, retina and other parts of the eye.

Palanker and his team found the proper balance through a series of experiments on enucleated porcine and human eyes. They then did further experiments to confirm that a laser at those settings would not cause retinal damage.

Still, a major hurdle remained. The laser needed to be guided as it made its incisions to ensure that it did not go astray, cutting nearby tissue, and that it would meet exacting specifications for the size of the disc-shaped hole in the lens capsule that it would be creating. The solution? Use optical coherence tomography -- a noncontact, noninvasive in vivo imaging technique -- to get a three-dimensional map of the eye. Using that image, he and his colleagues developed software that pinpoints the ideal pattern for the laser to follow. It is then superimposed on a three-dimensional picture of the patient's eye, so that the surgeon can confirm it's on track before starting the procedure, in addition to monitoring it as the cutting proceeds.

"Until this, we had no way to quantify the precision, no way to measure the size and shape of the capsular opening," Palanker said.

A clinical trial in 50 patients revealed no significant adverse events, supporting the study's goal of showing that the procedure is safe. What's more, the laser-based system came much closer to adhering to the intended size of the capsular disc (typically coming within 25 micrometers with the laser vs. 305 micrometers in the manual procedure). And using a measurement that ranks a perfect circle as a 1.0, the researchers found that the laser-based technique scored about .95 as compared with about .77 for the manual approach to cutting the disc from the capsule.

What this means is that when the plastic intraocular lens is placed in the capsular bag, it's going to be better centered and have a tighter fit, reducing the chances of a lens shift and improving the alignment of the lens with the pupil. This is increasingly important as more patients choose to have multifocal and accommodating lenses, which need to be aligned more precisely with the pupil to function well.

The laser-assisted surgery offered other benefits aside from the capsulotomy. The paper notes that because the laser has already spliced the lens, there's less need to use the ultrasound probe. Its excessive use in hard cataracts can sometimes create too much heat and damage the corneal endothelium and other surrounding tissue. The laser also can create a multi-planar zigzag pattern for the incision in the cornea, allowing the incision to self-seal and decreasing the likelihood of infection and other complications.

While not an endpoint of the study, the researchers found that the new procedure did improve visual acuity more than the traditional approach; however, the difference was not statistically significant due to the small number of patients enrolled. Palanker said a properly designed clinical study is needed to quantify improvements in vision with various types of intraocular lenses; such research may take place in the United States if the U.S. Food and Drug Administration approves the new machine. Data from Palanker's study is going to be submitted to the FDA for consideration.

"This will undoubtedly affect millions of people, as cataracts are so common," said Palanker, though he expects that it will take time for the new procedure to be adopted. At present, the new procedure takes longer than the current standard, and it would cost more, with Medicare unlikely to cover it in the immediate future. "But there will be people who elect to have it done the new way if they can afford it. There are competitors coming out with related systems. This is what's exciting. This technology is going to be picked up in the clinic."

The other Stanford co- author is Mark Blumenkranz, MD, professor and chair of ophthalmology.

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

Story Source:

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

http://www.sciencedaily.com/releases/2010/11/101117151222.htm

As Arctic Temperatures Rise, Tundra Fires Increase

The 2007 Anaktuvuk River Fire burned more than 1,000 square kilometers of tundra on Alaska's North Slope. It was the largest tundra fire in the region in recorded history. (Credit: Bureau of Land Management)

ScienceDaily (Nov. 17, 2010) — In September, 2007, the Anaktuvuk River Fire burned more than 1,000 square kilometers of tundra on Alaska's North Slope, doubling the area burned in that region since record keeping began in 1950. A new analysis of sediment cores from the burned area revealed that this was the most destructive tundra fire at that site for at least 5,000 years. Models built on 60 years of climate and fire data found that even moderate increases in warm-season temperatures in the region dramatically increase the likelihood of such fires.

The study was published this October in the *Journal of Geophysical Research*.

After the Anaktuvuk fire, University of Illinois plant biology professor Feng Sheng Hu sought to answer a simple question: Was this seemingly historic fire an anomaly, or were large fires a regular occurrence in the region?

"If such fires occur every 200 years or every 500 years, it's a natural event," Hu said. "But another possibility is that these are truly unprecedented events caused by, say, greenhouse warming."

On a trip to Alaska in 2008, Hu chartered a helicopter to the region of the Anaktuvuk fire and collected sediment cores from two affected lakes. He and his colleagues analyzed the distribution of charcoal particles in these cores and used established techniques to determine the approximate ages of different sediment layers.

The team found no evidence of a fire of similar scale and intensity in sediments representing roughly 5,000 years at that locale.

The researchers then analyzed 60 years of fire, temperature and precipitation records from the Alaskan tundra to determine whether specific climate conditions prevailed in years with significant tundra fires. They developed a model relating the tundra area burned in Alaska each year to the mean temperature and precipitation in the warmest period of the year: June through September.

This analysis uncovered a striking pattern, Hu said.

"There is a dramatic, nonlinear relationship between climate conditions and tundra fires, and what one may call a tipping point," he said. Once the temperature rises above a mean threshold of 10 degrees Celsius (50 degrees Fahrenheit) in the June-through-September time period, he said, "the tundra is just going to burn more frequently."

For the past 60 years, annual mean temperatures during this warm season have fluctuated between about 6 and 9 degrees Celsius (42.8 to 48.2 degrees Fahrenheit), with temperatures trending upward since 1995. In 2007, the year of the historic fire, the mean temperature was a record 11.1 degrees Celsius, while precipitation and soil moisture dipped to an all-time low.

Higher precipitation, if it occurs, could dampen the effects of higher temperatures, but only to a limited extent, said Philip Higuera, a professor of forest ecology and biogeosciences at the University of Idaho and a co-author on the study.

"As temperature rises, so too does evaporation," he said. "So even if future precipitation increases, it's likely that increased evaporation will result in overall lower moisture availability. This affects plants, but it also makes dead vegetation more flammable and fire prone."

The study team also included researchers from the University of Alaska Fairbanks, Neptune and Company, and the University of Washington.

The National Science Foundation and the Joint Fire Science Program supported this study.

Story Source:

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

Journal Reference:

1. Feng Sheng Hu, Philip E. Higuera, John E. Walsh, William L. Chapman, Paul A. Duffy, Linda B. Brubaker, Melissa L. Chipman. **Tundra burning in Alaska: Linkages to climatic change and sea ice retreat**. *Journal of Geophysical Research*, 2010; 115 (G4): G04002 DOI: 10.1029/2009JG001270

http://www.sciencedaily.com/releases/2010/11/101117141516.htm

New Technology Gives on-Site Assessments in Archaeology

This is Kristin Poduska of Duke University. (Credit: Kristin Poduska)

ScienceDaily (Nov. 17, 2010) — The ability to tell the difference between crystals that formed naturally and those formed by human activity can be important to archaeologists in the field. This can be a crucial bit of information in determining the ancient activities that took place at a site, yet archaeologists often wait for months for the results of laboratory tests.

Now, however, an international team of physicists, archaeologists and materials scientists has developed a process that can tell in a matter of minutes the origin of samples thousands of years old. The new device is easily portable and works by "lifting off" the spectral fingerprint of a material with infrared light.

The first material tested was the mineral calcite, commonly found in rocks such as limestone, which forms over millions years in sediments. These rocks can also contain the mineralized shells of sea creatures. Archaeological sites may also feature calcite that was a part of ash, plaster, or other building materials.

In the latest issue of the journal *Advanced Materials*, online November 17, Stefano Curtarolo, associate professor of mechanical engineering and materials sciences and physics at Duke University, and Kristin Poduska, associate professor of physics at Memorial University in Newfoundland, and their colleagues at the Weizmann Institute of Science in Israel, describe the new approach, which has already been successfully tested in archeological sites in Israel.

"The key to determining a sample's origin lay in figuring out how well the crystal structure is organized," Curtarolo said. "Naturally occurring calcite crystals are tightly organized, while a material created by humans from calcite is usually far less organized."

However, interpreting the information obtained using traditional methods is time-consuming and tricky, since such factors as particle size and the alignment of the atoms within the crystals can send out conflicting information.

"For this reason, getting useful and reliable information about the sample usually requires careful and time-intensive sample preparation with highly specialized equipment," Poduska said.

The researchers used infrared spectroscopy to take advantage of the fact that different molecular units absorb light differently, yielding distinct spectral peaks, or molecular fingerprints. They put a sample through a series of grindings -- sometimes as many as a dozen -- while taking detailed infrared spectroscopy readings after each one. By analyzing the absorption peaks at different points in the grinding process, as the particles got smaller and smaller, they could tease out the effects of size and organization.

For example, Curtarolo said, an archaeologist finds a sample and knows that it is calcite, but what cannot be determined at the site is whether it is a naturally occurring mineral, or a building material made of calcite. Plaster is made by heating limestone, grinding it up and mixing it with water.

"We've shown in the field that our method can quickly detect subtle differences in the organization of a crystal by decoupling the two factors that influence the spectral peaks," Poduska said. "Our method is particularly powerful because the direct measurement of particle size is not needed, and it can be used with any crystal that can be excited by infrared light."

Last summer, a team of archaeologists and scientists from the Weizmann Institute successfully tested the new approach at an ancient site in central Israel at Tel Safit, close to where David is thought to have slain Goliath.

"Whenever they found something white, they would call us over to do tests," Poduska said. "We were able to confirm whether the sample was rock or plaster, which helps us decide how to proceed at the excavation site."

Other members of the team, from the Weizmann Institute of Science, were structural biologists Steve Weiner and Lia Addadi, nuclear physicist Elisabetta Boaretto, PhD student Lior Regev, and theoretical physicist Leeor Kronik.

The researchers were supported by the Weizmann Institute and the Lize Meitner Minerva Center for Computational Quantum Chemistry and the National Science Foundation.

Story Source:

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

http://www.sciencedaily.com/releases/2010/11/101117124641.htm

Multiple Sclerosis Drug Serves as Model for Potential Drugs to Treat Botulism Poisoning

ScienceDaily (Nov. 17, 2010) — Scientists are reporting that variants of a drug already approved for treating multiple sclerosis show promise as a long sought treatment for victims of bioterrorist attack with botulinum neurotoxin -- which is 10,000 times deadlier than cyanide and the most poisonous substance known to man. The potential drugs also could be useful in treating other forms of botulism poisoning as well as Alzheimer's disease, multiple sclerosis, and myasthenia gravis, they say in an article in *ACS Chemical Biology*.

Kim D. Janda and colleagues explain that the lack of any approved drug treatment for botulism poisoning leaves a major gap in defenses against bioterrorism and biological warfare. People exposed to botulism toxin develop paralysis, cannot breathe, and may require months of treatment on respirators. "The numbers of medical care units capable of providing supportive care for recovery in the event of a bioterrorism incident would be limited," they note.

The scientists knew that the multiple sclerosis drug diaminopyridine showed promise for working inside nerve cells to counteract the effects of diaminopyridine botulism toxin. However, diaminopyridine itself had disadvantages, including its ability to pass into the brain and have toxic effects on brain tissue. They modified the molecular structure of diaminopyridine to produce two new substances that did not enter the brain and showed good potential as botulism treatments in mice that had been paralyzed by the toxin.

Funding was provided by the National Institute of Allergy and Infectious Diseases.

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

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **American Chemical Society**.

Journal Reference:

1. Alexander V Mayorov, Bert Willis, Antonia Di Mola, Derek Adler, Jennifer Borgia, Olin Jackson, Jie Wang, Yongyi Luo, Lei Tang, Richard J. Knapp, Chandra Natarajan, Michael Goodnough, Noam Zilberberg, Lance Simpson, Kim Janda. **Transient Relief of Botulinum Neurotoxin/A Intoxication with Aminopyridines - A New Twist on an Old Molecule**. *ACS Chemical Biology*, 2010; : 101011230605082 DOI: 10.1021/cb1002366

http://www.sciencedaily.com/releases/2010/11/101117124634.htm

Faster Water Flow Means Greater Diversity of Invertebrate Marine Life

Sponges, sea anemones, hydriods, soft corals, polychaetes, molluscs, barnacles — invertebrate marine life is more diverse when the water flows faster. (Credit: Image courtesy of Brown University)

ScienceDaily (Nov. 17, 2010) — On the rocks just beneath the tides, the faster the water is moving in an area, the greater the variety of invertebrate creatures that will live there. Understanding that water flow is a strong predictor of diversity could be a huge boon to efforts to manage coastal ecosystems.

One of biggest factors promoting the diversity of coastal ocean life is how fast the water flows, according to new research by ecologists at Brown University. Experiments and observation in Palau, Alaska, and Maine showed that the faster the flow, the greater the number of invertebrate species that live on rocks under the water.

The findings, published the week of Nov. 15 in the journal *Ecology Letters,* could help improve management of delicate and complex coastal ecosystems, said James Palardy, a former Brown doctoral student and the paper's lead author. Finding the fastest water could point scientists to areas where diversity is likely greatest -- and perhaps especially worthy of protection -- and to zones where invasive species could establish their first beachheads.

Jon Witman, professor of ecology and environmental biology and Palardy's co-author on the paper, said the results were clear and consistent at all three regions, including in Maine and Alaska where they experimentally manipulated water flow speed.

"It totally blew us a way that we got almost identical results in two marine regions of the world separated by 4,000 miles with completely different regional diversities, and no species shared in common," Witman said. "It's a wake-up call saying that water flow is a really strong predictor of how many species are present in a particular area of the ocean."

The reason why faster flow seems to promote diversity, Witman said, is that it allows for the larvae of rock-dwelling invertebrates, such as barnacles, sea squirts, corals and sponges, to spread farther. Although the environments are quite different, it's somewhat analogous to how trees and flowers can disperse their seeds farther in a stiff wind.

Novel experiment

Palardy and Witman are not the first to observe a connection between water flow and diversity, but they are the first researchers to prove it with experiments. The research began five years ago when the pair started brainstorming about how they might make the important scientific transition from being able to notice the phenomenon to being able to produce and test it.

The pair's goal was to speed up water flow without resorting to expensive and short-lived battery-powered pumps. Instead, the ecologists relied on simple physics that require a volume of water to flow faster when it moves through a narrowed space.

Based on prototypes developed in a giant flume in the basement of the BioMed research building at Brown, they built channels about 7 feet long and about 18 inches high. They lined the walls with plates where organisms could latch on and grow. The test channels narrowed to about half their width in the middle, taking on a bow tie shape. The control channels remained the same width throughout. The control and test channels were placed about 3 to 6 feet below the lowest tide in each of two sites in Maine and Alaskan coastal waters.

In every case they found that the number of different species on the plates in the test channels was much higher than on the plates in the control channels. The greater diversity was no flash in the pan, either. The pattern was visible from early stages and persisted for more than a year of study. Witman also surveyed natural areas in Palau, and Palardy and Witman did the same in Alaska, finding similar effects in areas with faster flow.

Witman said his hope is that the work will not just explain greater biodiversity but will help stem the tide of its loss.

"There's a global biodiversity crisis where we're losing species," he said. "Ecology is very much concerned with sustaining natural processes."

Funding for the research came from the National Oceanographic and Atmospheric Administration, the National Science Foundation, and Abt Associates Inc., a Cambridge, Mass., and Washington, D.C.-based consulting firm where Palardy now works as a senior environmental analyst.

Story Source:

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

Journal Reference:

1. James E Palardy, Jon D. Witman. **Water flow drives biodiversity by mediating rarity in marine benthic communities**. *Ecology Letters*, 2010; DOI: 10.1111/j.1461-0248.2010.01555.x

http://www.sciencedaily.com/releases/2010/11/101117104504.htm

Sonar Inspired by Dolphins

Tim Leighton with dolphin. (Credit: Image courtesy of National Oceanography Centre, Southampton (UK))

ScienceDaily (Nov. 17, 2010) — Scientists at the University of Southampton have developed a new kind of underwater sonar device that can detect objects through bubble clouds that would effectively blind standard sonar.

Just as ultrasound is used in medical imaging, conventional sonar 'sees' with sound. It uses differences between emitted sound pulses and their echoes to detect and identify targets. These include submerged structures such as reefs and wrecks, and objects, including submarines and fish shoals.

However, standard sonar does not cope well with bubble clouds resulting from breaking waves or other causes, which scatter sound and clutter the sonar image.

Professor Timothy Leighton of the University of Southampton's Institute of Soundand Vibration Research (ISVR), who led the research, explained:

"Cold War sonar was developed mainly for use in deep water where bubbles are not much of a problem, but many of today's applications involve shallow waters. Better detection and classification of targets in bubbly waters are key goals of shallow-water sonar."

Leighton and his colleagues have developed a new sonar concept called twin inverted pulse sonar (TWIPS). TWIPS exploits the way that bubbles pulsate in sound fields, which affects the characteristics of sonar echoes.

"To catch prey, some dolphins make bubble nets in which the best man-made sonar would not work. It occurred to me that either dolphins were blinding their sonar when making such nets, or else they have a better sonar system. There were no recordings of the type of sonar that dolphins use in bubble nets, so instead of producing a bio-inspired sonar by copying dolphin signals, I sat down and worked out what pulse I would use if I were a dolphin," said Leighton.

As its name suggests, TWIPS uses trains of twinned pairs of sound pulses. The first pulse of each pair has a waveform that is an inverted replica of that of its twin. The first pulse is emitted a fraction of a second before its inverted twin.

Leighton's team first showed theoretically that TWIPS might be able to enhance scatter from the target while simultaneously suppressing clutter from bubbles. In principle, it could therefore be used to distinguish echoes from bubble clouds and objects that would otherwise remain hidden.

In their latest study, the researchers set out to see whether TWIPS would work in practice. Using a large testing tank, they showed experimentally that TWIPS outperformed standard sonar at detecting a small steel disc under bubbly conditions resembling those found under oceanic breaking waves.

Encouraged by their findings, they next conducted trials at sea aboard the University of Southampton's coastal research vessel the RV *Bill Conway*. They compared the ability of TWIPS and standard sonar to discern the seabed in Southampton Water, which handles seven per cent of the UK's entire seaborne trade. The seabed in this area varies in depth between 10 and 20 metres.

"TWIPS outperformed standard sonar in the wake of large vessels such as passenger ferries," said co-author Dr Justin Dix of the University of Southampton's School of Ocean and Earth Science (SOES) based at the National Oceanography Centre, Southampton.

Possible future marine applications for TWIPS include harbour protection and the detection of bubbles in marine sediments and manufacturing. Technologies based on the same basic principles could be used in medical ultrasound imaging, which was already using pairs of inverted pulses to enhance (rather than suppress) contrast agents injected into the body. The TWIPS principle would work with other sensors such as in Magnetic resonance imaging(MRI), and Leighton has proposed TWIPR (Twin Inverted Pulse Radar) for the detection of improvised explosive devices or covert circuitry.

But what about the original inspiration for the research -- do dolphins and other echolocating animals use TWIPS?

"Key ingredients of a TWIPS system appear in separate species but they have never been found all together in a single species," said Leighton. "There is currently no evidence that dolphins use TWIPS processing, although no-one has yet taken recordings of the signals from animals hunting with bubble nets in the wild. How they successfully detect prey in bubbly water remains a mystery that we are working to solve. I have to pay credit to the team -- students Daniel Finfer and Gim-Hwa Chua of ISVR, and Paul White (ISVR) and Justin Dix of SOES. Our applications for funding this work were repeatedly turned down, and it took real grit and determination to keep going for the five years it took us to get this far."

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. T. G. Leighton, D. C. Finfer, P. R. White, G.- H. Chua, J. K. Dix. **Clutter suppression and classification using twin inverted pulse sonar (TWIPS)**. *Proceedings of the Royal Society A: Mathematical, Physical and Engineering Sciences*, 2010; DOI: 10.1098/rspa.2010.0154

http://www.sciencedaily.com/releases/2010/11/101117104502.htm

Life, Liberty and the Pursuit of Identity

By EDWARD ROTHSTEIN

PHILADELPHIA — Not far from where the National Museum of American Jewish History is opening its new building on Friday for a weekend of celebrations, the Liberty Bell can be seen with its biblical inscription: "Proclaim liberty throughout all the land unto all the inhabitants thereof." The balconies of this $150 million museum overlook Independence National Historical Park, where the Declaration of Independence and the Constitution were signed. The National Constitution Center is on the other end of the park, and next month, just across the mall, the President's House — the executive mansion where George Washington and John Adams lived when Philadelphia served as the nation's capital — will be the site of a museum, with a focus not just on liberty, but also on slavery.

So the location of this new Jewish museum is weighty with significance, and the museum has embraced the possibilities. Freedom — American freedom — is its theme. And while Philadelphia does not instantly come to mind as a national center for Jewish culture, this emphasis, and sheer ambition, give the museum an immediate importance, while highlighting both its weaknesses and its potential.

Founded in 1976 in a 15,000-square-foot building a half-block away, the museum was planning new construction when it learned that the KYW Newsradio building was for sale. That structure was razed, and in its place the museum erected this 100,000-square-foot, glass-and-terra-cotta-cloaked monument, designed by James Stewart Polshek and Ennead Architects and topped by an LED sculpture beaming light. It stands adjacent to the mall making its own proclamation of liberty "unto all the inhabitants thereof."

The institution, which will close on Monday for private events and reopen on Nov. 26, bills itself as "the only museum in the nation dedicated solely to telling the story of Jews in America." Under the guidance of a panel of scholars, led by Jonathan D. Sarna, that story unfolds over three floors, each offering a historical chapter: "Foundations of Freedom, 1654-1880," "Dreams of Freedom, 1880-1945" and "Choices and Challenges of Freedom 1945-Today." The exhibitions — designed by Gallagher & Associates, with the curatorial help of Josh Perelman, the museum's deputy director — give a capsule survey of the trials and triumphs of Jews in America, from their cold reception in New Amsterdam to the enthusiasms of recent pop culture. The path never strays too far from familiar terrain, drawing on the museum's collection of 25,000 artifacts along with lent objects, reproductions, video screens and museological play areas for the younger set.

In this sweep of history you may miss some of the unusual documents: a 1722 brochure by R. Judah Monis, explaining why "the Jewish Nation are not as yet converted to Christianity," though Monis had converted in order to teach Hebrew at Harvard College. Or a remarkable 1789 prayer for the new country from a synagogue in Richmond, Va., celebrating the ratification of the Constitution with a Hebrew acrostic spelling "Washington."

And throughout the 25,000 square feet of exhibition space are chronicles of migration, assimilation and invention. There are images of 19th-century Jewish settlers in Texas and New Mexico, and costumes from 19th-century Jewish charity balls; accounts of Jews in crime and in entertainment; examples of Jews as Confederates and as Union soldiers; anecdotes about Jews as distillers and as philanthropists. From more recent times we see displays of a baseball autographed by Sandy Koufax, a video of the comedian Sarah Silverman, Bella Abzug's hat and Rebecca Rubin, a 2009 doll from the popular American Girl series, meant to be the daughter of Jewish immigrants on the Lower East Side of Manhattan. Near the narrative's end displays on the suburbs and the Catskills yield to a three-screen theater space with film clips from 1960s counterculture and the feminist movement; then come Jewish-related record albums, television skits, campaign buttons and the open-ended future.

This museum shows the Jew as American, present at the country's founding and at each turning point. It is the latest incarnation of the "identity museum," a genre that typically celebrates hyphenated American identity. These museums are expressions of triumphs by minorities, announcing their allegiances, accounting for their hardships, chronicling their political awakenings, recalling their contributions. In a sense the identity museum is a morality tale about success in the cooled-off melting-pot of contemporary democracy; it is a declaration of political power to outsiders, an affirmation of shared experience to cohorts.

As in other identity museums, there is a Hall of Fame here, in this case a multimedia area in the lobby called the " 'Only in America' Gallery," with images and artifacts honoring 18 Jewish-Americans selected by voters on the Internet. But the museum's hand is evident in the careful distribution of honorees: Irving Berlin and Leonard Bernstein, Albert Einstein and Estée Lauder, Golda Meir and Barbra Streisand, Isaac Bashevis Singer and Mr. Koufax.

The museum's argument is that the success of the Jews in the United States can be attributed to the unprecedented character of American liberty. And that becomes evident. The museum is careful too not to turn celebration into a cartoon; there are many struggles along the way. It also points out that not all Jews were unambiguously devoted to ideas of freedom, nor, as it notes in passing, was liberty always an unalloyed blessing for Jewry — it implicitly accommodated assimilation and intermarriage. (One 1735 portrait here shows a Philadelphia Jew, resonantly named Phila Franks, who eloped to marry Oliver De Lancey, a Calvinist Huguenot.)

We learn of the development of Reform Judaism, which in its embrace of American liberalism rejected so many Jewish ritual obligations that when its seminary in Cincinnati, the Hebrew Union College, celebrated the ordination of its first rabbis in 1883, it served what became known as the Trefa Banquet. The menu, seen here, was dominated by "treyf," or nonkosher, foods, including oysters, clams, shrimp and frogs' legs, while readily mixing milk and meat.

But with its preoccupation with liberty, the museum has also given American Jewish history a spin. Freedom's importance surely includes freedom to worship, which has been far from guaranteed in Jewish history. It also includes freedom to participate in civil society as a secular citizen, and this too, even in Europe after the Enlightenment, could hardly be taken for granted. The United States has been the great exception. But then the museum leans heavily toward the right-hand side of the Jewish-American hyphen, being more preoccupied with the freedom Jews had to become Americans, than the freedom they had to remain Jews.

It is as if the museum so wanted to generalize from the Jewish experience and justify its mission as a beacon celebrating political and ethnic freedom, that it misses much of Judaism's particularity. The outline of the story becomes generic; it simply taps into the contemporary identity narrative. We never really understand what Judaism has been as a religion, as a collection of beliefs and laws; so we never see how those beliefs and laws might have been consistent with American visions of liberty. Nor do we understand how they might have contributed to the success of Jews in America or even shaped their lives in secular society.

The museum's focus is on particular Jews, their migrations, their political positions, their achievements, their enjoyments of American possibilities — all social or material aspects of identity. This is one reason so much of the final gallery is given over to the '60s counterculture, to feminism and to political protest: the emphasis, here as elsewhere, is on *civil* rights (though there is little exploration of why so many Jews were drawn to the counterculture).

Similarly, in the exhibition as a whole, Reform Judaism gets extensive attention, because close association with civil and secular life was one of its initial preoccupations. But we hardly learn anything about the growth of the other distinctive American Jewish movements, including Conservative, Reconstructionist, varieties of American Orthodoxy, or even, in more recent decades, Hasidism's resurrection as a potent religious (and political) force. The exhibition makes it seem as if the culmination of the American-Jewish experience was an amorphous cultural Judaism.

Something important is missed as a result. In European countries the administration of Jewish communities was typically highly centralized; these communities were answerable to central governments as alien bodies. Even where the Ottoman Empire ruled, Jews were considered metics — foreign resident groups, with semi-autonomous deferential administrations.

In the United States all that was thoroughly overturned. It wasn't just freedom of worship that changed things. It was a spirit of individualism. Communal Jewish regulation was weakened and possibilities multiplied. Without any central authority and spread over wide geographical distances, Jews could choose a community, a house of worship and, in a sense, a set of beliefs — or not. Independent movements could proliferate and gather adherents more easily than in Europe, which may be one reason American Jewish denominations have had such a profound impact. The United States inspired a kind of libertarian Judaism that led to strange tensions, given the traditional rigors of Jewish law and community life.

The museum's focus on freedom is actually too constrictive. It limits the ways Judaism can be understood, gives too much emphasis to some things, ignores others. The museum is partly correct about the emergence of cultural Judaism — without ever using that phrase — but we don't come closer to understanding it. What we are offered instead are glimpses into a remarkable history. We are also challenged — and perhaps this is sufficient — to make sense of its connection to the political culture that took shape a few hundred yards away.

The National Museum of American Jewish History, at 101 South Independence Mall East in Philadelphia, opens on Friday for celebrations running through Sunday; most events are sold out. It will then close, and reopen on Nov. 26; (215) 923-3811, nmajh.org.

http://www.nytimes.com/2010/11/12/arts/design/12museum.html

One of France's Largest Dinosaur Fossil Deposits Found in the Charente Region

On the right, part of the giant femur (more than 2.2 meters long) of a sauropod, and on the left a section of a humerus from the same animal. (Credit: Copyright Didier Néraudeau (CNRS/Université de Rennes 1))

ScienceDaily (Nov. 16, 2010) — The first excavations at the Audoin quarries in the town of Angeac, in the Charente region of south-western France, have confirmed that the site is one of the richest dinosaur fossil deposits in the country. Coordinated by the Musée d'Angoulême and the Géosciences Rennes laboratory (CNRS / Université de Rennes 1), the project involved researchers from CNRS and the Muséum National d'Histoire Naturelle (French Natural History Museum). With more than 400 bones brought to light, this site is remarkable both for the quantity of discoveries and their state of preservation.

The quarries have yielded a wide variety of fossils dating from the Lower Cretaceous Period, dating back 130 million years. The most impressive is a femur exceeding 2.2 meters, which could have belonged to the largest sauropod known in Europe. Unusually, the paleontologists at the site also discovered fossilized wood, leaves and seeds that will enable them to reconstitute the flora in which the animals lived. Based on these exceptional finds, the scientists hope to gain a clearer picture of the terrestrial ecosystems of the Lower Cretaceous, a little-known and insufficiently documented period in this region of Europe.

Although its existence had been suspected for years, the dinosaur fossil deposit in Angeac-Charente, near Angoulême, was only discovered in the Audoin quarries in January 2010, and turned out to be one of the largest paleontological sites in France. Covering several hundred square meters, the site consists of argillaceous strata from the Lower Cretaceous Period buried under the ancient quaternary alluvial deposits of the Charente River. The first excavation campaign, which took place over 20 days from late August to early September this year, was conducted by a team led by the Musée d'Angoulême and the Géosciences Rennes laboratory (CNRS / Université de Rennes 1), in collaboration with scientists and technicians from the Centre de Recherche sur la Paléobiodiversité et les Paléoenvironnements (Paleobiodiversity and Paleoenvironmental Research Center, CNRS / MNHN), the Université de Lyon and the Musée des Dinosaures in Esperaza (Aude region, south-western France).

Remains of herbivorous and carnivorous dinosaurs mixed with aquatic species

These initial excavations have already unearthed more than 400 bones, over 200 of which are of great scientific interest. The latter come from at least 3 dinosaur species, found alongside the remains of two types of turtle and three species of crocodile. The find is all the more exceptional as the bones are not only present

in large numbers, but are also remarkably well preserved, having been buried rapidly in the argillaceous sediments of a marsh that covered the Angeac-Charente region during the Lower Cretaceous.

The most impressive finds are indisputably the remains of the largest known sauropod in Europe. Its femur, which has for the moment been left in situ, exceeds 2.2 meters in length, suggesting a weight of some 40 tons and a body length of about 35 meters. The biological links between this giant herbivore and other species have yet to be determined, but its anatomy is not dissimilar to examples found in Spain and dating from the same period. The presence of small herbivorous dinosaurs has also been evidenced by the discovery of a tooth and a few bones. The most abundant fossil material gathered this summer (nearly 80% of the bones exhumed) belongs to a large carnivorous dinosaur with a body length of about 9 meters. The number of femurs found points to no fewer than five individuals, young and adult.

Dinosaurs from the Lower Cretaceous are rarely found in France, and are usually identified on the basis of fragmentary remains. So far only three dinosaur genera have been identified: the *ornithopod Iguanodon* and the two theropods *Genusaurus* and *Erectopus*. Richer faunas, most likely contemporary with that of the Angeac site, have been described in Britain (in particular on the Isle of Wight) and Spain (Cuenca Province). The most remarkable animal remains from the period, including feathered carnivorous dinosaurs, were found in the Liaoning Province of China. The newly-found Angeac dinosaurs will be compared to these other specimens to determine their shared and distinctive characteristics.

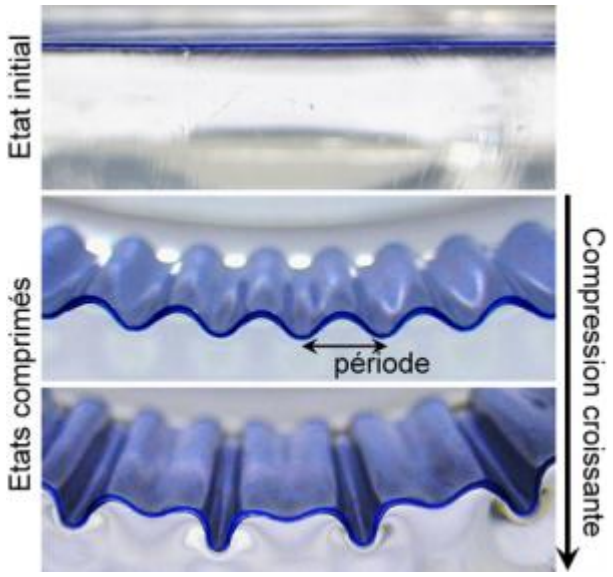
For the paleontologists involved in the project, the next step will be to study and analyze their discoveries, whether it be the animal bones or the fossilized plants. In parallel with this scientific research, a project will be undertaken to enhance the site, enabling the public to view each phase of the operation, from excavation to museum display, over the next few years.

Story Source:

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

http://www.sciencedaily.com/releases/2010/10/101013210804.htm

How Do Folded Structures Form?



Folded structure. (Credit: Copyright Fabian Brau)

ScienceDaily (Nov. 16, 2010) — What do the convolutions of the brain, the emergence of wrinkles, the formation of mountain chains, and fingerprints have in common? All these structures, albeit very different, result from the same process: the compression of a 'rigid membrane'. A French-Belgian team involving the Statistical Physics Laboratory (Laboratoire de physique statistique, CNRS/ENS Paris/UPMC/Université Paris Diderot) and the Interfaces and Complex Fluids Laboratory at the University of Mons in Belgium have shed light on one of the mysteries underlying the formation of such folded structures. This work will make it possible to better understand and thus predict their emergence.

Take a thin sheet of a solid material and try to compress it in such a way that it remains flat. You won't succeed, since the sheet bends systematically along its entire length. This is known as buckling. Now stick the same sheet onto a soft, thick substrate and compress it again in the same way: this time, it forms an extremely regular pattern of small wrinkles characterized by a particular distance between them, called the period. You can see these regular folds by compressing the skin on the top of your hand between thumb and forefinger, or by letting a piece of fruit dry up.

If at this stage you continue to compress the sheet, a totally new and unexpected phenomenon occurs. The folds formed divide into two families: in one of them the amplitude increases, while in the other it diminishes. One fold in two concentrates all the deformation energy, creating a structure with a period which is double that of the initial period. If you further increase compression, the same process starts over again, leading to a fourfold increase in the initial period, and so on. In a particularly original approach, the researchers have shown that the same mechanism governs the emergence of such doubling of the period both in folded structures and in the to-and-fro motion of oscillating systems such as a pendulum with varying length (like the enormous incense burner in the cathedral of Santiago de Compostela, the Botafumeiro), or a swing. There is thus a similarity between the equations that describe oscillations in space (as in folded structures) and oscillations in time (as in variable length pendulums).

This example forms part of a wider context: the researchers seek to explain the morphogenesis induced by mechanical instability. This phenomenon often occurs in nature, such as when folding of geological strata

gives rise to mountains, or when living tissue is formed of two layers growing at different rates (as in the brain, skin and intestines). The approach used here by the scientists reveals underlying connections between seemingly unrelated phenomena. The new theoretical model developed by the researchers will make it easier to understand and therefore predict the emergence of such folded structures. This work could also have repercussions in technological fields, since it opens the way to the development of new micro manufacturing methods to model matter by creating regular micrometer-scale structures.

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

Story Source:

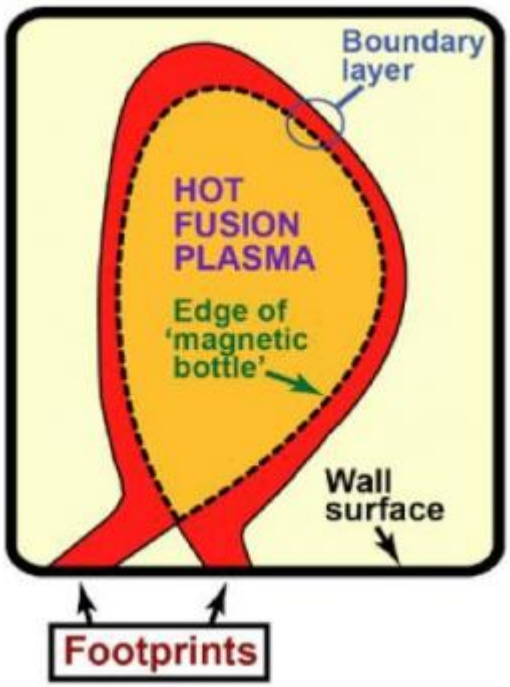
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **CNRS (Délégation Paris Michel-Ange)**.

Journal Reference:

1. Fabian Brau, Hugues Vandeparre, Abbas Sabbah, Christophe Poulard, Arezki Boudaoud, Pascal Damman. **Multiple-length-scale elastic instability mimics parametric resonance of nonlinear oscillators**. *Nature Physics*, 2010; DOI: 10.1038/nphys1806

http://www.sciencedaily.com/releases/2010/11/101105085315.htm

Major Fusion Advance: Breakthrough Could Help Reduce Heating of Plasma Container Walls



Heat escaping a fusion plasma tends to focus into narrow "footprints." (Credit: Image courtesy of American Physical Society)

ScienceDaily (Nov. 16, 2010) — Researchers at the Massachusetts Institute of Technology have taken steps toward practical fusion energy through better understanding of the physics that governs the interaction between plasmas and the material walls of the vessels that contain them.

The best developed approach for practical fusion energy employs magnetic bottles to hold and isolate extremely hot plasmas inside a vacuum vessel. Using magnetic fields for thermal insulation has proven quite effective, allowing plasma temperatures in excess of 100 million C to be attained -- conditions under which the nuclei fuse and release energy. The tokamak device, a torus or donut-shaped magnetic bottle, has been found to perform particularly well and is the basis for ITER, a full-scale international fusion experiment presently under construction in France with U.S. participation. Projections from current experiments to ITER, and beyond to energy producing reactors, presents a number of scientific and technical challenges. Prominent among these is handling the very large heat loads which occur at the interface between the plasma and the materials from which the reactor is constructed.

Magnetic insulation comes with a catch. Heat that leaks out of the bottle is focused into narrow channels as it streams along magnetic field lines in adjoining boundary layers. This produces narrow footprints on wall surfaces. The smaller the footprint, the more intense the heat flux becomes. In fact, the intensity can easily exceed the power handling ability of present technologies. Even worse, certain naturally occurring plasma oscillations can create transient heat loads which are larger still. Recent experiments on the Alcator C-Mod tokamak are aimed at understanding and overcoming this challenge by reducing the steady-state power conducted to the wall, by characterizing the physics which sets the area over which this power is distributed, and by investigating a confinement regime that eliminates transient heat loads.

One set of recent experiments in Alcator C-Mod used ultra-violet radiation from injected impurities to decrease power reaching the divertor, a portion of the wall with the highest heat flux footprint. These results are significant for ITER as well as future fusion reactors that will provide commercial electricity, and show that redistributing the exhaust power by impurity radiation is a viable option.

Different experiments, aimed at understanding the physics that sets the heat-flux footprint size, have discovered its width is independent of the magnetic field line length. This behavior appears counter-intuitive at first, but is part of a growing body of evidence that self-regulatory heat transport mechanisms are at play, which tend to clamp the width of the heat flux profiles at a critical scale-length value.

Another aspect of the plasma-wall challenge is the elimination of transient heat loads, which arise from a relaxation oscillation produced spontaneously in many high performance plasmas. These oscillations help expel unwanted impurities that can contaminate the plasma, but they can also lead to unacceptably high power loads. Ongoing experiments are studying a confinement regime that simultaneously achieves good energy confinement without accumulation of impurities and without the oscillations.

These new findings are being presented in three invited talks at the 52nd annual meeting of the American Physical Society's Division of Plasma Physics, being held Nov. 8-12 in Chicago.

Story Source:

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

http://www.sciencedaily.com/releases/2010/11/101108071910.htm

Film of Paul Bowles Short Story Rediscovered

By RANDY KENNEDY

The tale had all the hallmarks of a baroque Paul Bowles short story, set among the remaindered possessions of Bowles himself: a film director gets a call from a stranger, who says he has stumbled across an original print of the filmmaker's long-lost first film in a windowless Tangier apartment, coated in dust and insect powder. The director, Sara Driver, at first thought the call might be a joke, but for reasons almost as strange as fiction, she kept listening.

In the late 1970s she had fallen in love with a haunting 1948 Bowles story called "You Are Not I," about a young woman who escapes from an asylum, and decided she wanted to make a film of it. With no money for the rights and the thinnest of shoestrings to make the movie itself — a $12,000 budget, some of it supplied by her small salary at a copy shop — she forged ahead anyway. And before its well-received premiere at the Public Theater in 1983, she shipped a print of the 48-minute black-and-white film, the first screen adaptation of one of Bowles's stories, to his apartment in Tangier, Morocco, praying simply not to be sued.

"To my great relief, he liked it," Ms. Driver recalled recently. "And not only that, but he wrote me back with a long, detailed critique of the film, saying, among other things, that he thought one woman overacted — which he was right about."

Bowles's agent granted the rights to Ms. Driver, and the movie — shot in six days near her parents' house in western New Jersey, with an unlikely cast that included two friends, the writer Luc Sante, little known at the time, and an equally unknown photographer, Nan Goldin — developed a following. The film was named one of the best movies of the 1980s by a critic in Cahiers du Cinéma.

But almost as quickly as it built a cult reputation, the film fell from view, the victim of a leak in a New Jersey warehouse that destroyed Ms. Driver's negative. That left her with only one film-festival print so battered that it would barely run through a projector. When museums and art house theaters called over the years asking to show it, she would turn them down, not wanting the film to be seen in such bad shape.

"Every time I'd get back to someone and tell them, my heart would just sink," said Ms. Driver, now 54 and the director of three other films.

The film's story might have ended there, but two years ago a film librarian from the University of Delaware, one of the most important repositories of Bowles's papers, traveled to Morocco to speak at a conference. While in Tangier, the librarian, Francis Poole, who knew Bowles well during the last years of his life, was contacted by Abdelouahed Boulaich, Bowles's longtime butler and his heir, who after Bowles's death in 1999 had helped to secure many of his papers.

Mr. Boulaich told Mr. Poole that he still had a few of the writer's things and asked if he wanted to see them. The two took a taxi from Mr. Poole's hotel to an empty house owned by Mr. Boulaich, who unlocked a door to a small ground-floor salon that smelled as if it had been closed for years.

With a small flashlight and a digital camera, Mr. Poole set about documenting the room's contents, which included piles of letters and books and two manual Olympia typewriters, one long used by Paul Bowles and the other by his wife, Jane. Below them on a bookcase sat a film box with two reels inside; the label was faded except for a New York return address visible beneath the dust and insecticide.

"For a second I felt like I was in one of the bug powder scenes from David Cronenberg's film of William Burroughs's novel 'Naked Lunch,' " Mr. Poole said. "There were even letters from Burroughs to Paul Bowles scattered around. And some of those had insecticide on them."

The University of Delaware acquired the contents of the room from Mr. Boulaich, and Mr. Poole and Tim Murray, who oversees the special collections of the university's library, returned in 2008 and 2009 to box them all up. Mr. Poole still had no idea what was on the film reels, and he acknowledged that he almost decided to leave them. But he put the film box in his carry-on bag and took it to Delaware, where he watched the 16-millimeter reels for the first time — grimy but miraculously, given the humid storage conditions, in good shape — and realized what he had found.

"It was like stumbling upon some kind of treasure in an archaeological dig," he said. "I wasn't there thinking I was going to find a lost film. I must say it's been a once-in-a-lifetime bizarre experience for me."

For Ms. Driver, the film's rediscovery has been like opening a time capsule of the No Wave independent-film scene, which flourished in New York in the late 1970s and early '80s. It included directors like Jim Jarmusch (Ms. Driver's longtime romantic partner and the cinematographer and co-writer for "You Are Not I"), Amos Poe, Eric Mitchell, Bette Gordon, Susan Seidelman ("Desperately Seeking Susan") and even Kathryn Bigelow, of "The Hurt Locker" fame, who made her first short in New York in 1978 (featuring the odd pairing of Gary Busey and the French semiotician Sylvère Lotringer).

It was a tiny film world where favors and friendships often stood in for the money no one had. Mr. Sante recalled that his role in "You Are Not I" required him to be able to drive, which he could not.

"I just needed to go across a parking lot in one scene, and I thought, 'O.K., I can handle this,' " he said. "And I managed to run into a garbage can, which was the only other thing in the parking lot." (A volunteer body double was recruited.)

The unearthed print of the film, which will remain in the University of Delaware collection, has been completely cleaned and restored. A digital copy has been created, which was used to screen "You Are Not I" for the first time in almost 20 years, at the Reykjavik International Film Festival in Iceland in September and last month at the Portuguese Cinémathèque in Lisbon, where the film first played during its initial run in the

early 1980s. Ms. Driver is now applying for grants to help her produce a corrected negative and additional prints.

She said she had been overjoyed to have an important part of her past back, though she pointed out that, technically, “You Are Not I” was not her first film. “I made a little student short before it that was about Troilus and Cressida, and all the dialogue in it was in Middle English,” she said, adding, “That one I don’t think anyone’s ever going to see again.”

http://www.nytimes.com/2010/11/13/movies/13driver.html?ref=design

Astronomers Discover Merging Star Systems That Might Explode

The binary star system J0923+3028 consists of two white dwarfs: a visible star weighing 23 percent as much as our Sun and about four times the diameter of Earth, and an unseen companion weighing 44 percent of the Sun and about one Earth-diameter in size. The stars are currently separated by about 220,000 miles and orbit each other once per hour. The stars will spiral in toward each other and merge in about 100 million years. (Credit: Clayton Ellis (CfA))

ScienceDaily (Nov. 16, 2010) — Sometimes when you're looking for one thing, you find something completely different and unexpected. In the scientific endeavor, such serendipity can lead to new discoveries. Now, researchers who found the first hypervelocity stars escaping the Milky Way announced that their search also turned up a dozen double-star systems. Half of those are merging and might explode as supernovae in the astronomically near future.

All of the newfound binary stars consist of two white dwarfs. A white dwarf is the hot, dead core left over when a sun-like star gently puffs off its outer layers as it dies. A white dwarf is incredibly dense, packing as much as a sun's worth of material into a sphere the size of Earth. A teaspoon of it would weigh more than a ton.

"These are weird systems -- objects the size of the Earth orbiting each other at a distance less than the radius of the Sun," said Smithsonian astronomer Warren Brown, lead author of the two papers reporting the find.

The white dwarfs found in this survey are lightweight among white dwarfs, holding only about one-fifth as much mass as the Sun. They are made almost entirely of helium, unlike normal white dwarfs made of carbon and oxygen.

"These white dwarfs have gone through a dramatic weight loss program," said Carlos Allende Prieto, an astronomer at the Instituto de Astrofisica de Canarias in Spain and a co-author of the study. "These stars are in such close orbits that tidal forces, like those swaying the oceans on Earth, led to huge mass losses."

Remarkably, because they whirl around so close to each other, the white dwarfs stir the space-time continuum, creating expanding ripples known as gravitational waves. Those waves carry away orbital energy, causing the stars to spiral closer together. Half of the systems are expected to merge eventually. The tightest binary, orbiting once every hour, will merge in about 100 million years.

"We have tripled the number of known, merging white-dwarf systems," said Smithsonian astronomer and co-author Mukremin Kilic. "Now, we can begin to understand how these systems form and what they may become in the near future."

When two white dwarfs merge, their combined mass can exceed a tipping point, causing them to detonate and explode as a Type Ia supernova. Brown and his colleagues suggest that the merging binaries they have discovered might be one source of underluminous supernovae -- a rare type of supernova explosion 100 times fainter than a normal Type Ia supernova, which ejects only one-fifth as much matter.

"The rate at which our white dwarfs are merging is the same as the rate of underluminous supernovae -- about one every 2,000 years," explained Brown. "While we can't know for sure whether our merging white dwarfs will explode as underluminous supernovae, the fact that the rates are the same is highly suggestive."

Story Source:

The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **Harvard-Smithsonian Center for Astrophysics**.

Journal References:

1. Warren R. Brown, Mukremin Kilic, Carlos Allende Prieto, Scott J. Kenyon. **The ELM Survey. I. A Complete Sample of Extremely Low Mass White Dwarfs**. *The Astrophysical Journal*, ApJ, 2010, 723, 1072 DOI: 10.1088/0004-637X/723/2/1072
2. Warren R. Brown, Mukremin Kilic, Carlos Allende Prieto, Scott J. Kenyon. **The Merger Rate of Extremely Low Mass White Dwarf Binaries: Links to the Formation of AM CVn Stars and Underluminous Supernovae**. *Monthly Notices of the Royal Astronomical Society: Letters*, (in press) [link]

http://www.sciencedaily.com/releases/2010/11/101116152049.htm

How the Songbird's Brain Controls Timing During Singing

Group of adult zebra finches. (Credit: Liza Gross)

ScienceDaily (Nov. 16, 2010) — A team of scientists has observed the activity of nerve cells in a songbird's brain as it is singing a particular song. Dezhe Jin, an assistant professor in the Department of Physics at Penn State University and one of the study's authors, explained that understanding how birds string together sets of syllables -- or notes in a song -- may provide some insight into how the human brain learns language and produces speech.

The research will be published in the journal *Nature.*

"Unlike dogs and cats, whose vocalizations are innate and unlearned, songbirds learn a song in much the same way as humans learn a language -- through cultural transmission," Jin said. "So we decided to study exactly what is going on -- at the level of brain cells -- in a songbird called the zebra finch." Jin explained that both humans and zebra finches arrange sets of learned syllables to communicate. This arrangement of syllables is known as syntax. Jin said that, although finch syntax is much less complicated than human syntax, finch syntax can still provide a model for human speech.

Jin described the area of the brain responsible for a zebra finch's song production as a clump of neurons, which, if absent, renders the bird incapable of singing. To determine exactly how this clump is involved in syntactic production, Jin and his colleagues used special electrodes to monitor the brain cells in this neuronal clump. The electrodes recorded the pattern of neuronal firings that occurred while the finches were repeating a song. The scientists found that when a zebra finch produces its song, a specific set of neurons in this clump fire at precisely the moment when a particular syllable is being sung. "The result is a kind of domino or cascade effect," Jin said. "We saw that when one syllable was sung, a specific set of neurons in the clump fired, which in turn caused the next set of neurons to fire, and that was associated with the next syllable in the song being sung." Jin explained that the ordered firing of specific sets of neurons can be likened to a musical score. "The sequential bursts of brain-cell activity represent the sequential notes on the same piece of music," he said.

Jin also explained that Darwin's theory of sexual, as opposed to natural, selection could explain the songbird's musical prowess. Sexual selection is the theory that an animal chooses a member of the opposite sex based on some observable feature that signals good health and superior genes. The classic example is the male peacock's elaborate and calorically expensive tail, which attracts the female peahen. In male songbirds, an elaborate tail has been replaced by an elaborate song. "A skilled singer will win the attention of more females, and, as such, he will produce more offspring," Jin explained. "It's not that the song itself varies, just the skill

with which it's sung. Imagine different pianists playing the same Chopin piece. What sets one apart from the others is his sense of timing and rhythm. In the zebra finch, we found that the timing precision of singing was controlled by bursting properties of individual neurons."

Jin and his colleagues believe that the next step in their research will be to perform similar studies in other species of songbirds, including the Bengalese finch. "The zebra finch is a simple model because the bird perfects just one song during its lifetime," Jin explained. "However, other species learn several distinct songs. They have a larger repertoire."

Along with Jin, the study's co-authors include Michael A. Long and Michale S. Fee of the Massachusetts Institute of Technology's McGovern Institute for Brain Research.

Support for this research is provided by the National Science Foundation, the National Institutes of Health, and the Alfred P. Sloan Foundation.

Story Source:

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

Journal Reference:

1. Michael A. Long, Dezhe Z. Jin, Michale S. Fee. **Support for a synaptic chain model of neuronal sequence generation**. *Nature*, 2010; DOI: 10.1038/nature09514

http://www.sciencedaily.com/releases/2010/11/101108151342.htm

Engineers Test Effects of Fire on Steel Structures

Purdue civil engineering doctoral student Lisa Choe works with graduate student Sungwoo Oh in using a one-of-a-kind heating system to study the effects of fire on steel structures. Research assistant Michael Bratt, far left, looks on. The work is led by Amit Varma, a Purdue associate professor of civil engineering (green hardhat), seen here with graduate students Erica Fischer and Kristi Selden. (Credit: Purdue University photo/Mark Simons)

ScienceDaily (Nov. 16, 2010) — Researchers at Purdue University are studying the effects of fire on steel structures, such as buildings and bridges, using a one-of-a-kind heating system and a specialized laboratory for testing large beams and other components.

Building fires may reach temperatures of 1,000 degrees Celsius, or more than 1,800 degrees Fahrenheit, said Amit Varma, a Purdue associate professor of civil engineering who is leading the work.g1

"At that temperature, exposed steel would take about 25 minutes to lose about 60 percent of its strength and stiffness," he said. "As you keep increasing the temperature of the steel, it becomes softer and weaker."

One project focuses on how a building's steel-and-concrete floor and its connections to the building behave in a fire. Another project concentrates on how fire affects steel columns and a building's frame.

Such testing is customarily conducted inside large furnaces.

"However, in a furnace it is very difficult to heat a specimen while simultaneously applying loads onto the structure to simulate the forces exerted during a building's everyday use," Varma said.

To overcome this limitation, Purdue researchers designed a system made up of heating panels to simulate fire. The panels have electrical coils, like giant toaster ovens, and are placed close to the surface of the specimens. As the system is used to simulate fire, test structures are subjected to forces with hydraulic equipment.

In practice, beams and other steel components in buildings are covered with fireproofing materials to resist the effects of extreme heating.

"Because the steel in buildings is coated with a fireproofing material, the air might be at 1,000 degrees but the steel will be at 300 or 400 degrees," Varma said. "We conduct tests with and without fire protection."

The work is funded by the National Science Foundation and the U.S. Department of Commerce's National Institute of Standards and Technology.

The heating system is being used to test full-scale steel columns at Purdue's Robert L. and Terry L. Bowen Laboratory for Large-Scale Civil Engineering Research. It is believed to be the only such heating system in the world, Varma said.

Each panel is about 4 feet square, and the system contains 25 panels that cover 100 square feet. Having separate panels enables researchers to heat certain portions of specimens, recreating "the heating and cooling path of a fire event," Varma said.

The Bowen Lab is one of a handful of facilities where testing can be performed on full-scale structures to yield more accurate data. The 66,000-square-foot laboratory is equipped with special hydraulic testing equipment and powerful overhead cranes.

The research group also has tested 10-foot-by-10-foot "composite floor systems" -- made of steel beams supporting a concrete slab -- inside a furnace operated by Michigan State University. The composite design is the most common type of floor system used in steel structures.

Findings from that research will be compared with floor-system testing to be conducted at the Bowen Lab. Results from both experiments will be used to test and verify computational models used to design buildings.

"Most of these experiments are showing that we have good models, and we are using data to benchmark the models and make sure the theory and experiment agree with each other," Varma said.

Models are needed to design composite floor systems, which can be heavily damaged by fire.

"When you have a floor supporting weight, the floor starts sagging from the heat," Varma said. "It expands, but it's got nowhere to go so it starts bowing down, which produces pulling forces on the building's frame. It starts pulling on the columns and then it becomes longer and permanently deformed. After the fire, it starts cooling, and then it starts pulling on the columns even harder."

Recent research findings were detailed in a paper presented in June during the Structures in Fire conference at Michigan State University. The paper was written by graduate student Lisa Choe and Varma.

Story Source:

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

http://www.sciencedaily.com/releases/2010/11/101116122857.htm

The Workout Enigma

By GRETCHEN REYNOLDS

Erik Isakson/Getty Images

Recently, researchers in Finland made the discovery that some people's bodies do not respond as expected to weight training, others don't respond to endurance exercise and, in some lamentable cases, some don't respond to either. In other words, there are those who just do not become fitter or stronger, no matter what exercise they undertake. To reach this conclusion, the researchers enrolled 175 sedentary adults in a 21-week exercise program. Some lifted weights twice a week. Others jogged or walked. Some did both. Before and after the program, the volunteers' fitness and muscular strength were assessed. At the end of the 21 weeks, the results, published earlier this year in Medicine and Science in Sports and Exercise, were mixed. In the combined strength-and-endurance-exercise program, the volunteers' physiological improvement ranged from a negative 8 percent (meaning they became 8 percent less fit) to a positive 42 percent. The results were similar in the groups that undertook only strength or only endurance training. Some improved their strength enormously, some not at all. Others became aerobically fitter but not stronger, while still others showed no improvements in either area. Only a fortunate few became both fitter and more buff. As the researchers from the University of Jyvaskyla wrote with some understatement, "large individual differences" exist "in the responses to both endurance and strength training."

Hidden away in the results of almost any study of exercise programs is the fact that some people do not respond at all, while others respond at an unusually high rate. Averaged, the results may suggest that a certain exercise program reliably will produce certain results — that jogging, say, three times a week for a month will improve VO2max (maximal oxygen capacity) or reduce blood pressure; and for almost any given group of

exercisers, those results are likely to hold true. But for outliers, the impacts can be quite different. Their VO2max won't budge, or it will fall, or it will soar.

The implications of such wide variety in response are huge. In looking at the population as a whole, writes Jamie Timmons, a professor of systems biology at the Royal Veterinary College in London, in a review article published last month in The Journal of Applied Physiology, the findings suggest that "there will be millions of humans that cannot improve their aerobic capacity or their insulin sensitivity, nor reduce their blood pressure" through standard exercise.

But what is it about one person's body that allows it to react so vigorously to exercise, while for others the reaction is puny at best? One answer, to no one's surprise, would seem to be genetics, although the actual mechanisms involved are complex, as a recent study by Dr. Timmons and others underscored. In that work, researchers accurately predicted who would respond most to endurance exercise training based on the expression levels of 29 different genes in their muscles before the start of the training. Those 29 genes are not necessarily directly associated with exercise response. They seem to have more to do with the development of new blood vessels in muscles; they may or may not have initiated the response to exercise. Scientists just don't know yet.

In other words, this issue is as intricate as the body itself. There is a collection of compelling data that indicate that about half of our aerobic capacity "is genetic," Dr. Timmons wrote in an e-mail. "The rest may be diet," or it could be a result of epigenetics, a complicated process in which the environment (including where you live and what you eat) affects how and when genes are activated. "Or it could be other factors," he said. Although fewer studies have examined why people respond so variously to strength training, "we have no reason to doubt," he said, that genetics play a similar role.

But none of this means that if you once took up jogging or weight lifting and didn't respond, you should take to the couch. It may be that a different exercise regimen would prompt beneficial reactions from your particular genome and physiology, Dr. Timmons said. (Although scientists still have a long way to go before they can say, definitively, who needs what exercise, based on genetic and other differences.) In the meantime, Dr. Timmons stressed, even low responders should continue to sweat. Just as scientists don't yet understand the complicated underpinnings of the body's response to exercise, they also don't necessarily understand the full range of exercise's impacts. Even if you do not increase your VO2max, Dr. Timmons said, you are likely to be deriving other benefits, both big and small, from working out. Exercise does still remain, "on average," he said, "one of the best 'health' treatments we have."

http://well.blogs.nytimes.com/2010/11/17/phys-ed-the-workout-enigma/?ref=magazine

US reserves of rare earth elements assessed for first time

- 20:58 19 November 2010 by **Katharine Comisso**

A new report finds significant deposits of rare earth elements in 14 states, with the largest known deposits at Mountain Pass, California; Bokan Mountain, Alaska; and the Bear Lodge Mountains, Wyoming. "Placer" deposits are sandy sediments that sometimes contain rare earths. Phosphorite deposits, which mostly occur in the southeastern US, sometimes contain the rare earth elements yttrium and lanthanum (Image: USGS)

The US has 13 million tonnes of rare earth elements but it would take years to extract them, suggests the first detailed report on the country's supply.

"Rare earth" is an alternative name for the lanthanides – elements 57 to 71 – plus yttrium and scandium. The elements are integral to modern life, and are used in everything from disc drives, hybrid cars and sunglasses to lasers and aircraft used by the military.

China controls 97 per cent of the world's supply and has been tightening its export quotas, sparking concerns that the rare earths could live up to their name.

Now, the US Geological Survey has looked at all known national reserves of the elements as part of a larger assessment of the threat posed to defence by limited rare earth supplies.

It found that the domestic pipeline is "rather thin". The US boasts the third largest reserves in the world after China and the Commonwealth of Independent States, made up of nations that were formerly part of the Soviet Union. But the only rare earths mine the US has ever operated, at Mountain Pass, California, is currently inactive. Mining may restart there within two years, but any other mines will be far behind.

Down Under

Only a handful of sites are even being explored. "Then it's literally years before you start applying for permits to start mining or building infrastructure or putting processing facilities in place," says Gareth Hatch of consultancy firm Technology Metals Research in Carpentersville, Illinois, who was not involved in the new report. It could be 10 years or more before any new mines open, the report suggests.

The report says one of the most promising sites is Bokan Mountain on the southernmost island of Alaska. Ucore Rare Metals has been exploring there since 2007, and the region was once home to a uranium mine, so some infrastructure is already in place, together with a deep water port. See a map of other rare earth sites in the US.

The report suggests the US might break its dependency on China's rare earth monopoly by looking to other future suppliers of rare earths, including Australia and Canada. Australia has far fewer rare earths overall than the US, but the ore in its Mount Weld mine contain the highest concentration of the elements known anywhere in the world. Since the mine was completed in 2008, ore has been mined and is now stockpiled, ready for its rare earths to be extracted.

http://www.newscientist.com/article/dn19753-us-reserves-of-rare-earth-elements-assessed-for-first-time.html

Red wine packed with antidiabetes compounds

- 14:54 19 November 2010 by **Cian O'Luanaigh**

Antidiabetic dose? (Image: Eyecandy Images/Superstock)

Red wine is a potent source of antidiabetic compounds – but they might not get past your gut. The finding is sure to enliven the ongoing debate over the drink's health benefits.

Alois Jungbauer and colleagues at the University of Natural Resources and Life Sciences in Vienna, Austria, tested 10 reds and two whites to find out how strongly the wines bound to a protein called PPAR-gamma, which is targeted by the antidiabetic drug rosiglitazone. (This drug is marketed under the brand name Avandia and, while still available in the US, has been withdrawn in Europe because of fears over side effects.)

PPAR-gamma is a type of protein called a receptor. Among other things, it regulates the uptake of glucose in fat cells. Rosiglitazone targets PPAR-gamma in fat cells to make them more sensitive to insulin and improve the uptake of glucose. It is used as a treatment for type 2 diabetes, a condition where people either do not make enough insulin to keep their body's glucose levels down, or become resistant to normal insulin levels.

Several studies have shown that moderate consumption of red wine can reduce the risk of type 2 diabetes. So Jungbauer and colleagues determined the wines' binding affinity for PPAR-gamma and compared the results with the effects of rosiglitazone. They found that the white wines had low binding affinities, but all the reds bound readily: the tendency of 100 millilitres of red wine – about half a glass – to bind to PPAR-gamma is up to four times as strong as the same tendency in the daily dose of rosiglitazone.

Red and green

"It's incredible. It's a really high activity," says Jungbauer. "At first we were worried it was an artefact, but then we identified the compounds responsible in the wine."

The flavonoid epicatechin gallate – which is also present in green tea – had the highest binding affinity, followed by the polyphenol ellagic acid, which comes from the oak barrels the wine is kept in. The researchers think that some of the antidiabetic activity of red wine could be due to these compounds activating PPAR-gamma.

But Jungbauer warns that these compounds don't make red wine a magic bullet. The compounds in a glass of wine may have other antidiabetic effects and in any case, not all of the compounds will be absorbed and available to the body to use. "Wine also contains ethanol, which will add to your calories," he says.

Véronique Cheynier, research director at the department of oenology at the University of Montpellier 1, France, says that most polyphenols do not pass through the digestive tract unchanged and may not be absorbed at all.

True temperance

The next step for Jungbauer and his team will be to measure the metabolic effects of the wine compounds on healthy people.

Jungbauer stresses that moderate consumption is the key to health benefits from wine. "It is important to limit the intake of wine. Obesity is one of the major problems of our society," he says.

Paras Mishra of the University of Louisville, Kentucky, who was not involved in the study, warns that drinking too much wine "could be bad even in diabetes".

Journal reference: *Food and Function*, DOI: 10.1039/c0fo00086h

http://www.newscientist.com/article/dn19751-red-wine-packed-with-antidiabetes-compounds.html

In Fending Off Diseases, Plants and Animals Are Much the Same, Research Shows

Despite having gone their separate ways at least a billion years ago, plants and animals have developed remarkably similar mechanisms for detecting the molecular signatures of infectious organisms. (Credit: Image courtesy of Tree of Life Web Project)

ScienceDaily (Nov. 18, 2010) — Contrary to long-held beliefs, plants and animals have developed remarkably similar mechanisms for detecting microbial invasions. This holds promise for the future treatment of infectious diseases in humans.

It may have been 1 billion years since plants and animals branched apart on the evolutionary tree but down through the ages they have developed strikingly similar mechanisms for detecting microbial invasions and resisting diseases.

This revelation was arrived at over a period of 15 years by teams of researchers from seemingly disparate fields who have used classical genetic studies to unravel the mysteries of disease resistance in plants and animals, according to a historical overview that will appear in the Nov. 19 issue of the journal *Science*.

The report, written by Pamela Ronald, a UC Davis plant pathologist, and Bruce Beutler, an immunologist and mammalian geneticist at The Scripps Research Institute, describes how researchers have used common approaches to tease apart the secrets of immunity in species ranging from fruit flies to rice. It also forecasts where future research will lead.

"Increasingly, researchers will be intent on harnessing knowledge of host sensors to advance plant and animal health," said Ronald, who was a co-recipient of the 2008 U.S. Department of Agriculture's National Research Initiative Discovery Award for work on the genetic basis of flood tolerance in rice.

"Some of the resistance mechanisms that researchers will discover will likely serve as new drug targets to control deadly bacteria for which there are currently no effective treatments," she said.

At the heart of this research saga are receptors -- protein molecules usually found on cell membranes -- that recognize and bind to specific molecules on invading organisms, signaling the plant or animal in which the receptor resides to mount an immune response and fend off microbial infection and disease.

Beutler and Ronald have played key roles in this chapter of scientific discovery. In 1995, Ronald identified the first such receptor -- a rice gene known as known as Xa21 -- and in 1998, Beutler identified the gene for the first immune receptor in mammals -- a mouse gene known as TLR4.

Their overview in Science includes illustrated descriptions of the disease-resistance or immunity pathways in the mouse, Drosophila fruit fly, rice and a common research plant known as *Arabidopsis*. These represent the immune defense systems of vertebrates, insects, monocotyledons (grass-like plants) and dicotyledons (plants like beans that have two seed leaves.)

The researchers note that plant biologists led the way in discovering receptors that sense and respond to infection. The 1980s brought about an intense hunt for the genes that control production of the receptor proteins, followed by an "avalanche" of newly discovered receptor genes and mechanisms in the 1990s.

Another milestone included discovery in 2000 of the immune receptor in *Arabidopsis* known as FLS2 -- which demonstrated that a plant receptor could bind to a molecule that is present in many different microbial invaders.

The review also discuses how plant and animal immune responses have evolved through the years and which mechanisms have remained the same.

While the past 15 years have been rich in significant discoveries related to plant and animal immunity, Beutler and Ronald are quick to point out that researchers have just scratched the surface.

"If you think of evolution as a tree and existing plant and animal species as the leaves on the tips of the tree's branches, it is clear that we have examined only a few of those leaves and have only a fragmentary impression of what immune mechanisms exist now and were present in the distant past," said Beutler, an elected member of the U.S. National Academy of Sciences.

He and Ronald predict that, as results from new gene sequencing projects become available, scientists will likely find that some plant and animal species emphasize specific resistance mechanisms while having little use for others.

For example, the researchers point out that the Drosophila's immune system depends on only one immunologically active receptor, known as the Toll receptor, to sense invasion by fungi and gram-positive bacteria. In contrast, *Arabidopsis* has dozens of sensors to protect against microbial infections and rice has hundreds.

Ronald and Beutler project that many surprises will be uncovered by future research as it probes the disease-resistance mechanisms of other species.

The review study was supported with funding from the National Institutes of Health.

Story Source:

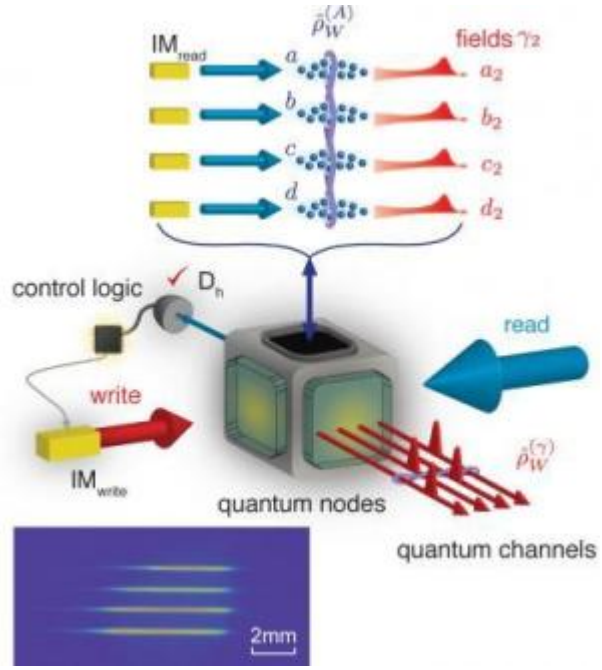
The above story is reprinted (with editorial adaptations by Science*Daily* staff) from materials provided by **University of California - Davis**.

Journal Reference:

1. Pamela C. Ronald and Bruce Beutler. **Plant and Animal Sensors of Conserved Microbial Signatures**. *Science*, 19 November 2010: Vol. 330 no. 6007 pp. 1061-1064 DOI: 10.1126/science.1189468

http://www.sciencedaily.com/releases/2010/11/101118141551.htm

Physicists Demonstrate a Four-Fold Quantum Memory



Writing laser pulses are switched on by the intensity modulator (IM_write) and generate correlated light scattering from four collections of atoms (atomic ensembles which serve as quantum memories). Detection of a single photon at Dh for the light scattered from the atoms creates the entangled state rho^(A)_w with one spin excitation shared collectively among the ensembles (as illustrated at the top of the figure). At later times, the intensity modulator (IM_read) switches on read laser pulses that read out the quantum information stored in the atoms, thereby creating four entangled beams of light in the state rho^(gamma)_w illustrated in the lower right corner of the figure. The inset is a fluorescence image of the laser-cooled atomic ensembles a, b, c and d that become entangled. (Credit: Akihisa Goban/Nature)

ScienceDaily (Nov. 17, 2010) — Researchers at the California Institute of Technology (Caltech) have demonstrated quantum entanglement for a quantum state stored in four spatially distinct atomic memories.

Their work, described in the November 18 issue of the journal *Nature,* also demonstrated a quantum interface between the atomic memories -- which represent something akin to a computer "hard drive" for entanglement -- and four beams of light, thereby enabling the four-fold entanglement to be distributed by photons across quantum networks. The research represents an important achievement in quantum information science by extending the coherent control of entanglement from two to multiple (four) spatially separated physical systems of matter and light.

The proof-of-principle experiment, led by William L. Valentine Professor and professor of physics H. Jeff Kimble, helps to pave the way toward quantum networks. Similar to the Internet in our daily life, a quantum network is a quantum "web" composed of many interconnected quantum nodes, each of which is capable of rudimentary quantum logic operations (similar to the "AND" and "OR" gates in computers) utilizing "quantum transistors" and of storing the resulting quantum states in quantum memories. The quantum nodes are "wired" together by quantum channels that carry, for example, beams of photons to deliver quantum information from node to node. Such an interconnected quantum system could function as a quantum

computer, or, as proposed by the late Caltech physicist Richard Feynman in the 1980s, as a "quantum simulator" for studying complex problems in physics.

Quantum entanglement is a quintessential feature of the quantum realm and involves correlations among components of the overall physical system that cannot be described by classical physics. Strangely, for an entangled quantum system, there exists no objective physical reality for the system's properties. Instead, an entangled system contains simultaneously multiple possibilities for its properties. Such an entangled system has been created and stored by the Caltech researchers.

Previously, Kimble's group entangled a pair of atomic quantum memories and coherently transferred the entangled photons into and out of the quantum memories. For such two-component -- or bipartite -- entanglement, the subsystems are either entangled or not. But for multi-component entanglement with more than two subsystems -- or multipartite entanglement -- there are many possible ways to entangle the subsystems. For example, with four subsystems, all of the possible pair combinations could be bipartite entangled but not be entangled over all four components; alternatively, they could share a "global" quadripartite (four-part) entanglement.

Hence, multipartite entanglement is accompanied by increased complexity in the system. While this makes the creation and characterization of these quantum states substantially more difficult, it also makes the entangled states more valuable for tasks in quantum information science.

To achieve multipartite entanglement, the Caltech team used lasers to cool four collections (or ensembles) of about one million Cesium atoms, separated by 1 millimeter and trapped in a magnetic field, to within a few hundred millionths of a degree above absolute zero. Each ensemble can have atoms with internal spins that are "up" or "down" (analogous to spinning tops) and that are collectively described by a "spin wave" for the respective ensemble. It is these spin waves that the Caltech researchers succeeded in entangling among the four atomic ensembles.

The technique employed by the Caltech team for creating quadripartite entanglement is an extension of the theoretical work of Luming Duan, Mikhail Lukin, Ignacio Cirac, and Peter Zoller in 2001 for the generation of bipartite entanglement by the act of quantum measurement. This kind of "measurement-induced" entanglement for two atomic ensembles was first achieved by the Caltech group in 2005.

In the current experiment, entanglement was "stored" in the four atomic ensembles for a variable time, and then "read out" -- essentially, transferred -- to four beams of light. To do this, the researchers shot four "read" lasers into the four, now-entangled, ensembles. The coherent arrangement of excitation amplitudes for the atoms in the ensembles, described by spin waves, enhances the matter-light interaction through a phenomenon known as superradiant emission.

"The emitted light from each atom in an ensemble constructively interferes with the light from other atoms in the forward direction, allowing us to transfer the spin wave excitations of the ensembles to single photons," says Akihisa Goban, a Caltech graduate student and coauthor of the paper. The researchers were therefore able to coherently move the quantum information from the individual sets of multipartite entangled atoms to four entangled beams of light, forming the bridge between matter and light that is necessary for quantum networks.

The Caltech team investigated the dynamics by which the multipartite entanglement decayed while stored in the atomic memories. "In the zoology of entangled states, our experiment illustrates how multipartite entangled spin waves can evolve into various subsets of the entangled systems over time, and sheds light on

the intricacy and fragility of quantum entanglement in open quantum systems," says Caltech graduate student Kyung Soo Choi, the lead author of the Nature paper. The researchers suggest that the theoretical tools developed for their studies of the dynamics of entanglement decay could be applied for studying the entangled spin waves in quantum magnets.

Further possibilities of their experiment include the expansion of multipartite entanglement across quantum networks and quantum metrology. "Our work introduces new sets of experimental capabilities to generate, store, and transfer multipartite entanglement from matter to light in quantum networks," Choi explains. "It signifies the ever-increasing degree of exquisite quantum control to study and manipulate entangled states of matter and light."

In addition to Kimble, Choi, and Goban, the other authors of the paper are Scott Papp, a former postdoctoral scholar in the Caltech Center for the Physics of Information now at the National Institute of Standards and Technology in Boulder, Colorado, and Steven van Enk, a theoretical collaborator and professor of physics at the University of Oregon, and an associate of the Institute for Quantum Information at Caltech.

This research was funded by the National Science Foundation, the National Security Science and Engineering Faculty Fellowship program at the U.S. Department of Defense (DOD), the Northrop Grumman Corporation, and the Intelligence Advanced Research Projects Activity.

Story Source:

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

Journal Reference:

1. K. S. Choi, A. Goban, S. B. Papp, S. J. van Enk, H. J. Kimble. **Entanglement of spin waves among four quantum memories**. *Nature*, 2010; 468 (7322): 412 DOI: 10.1038/nature09568

http://www.sciencedaily.com/releases/2010/11/101117141432.htm

As Glaciers Melt, Science Seeks Data on Rising Seas

By JUSTIN GILLIS

TASIILAQ, Greenland — With a tense pilot gripping the stick, the helicopter hovered above the water, a red speck of machinery lost in a wilderness of rock and ice.

To the right, a great fjord stretched toward the sea, choked with icebergs. To the left loomed one of the immense glaciers that bring ice from the top of the Greenland ice sheet and dump it into the ocean.

Hanging out the sides of the craft, two scientists sent a measuring device plunging into the water, between ice floes. Near the bottom, it reported a temperature of 40 degrees. It was the latest in a string of troubling measurements showing that the water was warm enough to melt glaciers rapidly from below.

"That's the highest we've seen this far up the fjord," said one of the scientists, Fiammetta Straneo.

The temperature reading was a new scrap of information in the effort to answer one of the most urgent — and most widely debated — questions facing humanity: How fast is the world's ice going to melt?

Scientists long believed that the collapse of the gigantic ice sheets in Greenland and Antarctica would take thousands of years, with sea level possibly rising as little as seven inches in this century, about the same amount as in the 20th century.

But researchers have recently been startled to see big changes unfold in both Greenland and Antarctica.

As a result of recent calculations that take the changes into account, many scientists now say that sea level is likely to rise perhaps three feet by 2100 — an increase that, should it come to pass, would pose a threat to coastal regions the world over.

And the calculations suggest that the rise could conceivably exceed six feet, which would put thousands of square miles of the American coastline under water and would probably displace tens of millions of people in Asia.

The scientists say that a rise of even three feet would inundate low-lying lands in many countries, rendering some areas uninhabitable. It would cause coastal flooding of the sort that now happens once or twice a century to occur every few years. It would cause much faster erosion of beaches, barrier islands and marshes. It would contaminate fresh water supplies with salt.

In the United States, parts of the East Coast and Gulf Coast would be hit hard. In New York, coastal flooding could become routine, with large parts of Queens and Brooklyn especially vulnerable. About 15 percent of the urbanized land in the Miami region could be inundated. The ocean could encroach more than a mile inland in parts of North Carolina.

Abroad, some of the world's great cities — London, Cairo, Bangkok, Venice and Shanghai among them — would be critically endangered by a three-foot rise in the sea.

Climate scientists readily admit that the three-foot estimate could be wrong. Their understanding of the changes going on in the world's land ice is still primitive. But, they say, it could just as easily be an underestimate as an overestimate. One of the deans of American coastal studies, Orrin H. Pilkey of Duke University, is advising coastal communities to plan for a rise of at least five feet by 2100.

"I think we need immediately to begin thinking about our coastal cities — how are we going to protect them?" said John A. Church, an Australian scientist who is a leading expert on sea level. "We can't afford to protect everything. We will have to abandon some areas."

Sea-level rise has been a particularly contentious element in the debate over global warming. One published estimate suggested the threat was so dire that sea level could rise as much as 15 feet in this century. Some of the recent work that produced the three-foot projection was carried out specifically to counter more extreme calculations.

Global warming skeptics, on the other hand, contend that any changes occurring in the ice sheets are probably due to natural climate variability, not to greenhouse gases released by humans.
Such doubts have been a major factor in the American political debate over global warming, stalling efforts by Democrats and the Obama administration to pass legislation that would curb emissions of heat-trapping gases. Similar legislative efforts are likely to receive even less support in the new Congress, with many newly elected legislators openly skeptical about climate change.

A large majority of climate scientists argue that heat-trapping gases are almost certainly playing a role in what is happening to the world's land ice. They add that the lack of policies to limit emissions is raising the risk that the ice will go into an irreversible decline before this century is out, a development that would eventually make a three-foot rise in the sea look trivial.

Melting ice is by no means the only sign that the earth is warming. Thermometers on land, in the sea and aboard satellites show warming. Heat waves, flash floods and other extreme weather events are increasing. Plants are blooming earlier, coral reefs are dying and many other changes are afoot that most climate scientists attribute to global warming.

Yet the rise of the sea could turn out to be the single most serious effect. While the United States is among the countries at greatest risk, neither it nor any other wealthy country has made tracking and understanding the changes in the ice a strategic national priority.

The consequence is that researchers lack elementary information. They have been unable even to measure the water temperature near some of the most important ice on the planet, much less to figure out if that water is warming over time. Vital satellites have not been replaced in a timely way, so that American scientists are losing some of their capability to watch the ice from space.

The missing information makes it impossible for scientists to be sure how serious the situation is.

"As a scientist, you have to stick to what you know and what the evidence suggests," said Gordon Hamilton, one of the researchers in the helicopter. "But the things I've seen in Greenland in the last five years are alarming. We see these ice sheets changing literally overnight."

Dodging Icebergs

In the brilliant sunshine of a late summer day in southeastern Greenland, the pilot at the controls of the red helicopter, Morgan Goransson, dropped low toward the water. He used the downdraft from his rotor to clear ice from the surface of Sermilik Fjord.

The frigid waters were only 30 feet below, so any mechanical problem would have sent the chopper plunging into the sea. "It is *so* dangerous," Mr. Goransson said later that night, over a fish dinner.

Taking the temperature of waters near the ice sheet is essential if scientists are to make sense of what is happening in Greenland. But it is a complex and risky business.

The two scientists — Dr. Straneo, of the Woods Hole Oceanographic Institution in Massachusetts, and Dr. Hamilton, of the University of Maine — are part of a larger team that has been traveling here every summer with financing from the National Science Foundation, the federal agency that sponsors much of the nation's most important research. Not only do they remove the doors of helicopters and lean over icy fjords to get their readings, but they dodge huge icebergs in tiny boats and traipse over glaciers scarred by crevasses that could swallow large buildings.

The reading that the scientists obtained a few weeks ago, of 40 degrees near the bottom of the fjord, fit a broader pattern that researchers have been detecting in the past few years.

Water that originated far to the south, in warmer parts of the Atlantic Ocean, is flushing into Greenland's fjords at a brisk pace. Scientists suspect that as it melts the ice from beneath, the warm water is loosening the connection of the glaciers to the ground and to nearby rock.

The effect has been something like popping a Champagne cork, allowing the glaciers to move faster and dump more ice into the ocean. Within the past decade, the flow rate of many of Greenland's biggest glaciers has doubled or tripled. Some of them have eventually slowed back down, but rarely have they returned to their speed of the 1990s.

Two seismologists, Meredith Nettles and Göran Ekström of Columbia University, discovered a few years ago that unusual earthquakes were emanating from the Greenland glaciers as they dumped the extra ice into the sea. "It's remarkable that an iceberg can do this, but when that loss of ice occurs, it does generate a signal that sets up a vibration that you can record all across the globe," Dr. Nettles said in an interview in Greenland.

Analyzing past records, they discovered that these quakes had increased severalfold from the level of the early 1990s, a sign of how fast the ice is changing.

Satellite and other measurements suggest that through the 1990s, Greenland was gaining about as much ice through snowfall as it lost to the sea every year. But since then, the warmer water has invaded the fjords, and air temperatures in Greenland have increased markedly. The overall loss of ice seems to be accelerating, an ominous sign given that the island contains enough ice to raise global sea levels by more than 20 feet.

Strictly speaking, scientists have not proved that human-induced global warming is the cause of the changes. They are mindful that the climate in the Arctic undergoes big natural variations. In the 1920s and '30s, for instance, a warm spell caused many glaciers to retreat.

John R. Christy, a climatologist at the University of Alabama in Huntsville who is often critical of mainstream climate science, said he suspected that the changes in Greenland were linked to this natural variability, and added that he doubted that the pace would accelerate as much as his colleagues feared.

For high predictions of sea-level rise to be correct, "some big chunks of the Greenland ice sheet are going to have to melt, and they're just not melting that way right now," Dr. Christy said.

Yet other scientists say that the recent changes in Greenland appear more pervasive than those of the early 20th century, and that they are occurring at the same time that air and ocean temperatures are warming, and ice melt is accelerating, throughout much of the world.

Helheim Glacier, which terminates in Sermilik Fjord, is one of a group of glaciers in southeastern Greenland that have shown especially big changes.

On a recent day, the red helicopter landed on a rocky outcrop above the glacier, a flowing river of ice about 25 miles long and nearly four miles wide. On the side of the canyon, Dr. Hamilton pointed toward a band of light-colored rock.

It was, in essence, a bathtub ring.

Something caused the glacier, one of Greenland's largest, to speed up sharply in the middle of the last decade, and it spit so much ice into the ocean that it thinned by some 300 feet in a few years. A part of the canyon that was once shielded from the sun by ice was thus left exposed.

The glacier has behaved erratically ever since, and with variations, that pattern is being repeated all over Greenland. "All these changes are happening at a far faster pace than we would have ever predicted from our conventional theories," Dr. Hamilton said.

A few days after the helicopter trip, an old Greenlandic freighter nudged its way gingerly up Sermilik Fjord, which was so choked with ice that the boat had to stop well short of its goal. "You have to be flexible to work out here," said the leader of the team that day, Dr. Straneo of Woods Hole.

Soon she was barking orders, and her team swung into motion. A cold, Arctic drizzle fell on the boat and the people. Off the port side in a rickety skiff, David Sutherland, a young scientist at the University of Washington, tossed a floating buoy, carrying a string of instruments, into the water, and an anchor snatched it below the surface. Over the next year, it will measure temperature, currents and other factors in the fjord.

Dr. Sutherland climbed back aboard the freighter with cold, wet feet. As the boat headed back to port, it passed icebergs the size of city blocks, chunks of the Greenland ice sheet bound for the open sea.

An Ocean in Flux

The strongest reason to think that the level of the sea could undergo big changes in the future is that it has done so in the past.

With the waxing and waning of ice ages, driven by wobbles in the earth's orbit, sea level has varied by hundreds of feet, with shorelines moving many miles in either direction. "We're used to the shoreline being fixed, and it's not," said Robin E. Bell, a scientist at the Lamont-Doherty Earth Observatory of Columbia University.

But at all times in the past, when the shoreline migrated, humans either had not evolved yet or consisted of primitive bands of hunter-gatherers who could readily move. By the middle of this century, a projected nine billion people will inhabit the planet, with many millions of them living within a few feet of sea level.

To a majority of climate scientists, the question is not whether the earth's land ice will melt in response to the greenhouse gases those people are generating, but whether it will happen too fast for society to adjust.

Recent research suggests that the volume of the ocean may have been stable for thousands of years as human civilization has developed. But it began to rise in the 19th century, around the same time that advanced countries began to burn large amounts of coal and oil.

The sea has risen about eight inches since then, on average. That sounds small, but on a gently sloping shoreline, such an increase is enough to cause substantial erosion unless people intervene. Governments have spent billions in recent decades pumping sand onto disappearing beaches and trying to stave off the loss of coastal wetlands.

Scientists have been struggling for years to figure out if a similar pace of sea-level rise is likely to continue in this century — or whether it will accelerate. In its last big report, in 2007, the United Nations group that assesses climate science, the Intergovernmental Panel on Climate Change, said that sea level would rise at least seven more inches, and might rise as much as two feet, in the 21st century.

But the group warned that these estimates did not fully incorporate "ice dynamics," the possibility that the world's big ice sheets, as well as its thousands of smaller glaciers and ice caps, would start spitting ice into the ocean at a much faster rate than it could melt on land. Scientific understanding of this prospect was so poor, the climate panel said, that no meaningful upper limit could be put on the potential rise of sea level.

That report prompted fresh attempts by scientists to calculate the effect of ice dynamics, leading to the recent, revised projections of sea-level rise.

Satellite evidence suggests that the rise of the sea accelerated late in the 20th century, so that the level is now increasing a little over an inch per decade, on average — about a foot per century. Increased melting of land ice appears to be a major factor. Another is that most of the extra heat being trapped by human greenhouse emissions is going not to warm the atmosphere but to warm the ocean, and as it warms, the water expands.

With the study of the world's land ice still in its early stages, scientists have lately been trying crude methods to figure out how much the pace might accelerate in coming decades.

One approach, pioneered by a German climate researcher named Stefan Rahmstorf, entails looking at the past relationship between the temperature of the earth and sea level, then making projections. Another, developed by a University of Colorado glaciologist named Tad Pfeffer, involves calculations about how fast the glaciers, if they keep speeding up, might be able to dump ice into the sea.

Those two methods yield approximately the same answer: that sea level could rise by 2 1/2 to 6 1/2 feet between now and 2100. A developing consensus among climate scientists holds that the best estimate is a little over three feet.

Calculations about the effect of a three-foot increase suggest that it would cause shoreline erosion to accelerate markedly. In places that once flooded only in a large hurricane, the higher sea would mean that a routine storm could do the trick. In the United States, an estimated 5,000 square miles of dry land and 15,000 square miles of wetlands would be at risk of permanent inundation, though the actual effect would depend on how much money was spent protecting the shoreline.

The worst effects, however, would probably occur in areas where land is sinking even as the sea rises. Some of the world's major cities, especially those built on soft sediments at the mouths of great rivers, are in that situation. In North America, New Orleans is the premier example, with large parts of the city already sitting several feet below sea level.

Defenses can be built to keep out the sea, of course, like the levees of the New Orleans region and the famed dikes of the Netherlands. But the expense is likely to soar as the ocean rises, and such defenses are not foolproof, as Hurricane Katrina proved.

Storm surges battering the world's coastlines every few years would almost certainly force people to flee inland. But it is hard to see where the displaced would go, especially in Asia, where huge cities — and even entire countries, notably Bangladesh — are at risk.

Moreover, scientists point out that if their projections prove accurate, the sea will not stop rising in 2100. By that point, the ice sheets could be undergoing extensive melting.

"Beyond a hundred years out, it starts to look really challenging," said Richard B. Alley, a climate scientist at Pennsylvania State University. "You start thinking about every coastal city on the planet hiding behind a wall, with storms coming."

A Shortage of Satellites

One Saturday morning a few months back, a University of Colorado student named Scott Potter, sitting in a control room on the Boulder campus, typed a word into a computer.

"GO."

Over the next 40 seconds, indicators in the control room turned red. Alarms rang. Pagers buzzed. High above the earth, a satellite called ICESat, reacting to Mr. Potter's order, prepared itself to die.

The commotion was expected. Mr. Potter, one of several Colorado students who hold part-time jobs as satellite controllers under professional supervision, was doing the bidding of NASA. His command that day formally ended the ICESat mission, which had produced crucial information about the world's ice sheets for seven years.

At the end of August, two weeks after Mr. Potter sent his order, the remains of ICESat plunged into the Barents Sea, off the Russian coast. Its demise was seen by many climate researchers as a depressing symbol.

After a decade of budget cuts and shifting space priorities in Washington, several satellites vital to monitoring the ice sheets and other aspects of the environment are on their last legs, with no replacements at hand. A replacement for ICESat will not be launched until 2015 at the earliest.

"We are slowly going blind in space," said Robert Bindschadler, a polar researcher at the University of Maryland, Baltimore County, who spent 30 years with NASA studying ice.

Several federal agencies and two presidential administrations, Democratic and Republican, have made decisions that contributed to the problems.

For instance, an attempt by the Clinton and Bush administrations to combine certain military and civilian satellites ate up $5 billion before it was labeled a "horrendous and costly failure" by a Congressional committee.

A plan by President George W. Bush to return to the moon without allocating substantial new money squeezed budgets at NASA.

Now, the Obama administration is seeking to chart a new course, abandoning the goal of returning to the moon and seeking a substantial increase in financing for earth sciences. It is also promising an overall strategy for improving the country's environmental observations.

Major elements of the administration's program won support from both parties on Capitol Hill and were signed into law recently, but amid a larger budget impasse, Congress has not allocated the money President Obama requested.

In the meantime, NASA is spending about $15 million a year to fly airplanes over ice sheets and glaciers to gather some information it can no longer get by satellite, and projects are under way in various agencies to plug some of the other information gaps. NASA has begun planning new satellites to replace the ones that are aging.

"The missions that are being designed right now are fantastic," said Tom Wagner, who runs NASA's ice programs.

The satellite difficulties are one symptom of a broader problem: because no scientifically advanced country has made a strategic priority of studying land ice, scientists lack elementary information that they need to make sense of what is happening.

They do not know the lay of the land beneath most of the world's glaciers, including many in Greenland, in sufficient detail to calculate how fast the ice might retreat. They have only haphazard readings of the depth and temperature of the ocean near Greenland, needed to figure out why so much warm water seems to be attacking the ice sheet.

The information problems are even more severe in Antarctica. Much of that continent is colder than Greenland, and its ice sheet is believed to be more stable, over all. But in recent years, parts of the ice sheet have started to flow rapidly, raising the possibility that it will destabilize in the same way that much of the world's other ice has.

Certain measurements are so spotty for Antarctica that scientists have not been able to figure out whether the continent is losing or gaining ice. Scientists do not have good measurements of the water temperature beneath the massive, floating ice shelves that are helping to buttress certain parts of the ice sheet in West Antarctica. Since the base of the ice sheet sits below sea level in that region, it has long been thought especially vulnerable to a warming ocean.

But the cavities beneath ice shelves and floating glaciers are difficult to reach, and scientists said that too little money had been spent to develop technologies that could provide continuing measurements.

Figuring out whether Antarctica is losing ice over all is essential, because that ice sheet contains enough water to raise global sea level by nearly 200 feet. The parts that appear to be destabilizing contain water sufficient to raise it perhaps 10 feet.

Daniel Schrag, a Harvard geochemist and head of that university's Center for the Environment, praised the scientists who do difficult work studying ice, but he added, "The scale of what they can do, given the resources available, is just completely out of whack with what is required."

Climate scientists note that while the science of studying ice may be progressing slowly, the world's emissions of heat-trapping gases are not. They worry that the way things are going, extensive melting of land ice may become inevitable before political leaders find a way to limit the gases, and before scientists even realize such a point of no return has been passed.

"The past clearly shows that sea-level rise is getting faster and faster the warmer it gets," Dr. Rahmstorf said. "Why should that process stop? If it gets warmer, ice will melt faster."

http://www.nytimes.com/2010/11/14/science/earth/14ice.html?ref=earth

Worm Can Deal Double Blow to Nuclear Program

By JOHN MARKOFF
The German software engineer who in September was the first to report that a computer worm was apparently designed to sabotage targets in Iran said Friday that the program contained two separate "digital warheads." The malicious program, known as Stuxnet, is designed to disable both Iranian centrifuges used to enrich uranium and steam turbines at the Bushehr nuclear power plant, which is scheduled to begin operation next year, said the engineer, Ralph Langner, an industrial control systems specialist based in Hamburg, Germany.

His analysis adds further detail to a report by researchers at the Symantec Corporation, an American computer security company, which concluded that the software code was intended to induce fluctuations in the rotational speed of motors, by taking over a power device known as a frequency converter.

"It's an awful complex code that we are looking at," said Mr. Langner, who has spent several months studying the program, which was discovered by a Russian antivirus company in June, after the company received complaints from Iranian customers. The link between the worm and an Iranian target was first made at an industrial systems cybersecurity conference in the Washington area on Sept. 20 by Mr. Langner. In a statement Friday on his Web site, he described two different attack modules that are designed to run on different industrial controllers made by Siemens, the German industrial equipment maker. "It appears that warhead one and warhead two were deployed in combination as an all-out cyberstrike against the Iranian nuclear program," he wrote.

In testimony before the Senate on Wednesday, federal and private industry officials said that the Iranian nuclear program was a probable target, but they stopped short of saying they had confirming evidence. Mr. Langner said, however, that he had found enough evidence within the programs to pinpoint the intended targets. He described his research process as being akin to being at a crime scene and examining a weapon but lacking a body.

The second code module — aimed at the nuclear power plant — was written with remarkable sophistication, he said. The worm moves from personal computers to Siemens computers that control industrial processes. It then inserts fake data, fooling the computers into thinking that the system is running normally while the sabotage of the frequency converters is taking place. "It is obvious that several years of preparation went into the design of this attack," he wrote.

When asked about Mr. Langner's new analysis, Eric Chien of Symantec said the company's researchers had also seen evidence of a second attack module, but that the module was disabled in the version of Stuxnet they studied.

Mr. Langner is among a small group of industrial control specialists who warned that the widespread distribution of the Stuxnet code could lead to disaster. Equipment made by Siemens and its competitors is used around the globe to manage virtually all of the world's transportation, power distribution and communications systems.

Joe Weiss, managing partner at Applied Control Systems, a consulting firm based in the Silicon Valley that organized the conference in September, said he was concerned that computer security organizations were not adequately conveying the potential for serious industrial sabotage that Stuxnet foretells.

"I just want the lights to stay on and water flowing, and people not dying," he said.

http://www.nytimes.com/2010/11/20/world/middleeast/20stuxnet.html?ref=science

A Costly Quest for the Dark Heart of the Cosmos

By DENNIS OVERBYE

After 16 years and $1.5 billion of other people's money, it is almost showtime for NASA and Sam Ting.

Sitting and being fussed over by technicians in a clean room at the Kennedy Space Center in preparation for a February launching — and looking for all the world like a giant corrugated rain barrel — is an eight-ton assemblage of magnets, wires, iron, aluminum, silicon and electronics that is one of the most ambitious and complicated experiments ever to set out for space.

The experiment, if it succeeds, could help NASA take a giant step toward answering the question of what the universe is made of. It could also confer scientific glory on both the International Space Station and a celebrated physicist reaching one last time, literally, for the stars. If it fails, it will validate critics who think it a scandal the experiment was ever approved.

The device, named the Alpha Magnetic Spectrometer, is designed to sift the high-energy particles flying through space known as cosmic rays. On Feb. 27, the space shuttle Endeavour will ferry the spectrometer to a permanent berth on the space station. But the real destination is the shadow universe.

You might think you learned in high school that the universe is made of atoms and molecules, protons and electrons, stars and galaxies, but over the last few decades astronomers have concluded — not happily — that all this is just a scrim overlying a much vaster shadowy realm of invisible "dark matter" whose gravity determines the architecture of the cosmos.

If they are lucky, scientists say, the Alpha spectrometer could confirm that mysterious signals recorded by other satellites and balloons in recent years are emanations from that dark matter, revealing evidence of particles and forces that have only been theoretical dreams until now.

Even if dark matter won't ever become the ultimate diet — eat it and disappear — knowing what nature is made of could be useful someday in ways nobody can dream. Einstein's curved spacetime, equally elusive to the senses, proved crucial to the function of GPS devices that were invented decades after Einstein's death.

Or the device could find even something weirder.

"Real discovery is outside the ring of existing knowledge," said Samuel Chao Chung Ting, the 74-year-old Nobel laureate, Massachusetts Institute of Technology professor and leader of the cosmic ray project, in his laboratory at CERN outside Geneva in August. A few yards away, the hulking spectrometer was sitting in a test frame, being pinged by a beam of protons in final tests before being shipped to Cape Canaveral.

Dr. Ting, one of science's great control freaks and worrywarts, has spent his life commanding armies of physicists. In 1974 he discovered a particle that would revolutionize physics, but he took so long checking for errors and looking for more particles that another lab found it and he wound up splitting the Nobel.

Gazing at his spectrometer, almost ready for space at last, Dr. Ting shrugged off the question of what he had up his sleeve next.

"You must think I am really stupid," he said. "You see how much trouble this was."

The experiment was born in the early 1990s when, despite his prestige, Dr. Ting failed to land a role on the largest physics machines ever contemplated, the Superconducting Supercollider (canceled before completion in 1993 by Congress) or the Large Hadron Collider (now operating at CERN, as the European Organization for Nuclear Research is known).

So he turned his eyes to the heavens. According to the laws of physics, equal amounts of matter and its science-fiction-sounding evil twin, antimatter, which annihilates ordinary matter in a flash of energy upon contact, should have been created during the Big Bang. It is one of the abiding mysteries of science why the universe is now all matter. Or is it?

The discovery of a single atomic nucleus heavier than anti-helium could mean there was an anti-star or maybe a whole anti-galaxy somewhere.

"If you don't do the measurement, you will never know," Dr. Ting said.

In 1994 Dr. Ting told Dan Goldin, then NASA's administrator, that he could make that measurement with a space-based cosmic ray detector. Mr. Goldin was instantly smitten and agreed to put the spectrometer on the International Space Station, which was desperately lacking scientific credibility, bypassing the agency's normal peer-review procedures and setting off resentment among other cosmic-ray physicists that still lingers.

Part of the lure was that the space agency would not have to pay for it. The bulk would be paid for by Dr. Ting's army of collaborators abroad, which grew to 600 scientists from 16 countries, including Italy, Germany, Russia, China and Taiwan.

In 1998, a prototype of the spectrometer was built and flown successfully on the space shuttle for 10 days on a trip to the Mir space station, although not without some Tingian drama. Behind in the construction schedule, Dr. Ting announced one day that he was canceling the Christmas break. "Perhaps on Christmas Day we will take a few minutes to reflect," Peter Fisher, an M.I.T. physicist who was there, recalled Dr. Ting saying.

The work got done on time.

After the shuttle Columbia disintegrated in 2003, killing its crew of seven astronauts, Dr. Ting's fortunes took a turn for the worse. NASA decreed an early end to the shuttle era, and the Alpha spectrometer was dropped from the flight manifest.

Dr. Ting fought back. In 2005, invited to address a Senate committee on the state of American science, he used his five minutes and nine transparencies to mount a rousing defense of basic science and of his experiment. "They were surprised to hear that the space station can do good science," Dr. Ting recalled.

In the following years powerful senators like Ted Stevens of Alaska, Bill Nelson of Florida and Kay Bailey Hutchison of Texas sat through Dr. Ting's PowerPoint shows or visited the project at CERN. In the end, Congress ordered NASA to provide an extra shuttle flight for the experiment.

"Three days after Barack Obama's inauguration, we were back on the manifest," Dr. Ting said.

By then nobody, with the possible exception of Dr. Ting, expected the experiment to find any primordial antimatter. Most theorists have concluded that it disappeared in the first moments after the Big Bang. "The original goal has evaporated," said Greg Tarle, a cosmic-ray physicist at the University of Michigan and longtime critic of the experiment.

Instead, the heavens were crackling with intimations of dark matter. Two years ago a European satellite named Pamela registered an excess of anti-electrons, or positrons, in space — perhaps from collisions of dark matter particles.

But that satellite had no way to tell positrons, which are exotic, from protons, which are humdrum, being the nuclei of hydrogen, and everywhere.

The Alpha spectrometer does. "It will tell us whether these things are there or not," said John Ellis, a CERN theorist.

The spectrometer is a miniature spacegoing version of the cathedral-size particle detectors that now line the Large Hadron Collider. At its heart was to be the most powerful magnet ever flown in space, a superconducting electromagnet like the ones in the collider, which would sort high energy particles according to their electrical charges and momenta.

According to some physicists, including Dr. Ellis and Dr. Ting, the positrons from dark matter should have a unique spectral signature that the cosmic ray spectrometer can measure. If the signal follows the model, Dr. Ting said, "Everyone will believe it is dark matter."

Others say it will be difficult, if not impossible, to distinguish the dark matter signal from the background violence of pulsars and black holes in the local universe. David Spergel, a Princeton astrophysicist, said, "Cosmic rays are the dirtiest way of looking for dark matter."

And many physicists say they will not be satisfied that dark matter has been found until there is supporting data from particle accelerators and underground experiments that seek to detect the particles directly.

Nevertheless, Burton Richter, who shared the Nobel with Dr. Ting in 1976, said, "This was a good experiment when Sam proposed it; it's even hotter now."

But even Dr. Ting's supporters were nonplused by the latest twist in the Alpha experiment saga. Earlier this year, with a fall flight date finally secured, Dr. Ting announced he was ripping out the heart of his experiment

and replacing his superconducting magnet with a weaker permanent magnet that had flown on the prototype flight. That meant he would miss the deadline for shipping the instrument to Cape Canaveral.

NASA promptly reshuffled the schedule and moved the flight to next year.

“If you’re Sam, you’re allowed to show up at the airport a few seconds before your flight,” Michael Turner, a cosmologist at the University of Chicago, said.

Dr. Ting gave two main reasons for the last-minute change. Vacuum chamber tests in February revealed that the helium needed to keep the magnet cold and superconducting could run out in as little as two years. Refilling it in space was not an option.

In the meantime, he said, the station’s lifetime had been extended from 2015 to 2020 or 2028, and it would not be right to occupy space on the station for all those years with a dead experiment.

The weaker field of the permanent magnet, Dr. Ting said, would be more than offset by the longer time the equipment would be aloft and a slight redesign of the particle tracking arrays. Indeed, Dr. Ting called it an “upgrade.”

“If the space station was coming down in 2015, we would not change the magnet,” he said.

The late change, however, led to renewed criticism from scientists who wondered if the experiment had been degraded or whether it was even safe to fly now. “This project has been given some kind of pass on everything,” said Dr. Tarle.

Shuttle engineers, however, said they were relieved that they would not have to deal with liquid helium, which can vaporize explosively — as it did in the Large Hadron Collider two years ago.

Barry Barish of the California Institute of Technology, who had helped evaluate the project for the Department of Energy, said in an e-mail that despite the “apparently flawed process” by which the experiment had originally been approved, it should fly. “I wouldn’t bet against Sam,” he added.

http://www.nytimes.com/2010/11/17/science/space/17dark.html?ref=science

What if Captured Carbon Makes a Getaway?

By FELICITY BARRINGER

The political clout of the fossil-fuel industries was driven home this year with the death of cap-and-trade legislation in Congress. Among those flexing their muscles was the coal industry, which is responsible for more than 45 percent of the country's generating capacity.

Kevin Riddell for The New York Times The AEP Mountaineer plant in New Haven, W.Va., which boasts new coal capture technology.

In August, the Department of Energy reported that coal-fired power generation was up 8.7 percent from a year earlier. Total generation rose somewhat less, about 7.4 percent. In the short term, at least, the more power we use, the greater the proportion will be coming from coal.

One leading solution to the problem to the fossil fuel emissions generated by a coal-fired plant is injecting it into underground storage areas thousands of feet below the surface, a technology known as carbon capture and sequestration. The Energy Department announced this summer that it would finance 15 separate projects to develop iterations of this technology.

But the technology may hold some unwelcome surprises if the carbon dioxide finds its way out and up to groundwater aquifers, a new study by Duke University researchers indicates. It could react with minerals there and increase levels of pollutants, perhaps so much that federal regulators would deem the water undrinkable, experiments suggest.

Two researchers took samples of dry sediments from groundwater aquifers that sit above likely sites for carbon storage in eastern Maryland, Virginia, northern Texas and Illinois and exposed them to a steady stream of carbon dioxide.

"The chemical composition of our groundwater experiments was significantly affected by the addition of CO2," wrote the authors, Mark G. Little of Duke's Center on Global Change and Robert B. Jackson, a biologist with the Nicholas School of the Environment. The hypothetical "groundwater" in the experiments became more acidic, which in turn had the effect of dissolving some of the minerals in the sediments.

In particular, the concentrations of iron, cadmium and zinc, among other minerals, increased by more than 1,000 percent after exposure to carbon dioxide.

A post on the Green Grok site of the Nicholas School predicts that the discovery "will provide fodder for the Nimby opponents of C.C.S. when the coal industry comes knocking on their door looking for storage sites."

http://green.blogs.nytimes.com/2010/11/19/what-if-captured-carbon-makes-a-getaway/?ref=science

Surprise at a Comet Visited by NASA: A Snowstorm

By KENNETH CHANG

A peanut-shaped comet was spewing hundreds of tons of fluffy ice chunks every second as a NASA spacecraft swung by it two weeks ago.

"To me, this whole thing looks like a snow globe that you've simply just shaken," Peter H. Schultz, a Brown University professor working on the mission, said Thursday during a news conference.

The Deep Impact spacecraft passed within 435 miles of Comet Hartley 2 two weeks ago, producing a series of photographs that showed bright jets coming off a rough surface.

What fascinated the mission scientists most was that the chunks of water ice in the jets were not being lifted off the surface by the force of water vapor heated by the sun, but rather by jets of carbon dioxide. This was the first time that such carbon dioxide jets had been observed at a comet.

Frozen carbon dioxide — dry ice — turns to carbon dioxide gas at a temperature of about minus 100 degrees Fahrenheit. Water ice stays frozen until it reaches much higher temperatures. Thus, it appears that the carbon dioxide gas on the comet is blowing apart the still-frozen water ice, along with dust particles, and sending it into space.

The scientists who analyzed the photos of Hartley 2 said that the frozen carbon dioxide within the comet must date from the beginnings of the solar system, because once it turns to gas, it disperses into space. "If it's there, it's primordial," Lori M. Feaga, another member of the science team, said in an interview.

While the bright specks seen in the images ranged in size from golf balls to perhaps basketballs, the spacecraft did not suffer any damage as it flew through the storm at a speed of 27,000 miles an hour.

From the absorption of light by the specks, the scientists deduced that the chunks were not solid ice.

"We're not seeing hail-size softballs or even ice cubes," said Jessica M. Sunshine, a deputy principal investigator on the mission. "What we're seeing are fluffy aggregates of very small pieces of ice. And so, they're akin more to maybe a dandelion puff that is very empty air that can be easily broken apart."

The carbon dioxide jets are coming off the two lobe-shaped ends of the comet, which is just three-quarters of a mile long. The spacecraft also found large amounts of water vapor — and not carbon dioxide — emanating from the central narrow waist region between the two lobes. This may mean that, for reasons not yet deciphered, the middle part of the comet does not contain much carbon dioxide, and thus the water ice in it can warm into vapor.

"We wouldn't expect this at all," Dr. Sunshine said. "This comet is doing two things at once."

The Hartley 2 findings differ significantly from what the Deep Impact spacecraft found when it visited Comet Tempel 1 five years ago. At Tempel 1, Deep Impact found water vapor emissions similar to those coming from the middle of Hartley 2, but no carbon dioxide jets and no visible chunks of water ice.

After the Tempel 1 visit, NASA decided to reuse the spacecraft, which still had ample maneuvering fuel left, to head to a second comet. The mission was renamed Epoxi, an amalgamation of two acronyms: Epoch, or Extrasolar Planet Observation and Characterization, which has been using one of the spacecraft's cameras to look at stars known to have planets, and Dixi, or Deep Impact Extended Investigation, for the second comet fly-by.

"It has emphasized how different comets are from one another and how understanding them is a much more complex problem than the rather simplistic approach I like to normally take," said Michael F. A'Hearn, Epoxi's principal investigator.

This article has been revised to reflect the following correction:

Correction: November 18, 2010

A previous version of this article omitted the word "minus" in describing the temperature at which dry ice turns to carbon dioxide.

http://www.nytimes.com/2010/11/19/science/space/19comet.html?_r=1&ref=science

Accelerator supercomputers dominate newest Green500 List's Top 10

19 November 2010 Virginia Tech

Accelerator-based supercomputers hold eight of the top 10 spots on The Green500 List, released yesterday. These supercomputers use dedicated hardware to perform computations faster than a typical central processing unit (CPU).

Accelerators also topped the June edition of the Green500 List. "One might argue that this year's Green500 marks The Year of the Accelerator," said Green500 co-founder Wu Feng, an associate professor with the Virginia Tech College of Engineering computer science and electrical and computer engineering departments.

The Green500 has ranked the energy efficiency of the world's 500 fastest supercomputers since its debut in 2007, serving as a complement to the well-known supercomputer industry marker TOP500.

Topping the Green500 is the IBM BlueGene/Q prototype supercomputer, the third in a series of energy-efficient Blue Gene supercomputers, following Blue Gene/L and Blue Gene/P. In a 2004 Top500 ranking, Blue Gene/L bested the powerful Japanese Earth Simulator, which itself created in 2002 a so-called "Computenik" event – a pun of the Soviet Union satellite Sputnik – by shattering the United States' then unchallenged hold on the supercomputer industry.

Despite not making the No. 1 spot, the overall energy efficiency of accelerator supercomputers nonetheless dominated the overall Green500. The Tokyo Institute of Technology-based production supercomputer TSUBAME 2.0 holds the second spot on the latest Green500.

Accelerators have been making waves and headlines worldwide. At No. 11 on the Green500 is China's Tianhe-1A supercomputer, deemed the world's fastest supercomputer by the November Top500 list. Built at the National University of Defense Technology research lab in Tianjin, China, Tianhe boats 1.4 times the computing power of the United States' then-top contender.

"What is scary about this is that the U.S. dominance in high-performance computing is at risk," Feng told the "New York Times" in October upon Tianhe's debut and its No. 1 ranking on the Top500. "One could argue that this hits the foundation of our economic future."

"Accelerator-based supercomputers on the Green500 List produce an average efficiency of 573 Megaflops/Watts, whereas the other measured supercomputers on the list produce only an average efficiency of 206 Megaflops/Watts," Feng said. "That makes the accelerator-based supercomputers on the Green500 nearly three times more energy efficient than their non-accelerated counterparts."

Accelerator-based supercomputers come largely in two flavors: one is based on the commodity graphics processing unit (GPU) and the second is based on the custom PowerXCell 8i processor from IBM. The latter is an enhancement of the Cell Broadband Engine developed for the game console PlayStation 3, and includes a network of programmable units called field programmable gate arrays or FPGAs.

The Green500 List is released twice a year, in June and in November. To measure energy efficiency, Feng uses a Megaflops/W metric, or millions of floating-point operations per second (Megaflops) divided by Watts.

http://people.cs.vt.edu/~feng/

http://www.alphagalileo.org/ViewItem.aspx?ItemId=90254&CultureCode=en

A New Take on Computer Security

19 November 2010 Eureka

What if you were required to manually enter a password each time you wanted to use a program on your computer? This is exactly the kind of measure we, as technology users, should consider taking up in order to protect ourselves from a complex cyberspace, prey to attacks from all sides. The MEDEA+ Trusted Secure Computing project set out to develop a family of components and software able to efficiently secure our computing, communication and multimedia devices. The innovations developed in the project embrace integrity management, user identification/authentication, as well as privacy management.

In the IT jargon, a trusted security device is a piece of hardware component we all rely on for our computer's security. Current security and privacy methods are mainly based on specific add-on software or specially tailored protection hardware, but this project goes much further. "Protection mechanisms must be present in all system layers from basic hardware, to the basic input/output system (BIOS) and including the operating system" says Jean-Pierre Tual, the project's leader and Director of Industrial Relations at Gemalto. Moreover, the components developed in the project, have been designed in a way that make them compatible with future generations of online connected personal devices – this includes everything from personal digital assistants, TV set-top boxes, Internet services, professional radio, personal video recorders and mobile phones.

Keeping Europe ahead of the competition

Originally launched in mid-2007, the project had two main objectives: "to develop a family of embedded silicon components enforcing secure and trusted computing and to propose a European alternative to US-initiatives related to trusted computing standards while keeping interoperability with some already existing approaches. The TSC project established a solid industrial and academic partnership and the Consortium's ability to cover a wide variety of areas equally and comfortably enabled the project to reach its objectives with rather limited resources.

"It is very satisfying to now have more than ten different applications making full use of components for securing and enforcing privacy in numerous applications or services, pertaining to a large set of day to day activities, in both personal and professional areas" says Mr. Tual. Demonstrators were able to display, for example, direct transcoding of digital-rights information from Blue-ray to DVD recorders, file-transfer

control in entertainment networks and anonymity management in a 3G mobile phone. Philips and Gemalto, some of the major industry players involved in the project have already included the new technology in their general offer.

90% of laptops already equipped

Millions of people are regularly downloading applications onto their smartphone. It is essential, whilst making the most of a selection of applications, to guarantee the safety of the vast amount of personal information that a smartphone is able to hold. For example, the mobile, anonymous, access-control services (MACCS) system developed by Orange and Gemalto enables mobile-phone users access to a higher level of security. This privacy enhancing solution also finds applications in other fields such as ticket-based services including transport or cultural and events. The corresponding market is expected to explode from 2011 onwards.

The exploitation of the project results in fact already well on its way: at the moment, about 90% of laptops are equipped with a trusted processor module (TPM), and TSC has helped STMicroelectronics, one of the main partners in the project, to maintain its leadership in a market in which European Union countries hold over a 70% market share. STMicroelectronics also plans to sell the new TPM solutions to most personal computer (PC) manufacturers from Asia and the USA and is expecting important return on investment linked to the boom of new Internet linked devices to come.

Taking the public sector on board

Interestingly, many partners in the project, mainly French and Spanish on their hand will exploit project results in their multilevel security systems targeting not only companies but also the public sector through e-government and e-services applications. The hardware modules developed by Bull, another project participant, will be used in the coming years for the delivery of electronic passports.

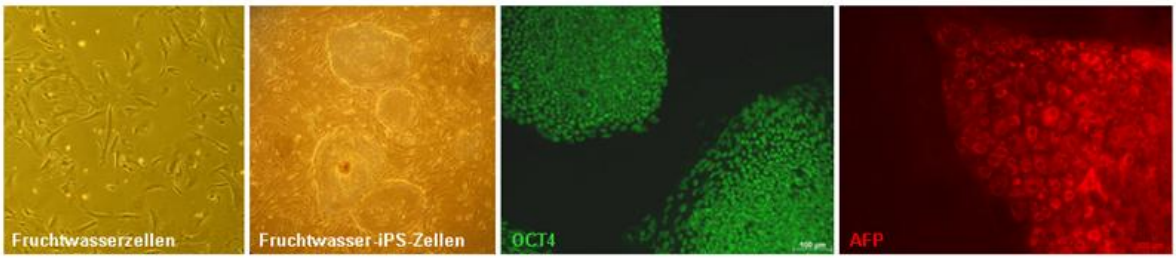
The MEDEA+ TSC project brought a decisive contribution in securing the competitive power of the European industry in a wide range of key industrial sectors (computer, mobile, professional radio, consumer sector) where security and trust are becoming a decisive appreciation factor for the users. In their own individual ways, The EUREKA Project's partners each made the most of the extraordinary results of this major project, and succeed in providing every type of consumer with improved trusted computing.

http://www.eurekanetwork.org/showsuccessstory?p_r_p_564233524_articleId=620423&p_r_p_564233524_groupId=10137

http://www.alphagalileo.org/ViewItem.aspx?ItemId=90248&CultureCode=en

Stem cells from amniotic fluid

19 November 2010 Max-Planck-Gesellschaft



Reprogrammed amniotic fluid cells can generate all types of body cells. High hopes rest on stem cells: one day, they may be used to treat many diseases. To date, embryos are the main source of these cells, but this raises ethical problems. Scientists at the Max Planck Institute for Molecular Genetics in Berlin have now managed to convert amniotic fluid cells into pluripotent stem cells. These amniotic fluid-derived iPS cells are hardly distinguishable from embryonic stem cells - however, they "remember" where they came from. (PLoS One, October 29, 2010)The special abilities of embryonic stem cells can today be used in multiple "grown-up" cells (e.g. skin and hair cells). This is done by reprogramming the cells and converting them to "induced pluripotent stem cells" (iPS cells). These then possess the typical properties of embryonic stem cells, meaning they can generate any of the cell types of the human body (pluripotency), and they can multiply endlessly.

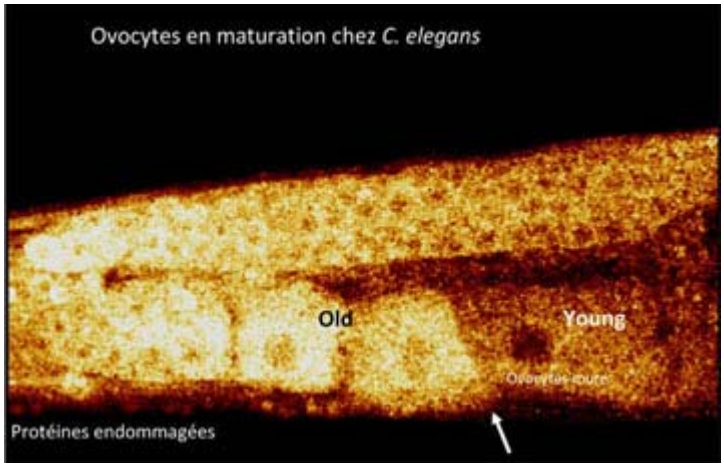
Stem cells with memory
The scientists have shown that the amniotic fluid iPS cells can form different human cell types. They have also discovered that induced pluripotent stem cells can remember the original cell type from which they were generated. During cellular reprogramming, various genes that control the development of stem cells are apparently switched on or remain active. This confirms other current research results, which show that iPS cells derived from distinct tissues are prone to follow their pre-destined developmental path upon spontaneous differentiation. "We don't know just yet whether this donor-cell type memory will have an impact on possible medical treatment, or which type of somatic cell-derived iPS cell will be most suitable for treatment", cautions Katharina Wolfrum of the Max Planck Institute for Molecular Genetics.
Amniotic fluid cells have a number of advantages over other cell types. For one thing, amniotic fluid cells are routinely harvested in antenatal examinations to enable the early detection of disease. In most cases, more cells are obtained than are actually needed. In addition, the amniotic fluid mixture contains different types of cells from the unborn child, including stem-cell-like cells. As they are not very old, they have fewer environmentally-induced mutations, making them genetically more stable. "This may mean that it is possible to reprogram these amniotic fluid cells faster and more easily than other cell types, making amniotic fluid-derived iPS cells an interesting complement to embryonic stem cells", explains James Adjaye of the Max Planck Institute in Berlin.
Moreover, amniotic fluid cells could be extracted for cellular reprogramming before the birth of a child and be prepared for their intended use while the pregnancy is still ongoing. "This would make it possible to test which drugs work for a baby and whether they are tolerated, before that baby is born. Moreover, in the future, sick newborns can be treated with cells from their own body", says Adjaye.

http://goto.mpg.de/mpg/news/20101119/

http://www.alphagalileo.org/ViewItem.aspx?ItemId=90242&CultureCode=en

Understanding ageing by studying reproduction!

19 November 2010 CNRS (Délégation Paris Michel-Ange)



Do examples of rejuvenation exist in nature? Yes, during reproduction! For the first time, a team from the Laboratoire de Biologie Moléculaire de la Cellule (CNRS/ENS Lyon/Université de Lyon 1) has managed to visualize, in the model organism *C. elegans*, the sudden "rejuvenation" of oocytes just before fertilization. Published in the journal *Aging Cell*, this work opens new avenues for understanding ageing and the diseases that are associated with it.

Traditionally, studies on ageing compare elderly individuals with younger individuals or normal individuals with individuals with proven longevity. A study carried out by Hugo Aguilaniu's team at the Laboratoire de Biologie Moléculaire de la Cellule (CNRS/ENS Lyon/Université Lyon 1) tackled the issue under a conceptually new angle: do examples of rejuvenation exist in nature? They do indeed, quite simply during reproduction! The scientists sought to understand why newborn babies do not inherit the same risks of developing ageing diseases, such as cancers, as their parents.

What are the potential genetic mechanisms for this "rejuvenation"? The researchers based their work on a model organism for ageing studies, *C. elegans*. This nematode worm is small, transparent, hermaphrodite, and capable of self-fertilization. It reproduces very quickly and makes it possible to monitor every step of fertilization in a single organism.

Over time, carbonylation and oxidation damage proteins, the main constituent of our cells, and can therefore act as ageing markers. In their study, the scientists developed a technique to "visualize", in oocytes, the level of oxidation of proteins in cells. They firstly noted that the germline (of gametes) is oxidized, precluding the idea that the germline does not age. But, above all, they showed that at a precise stage of maturation of the oocytes the level of oxidation dropped suddenly. How? The researchers highlighted the role of the proteasome (which serves to degrade proteins) in this process. When it is inhibited, "rejuvenation" occurs with difficulty or not at all, thereby leading to sterility. During reproduction, the proteins in our cells are therefore "cleansed" and rejuvenated to form new, young individuals.

This study paves the way for a number of fascinating biological questions: what must individuals inherit from their parents and, on the other hand, what must they not inherit? How do we manage, each time we reproduce, to reduce the incidence of ageing diseases (cancer, neuro-degeneration, etc.)?

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Eating a variety of fruit cuts lung cancer risk

19 November 2010 Plataforma SINC

Eating five portions of fruit and vegetables per day is one of the means that experts most frequently recommend for preventing cancer. Now, the European EPIC study carried out by researchers from 10 countries has shown that, in the case of lung cancer, the important thing is not just the quantity but also the variety of fruit consumed, which can reduce the risk by up to 23%.

"This research looks more deeply into the relationship between diet and lung cancer", María José Sánchez Pérez, co-author of the study and director of the Granada Cancer Registry at the Andalusian School of Public Health, tells SINC.

She says: "Aside from the amount consumed, it's also important to take into account the variety. A varied diet reduces the risk of developing this cancer, above all in smokers".

The results of this study, which have been published in the Journal Cancer Epidemiology, Biomarkers & Prevention, show that eating "more than eight sub-groups" of vegetables cuts this risk by 23% compared with eating "less than four sub-groups". In addition, this risk falls by a further 4% for each unit added to the diet from another sub-group.

"A significant link was only found in smokers", the researcher stresses. "For every two additional units of different kinds of fruits and vegetables in the diet, the risk of lung cancer falls significantly by 3%. So if smokers increase the variety of fruit they eat they could have a lower risk of developing this type of cancer".

The European Prospective Investigation into Cancer and Nutrition (EPIC) involves 23 centres from 10 European countries (Germany, Denmark, Spain, France, Greece, Holland, Italy, Norway, the United Kingdom and Sweden, working with a sample of 500,000 European subjects (41,000 of whom live in the Spanish regions of Asturias, Granada, Guipúzcoa, Murcia and Navarre).

Lung cancer continues to be one of the most common cancers in developed countries. For this reason, despite the encouraging results of this study, Sánchez Pérez concludes that "the most effective way of preventing it continues to be reducing the prevalence of tobacco consumption among the populace".

The effect by type of cancerous tissue

Greater variety in fruit and vegetable consumption is associated with a lower risk of developing epidermoid carcinoma of the lung, with an additional two units of fruit and vegetable consumption leading to a 9% reduction in risk. This effect is clearer among smokers (where the risk falls by 12%).

No significant association between fruit and vegetable consumption and the risk of developing lung cancer was seen for the other kinds of tissues affected (adenocarcinoma and small and large cell carcinoma).

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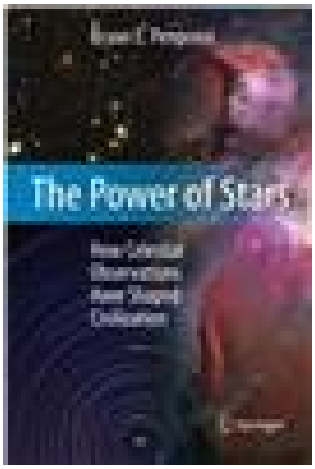
The incredible impact of stars on culture

19 November 2010 Springer Science+Business Media



- **Publication title:** The Power of Stars: How Celestial Observations Have Shaped Civilization
- **Author:** B.E. Penprase, Pomona College, CA, USA
- **Publication type:** Book (Hardback)
- **Number of pages:** 348
- **ISBN number:** 978-1-4419-6802-9
- **Price:** 39.95 EUR Euros

New book examines the power of stars to inspire and inform ancient and modern civilizations

For Hawaiian navigators, the star Sirius was "Hokuho'okelewa'a," meaning "star to guide canoe." Traditional Aboriginal Australians looked at the Magellanic Clouds and saw distant campfires in the sky.

In every culture, from prehistory to the modern day, the stars have played a key role in inspiring and shaping human efforts to understand and master the universe we live in. In a newly published book, *The Power of Stars: How Celestial Observations Have Shaped Civilization*, Bryan Penprase traces the cultural roots of modern astronomy through the various cosmologies, mythologies, calendaring systems, monuments and theories with which people around the world have connected the heavens to their own lives.

"In these pages," Penprase says in the opening section of the book, "we will explore the many ways in which humans throughout time have responded to the sky. Sometimes they responded with fear, sometimes with great artistry and other times with great rationality. Each culture of the world for thousands of years viewed the same stars and planets we can observe on any clear night. And the power of the night sky, filled with shimmering stars, has left its mark on human civilization."

The book ranges around the globe from the ancient Babylonians to the Incas, from Greek myths to Australian creation stories, from Mayan calendars to the Chinese Zodiac, and from the Egyptian pyramids to such modern celestial structures as the Rodin Crater Project of artist James Turrell, concluding with a brief history of the modern scientific understanding of the universe. The book also includes more than 200 images.

Penprase has been a member of the Pomona College (USA) faculty since 1993. He received his Ph.D. in astronomy and astrophysics from the University of Chicago. Penprase's research in astronomy and astrophysics has taken him around the world. He is currently a member of an international team conducting the largest study ever of near-Earth asteroids. *The Power of Stars* is his first book.

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Perceptual changes – a key to our consciousness

19 November 2010 Max Planck Institute for Biological Cybernetics

With his coat billowing behind him and his right eye tightly closed, Captain Blackbeard watches the endless sea with his telescope. Suddenly the sea disappears as the pirate opens his right eye. The only thing he sees is his hand holding the telescope. And then, a moment later, the sea is back again. What happened was a change in perception. Our brain usually combines the two slightly divergent images of our eyes into a single consistent perception. However, if the visual information does not match, only one image is seen at a time. This phenomenon is called "binocular rivalry". Researchers around Andreas Bartels at the Werner Reichardt Centre for Integrative Neurosciences (CIN) and the Max Planck Institute for Biological Cybernetics in Tübingen, Germany used this phenomenon to decipher a key mechanism of the brain functions that contributes to conscious visual perception.

We do not consciously perceive everything around us, even if it falls into our field of vision. The overwhelming abundance of information forces our brain to focus on a few important things; our perception is an ongoing process of selecting, grouping and interpreting visual information. Even though we have two eyes, our brain combines the two impressions. Experts call this binocular vision. Yet, if conflicting information is presented to the eyes, only the input to one eye is perceived at a time, while the other is suppressed. Our perception changes at specific intervals between the two images - a phenomenon called “binocular rivalry”. This process occurs automatically without voluntary control.

The scientists, Natalia Zaretskaya, Axel Thielscher, Nikos Logothetis and Andreas Bartels demonstrated that the frequency at which alternations between the visual information occurred could be experimentally reduced: Two different stimuli, a house and a face, were projected into the right and left eyes, respectively, of 15 experimental subjects. Since the brain could not match the pictures, alternations in perception occurred. When the scientists temporarily applied an alternating magnetic field to the subjects’ posterior parietal cortex, a higher-order area of the brain, the perception of each individual image was prolonged.

“Our findings suggest that the parietal cortex is causally involved in selecting the information that is consciously perceived,” explains Natalia Zaretskaya, a Ph.D. student involved in the project. „It also demonstrates the important role of this area in visual awareness.”

“Understanding the neural circuits underlying the percepts and their switches might give us some insight into how consciousness is implemented in the brain, or at least into the dynamic processes underlying it“, explains Andreas Bartels, scientist at the CIN.

http://tuebingen.mpg.de/en/homepage/detail/perceptual-changes-a-key-to-our-consciousness.html

http://www.alphagalileo.org/ViewItem.aspx?ItemId=90209&CultureCode=en

Trained bacteria convert bio-wastes into plastic

19 November 2010 Delft University of Technology

Researcher Jean-Paul Meijnen has 'trained' bacteria to convert all the main sugars in vegetable, fruit and garden waste efficiently into high-quality environmentally friendly products such as bioplastics. He will be defending his doctoral thesis on this topic, which was carried out in the context of the NWO B-Basic programme, at TU Delft on Monday 22 November 2010.

There is considerable interest in bioplastics nowadays. The technical problems associated with turning potato peel into sunglasses, or cane sugar into car bumpers, have already been solved. The current methods, however, are not very efficient: only a small percentage of the sugars can be converted into valuable products. By adapting the eating pattern of bacteria and subsequently training them, Meijnen has succeeded in converting sugars in processable materials, so that no bio-waste is wasted.
The favoured raw materials for such processes are biological wastes left over from food production. Lignocellulose, the complex combination of lignin and cellulose present in the stalks and leaves of plants that gives them their rigidity, is such a material. Hydrolysis of lignocellulose breaks down the long sugar chains that form the backbone of this material, releasing the individual sugar molecules. These sugar molecules can be further processed by bacteria and other micro-organisms to form chemicals that can be used as the basis for bioplastics. The fruit of the plant, such as maize, can be consumed as food, while the unused waste such as lignocellulose forms the raw material for bioplastics.

Cutting the price of the process
'Unfortunately, the production of plastics from bio-wastes is still quite an expensive process, because the waste material is not fully utilized,' explains Jean-Paul Meijnen. (It should be noted here that we are talking about agricultural bio-wastes in this context, not the garden waste recycled by households.) The pre-treatment of these bio-wastes leads to the production of various types of sugars such as glucose, xylose and arabinose. These three together make up about eighty per cent of the sugars in bio-waste.
The problem is that the bacteria Meijnen was working with, *Pseudomonas putida* S12, can only digest glucose but not xylose or arabinose. As a result, a quarter of the eighty per cent remains unused. 'A logical way of reducing the cost price of bioplastics is thus to 'teach' the bacteria to digest xylose and arabinose too.'

Enzymes
The xylose has to be 'prepared' before *Pseudomonas putida* S12 can digest it. This is done with the aid of certain enzymes. The bacteria are genetically modified by inserting specific DNA fragments in the cell; this enables them to produce enzymes that assist in the conversion of xylose into a molecule that the bacteria can deal with.

Meijnen achieved this by introducing two genes from another bacterium (*E. coli*) which code for two enzymes that enable xylose to be converted in a two-stage process into a molecule that *P. putida* S12 can digest.

Evolution

This method did work, but not very efficiently: only twenty per cent of the xylose present was digested. The modified bacteria were therefore 'trained' to digest more xylose. Meijnen did this by subjecting the bacteria to an evolutionary process, successively selecting the bacteria that showed the best performance.
'After three months of this improvement process, the bacteria could quickly digest all the xylose present in the medium. And surprisingly enough, these trained bacteria could also digest arabinose, and were thus capable of dealing with the three principal sugars in bio-wastes.'
Meijnen also incorporated other genes, from the bacterium *Caulobacter crescentus*. This procedure also proved effective and efficient from the start.

Blend

Finally, in a separate project Meijnen succeeded in modifying a strain of *Pseudomonas putida* S12 that had previously been modified to produce para-hydroxybenzoate (pHB), a member of the class of chemicals known as parabens that are widely used as preservatives in the cosmetics and pharmaceutical industries. Meijnen tested the ability of these bacteria to produce pHB, a biochemical substance, from xylose and from other sources such as glucose and glycerol. He summarized his results as follows: 'This strategy also proved successful, allowing us to make biochemical substances such as pHB from glucose, glycerol and xylose. In fact, the use of mixtures of glucose and xylose, or glycerol and xylose, gives better pHB production than the use of unmixed starting materials. This means that giving the bacteria pretreated bio-wastes as starting material stimulates them to make even more pHB.'

http://www.tudelft.nl/live/pagina.jsp?id=ed5b6410-5cdd-4e8d-a6ff-3682a0bacbf4&lang=en

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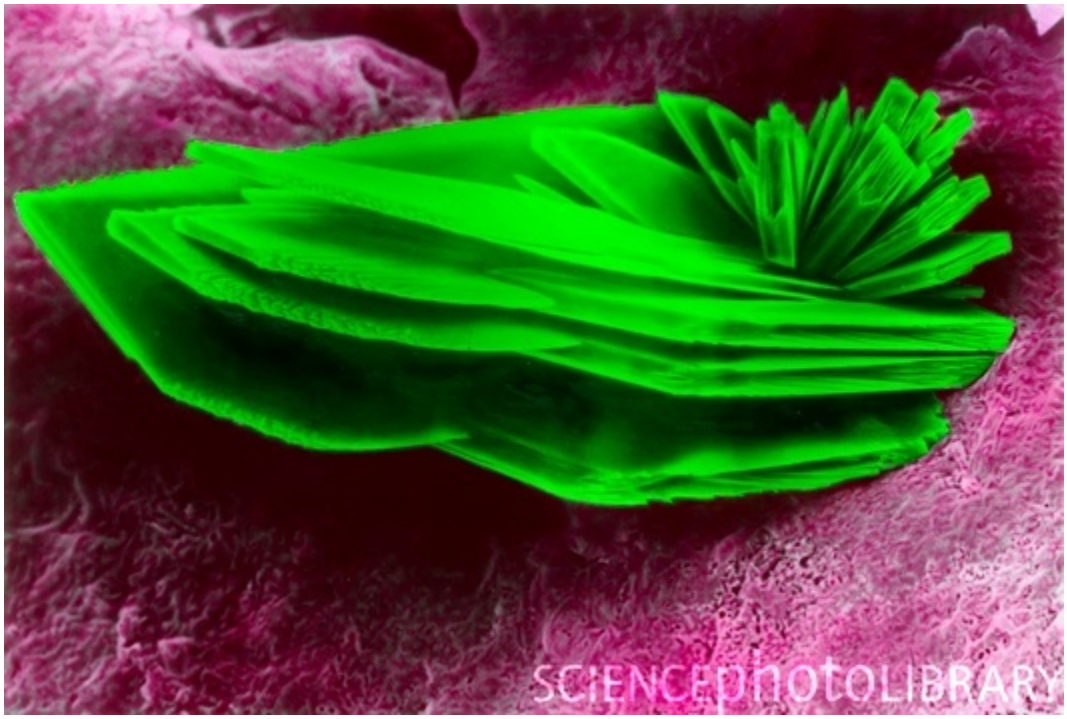
Abnormal blood values indicate increased mortality in PEG-operations

19 November 2010 Karolinska Institutet



The combination of high CRP and low levels of the protein albumin in the blood, is associated with an increased risk of death after a PEG-operation; implantation of a nutritional catheter into the stomach through the abdominal wall. This was shown in a new study from the Swedish medical university Karolinska Institutet, published in the scientific journal Gastrointestinal Endoscopy. Of the PEG patients in the study that showed both current indicators, 20 percent died within 30 days.

Percutaneous Endoscopic Gastrostomy (PEG) means that you are operating a silicone tube for gastric feeding directly through the abdominal wall into the stomach. The method is used primarily on patients who for a long time have been unable to swallow and eat in the usual way to get nutrients, for example cancer of the throat or oesophagus or after a stroke. In Sweden, there are several thousands of PEG operations per year. One problem with surgery is that the risk of infection and other complications are high, which at worst can lead to death.

Albumin is the most abundant protein in the blood and is especially important to keep the blood fluid in the blood vessels. It is also associated with malnutrition and inflammation. CRP is a part of the immune system, and increase significantly in the concentration of bacterial infections and other inflammatory conditions. The researchers behind the current study say that their results suggest that healthcare providers should consider waiting before adding PEG at low albumin levels combined with high CRP.

The study included 484 patients at the Karolinska University Hospital in Stockholm County during the years 2005 to 2009. It shows that of the 167 patients who had the combination of low albumin and high CRP more than 20 percent died (34 patients) within 30 days. The mortality rate for the patients who had no such risk indicators was less than 3 percent. This corresponds to an increased risk of more than seven times, after taking

into account possible confounding factors such as age, sex and underlying diseases such as diabetes, cardiovascular diseases including stroke and neurological diseases. 58 of the patients who participated in the study died.

"It may be worth trying to treat high CRP and provide the patient with nutrition with alternative methods, and then come back for PEG insertion if the infection has subsided and the patient feels better, says John Blomberg, surgeon and one of the researchers behind the study."In addition, the treating physician should inform the patient, relatives and remittent about the risks of PEG insertion, especially when the markers for premature death are so strong."

http://ki.se/ki/jsp/polopoly.jsp?d=130&a=111884&l=en&newsdep=130

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Biochemistry of how plants resist insect attack determined

18 November 2010 Virginia Tech

Blacksburg, Va., USA -- Many plants, including crops, release volatiles in response to insect attack. The chemical compounds can be a defense or can be an aromatic call for help to attract enemies of the attacking insect. Researchers from Virginia Tech, Michigan State University, and Georg-August-University Göttingen have discovered how plants produce the defensive compounds.

The research is reported this week in the online early edition of the *Proceedings of the National Academy of Sciences*. The article, "Herbivore-induced and floral homoterpene volatiles are

biosynthesized by a single P450 enzyme (CYP82G1) in Arabidopsis," is by Sungbeom Lee, postdoctoral associate in biological sciences in the College of Science; Somayesadat Badieyan, Ph.D. student in biological systems engineering in the College of Engineering; and David R. Bevan, associate professor of biochemistry in the College of Agriculture and Life Sciences, all at Virginia Tech; Marco Herde, postdoctoral associate with the Michigan State University, Department of Biochemistry and Molecular Biology; Christiane Gatz, professor and head of the Albrecht-von-Haller-Institute for Plant Sciences at Georg-August-University Göttingen, Germany, and Dorothea Tholl, assistant professor of biological sciences at Virginia Tech.

To gain detailed insight into volatile defense metabolism and its regulation in plant tissues, the researchers focused on the formation of two common volatile compounds, or homoterpenes -- DMNT (4,8-dimethylnona-1,3,7-triene) and TMTT (4,8,12-trimethyltrideca-1,3,7,11-tetraene). They discovered that formation of both compounds is initiated by the same P450 enzyme – belonging to a family of enzymes that initiates oxidation of organic compounds in most plants, animals, and bacteria. In plants, the enzyme is specifically activated by insect attack.

" We are excited to finally have elucidated the biosynthesis of these common plant volatiles. The discovered P450 protein was a long-missing enzymatic link in the formation of homoterpenes," said Tholl.

Lee and colleagues created a model using mammalian forms of P450 to study the catalytic specificity of the plant enzyme in greater detail. "The approach supports future efforts to fully understand and optimize the enzymatic reaction," said Tholl. "A primary aim of the study is to engineer the discovered enzymatic pathway in important crop plants to improve their natural pest controls."

"This work illustrates the power of combining computational model-building with experimental methods in elucidating important biochemical activities," said Bevan. "Our detailed understanding of the biology underlying the production of these plant volatiles will now enable us to apply our new knowledge in agriculture in novel ways."

"We now are in the position to use this and previously identified genes of the biosynthetic pathway as tools to change volatile profiles in plants," said Tholl. "This approach can help us to design insect-induced volatile mixtures that are especially attractive to natural enemies used in biological pest control."

Another intriguing aspect of homoterpene volatiles is that they can elicit defensive responses in unattacked neighboring plants. "It may therefore be possible to exploit these signaling activities by priming defenses in crop fields prior to insect attack via specific transgenic 'emitter' plants," Tholl said.

http://www.biology.vt.edu/faculty/tholl/

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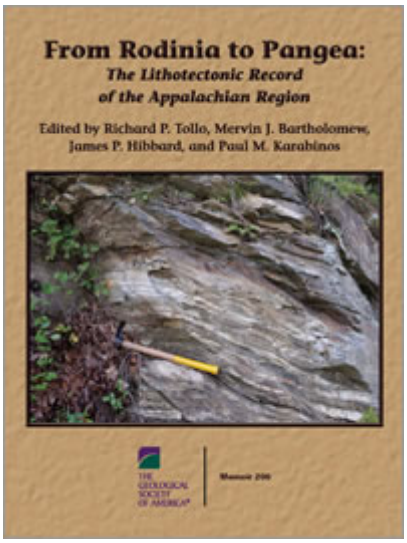
Appalachians in the limelight

18 November 2010 Geological Society of America, The



- **Publication title:** From Rodinia to Pangea: The Lithotectonic Record of the Appalachian Region
- **Author:** Richard P. Tollo, Mervin J. Bartholomew, James P. Hibbard, and Paul M. Karabinos (editors)
- **Publication type:** Book (Hardback)
- **Publication date:** 18 November 2010
- **Number of pages:** 956
- **ISBN number:** 978-0-8137-1206-2
- **Price:** 160.00 USD US Dollars

Boulder, CO, USA – The Appalachians have served as a springboard for innovative geologic thought for more than 170 years. A new volume from The Geological Society of America contains 36 original papers reporting the results of research performed throughout nearly the entire length and breadth of the Appalachian region, including all major provinces and geographical areas.

Memoir 206, From Rodinia to Pangea: The Lithotectonic Record of the Appalachian Region, grew out of GSA's 2007 Northeastern Section meeting in Durham, New Hampshire, and commemorates the (near) fortieth anniversary of the publication of the classic Studies of Appalachian Geology volumes that appeared just prior to the application of plate tectonic concepts to the region.

Contributions in structural evolution, sedimentation, stratigraphy, magmatic processes, metamorphism, tectonics, and terrane accretion illustrate the wide range of ongoing research in the area and collectively serve to mark the considerable progress in scientific thought that has occurred during the past four decades.

Research highlights 3D perspectives, sequence stratigraphic techniques, and improved geochemical databases for the exploration of regional-scale modeling.

Individual copies of the volume may be purchased through the Geological Society of America online bookstore, http://rock.geosociety.org/Bookstore/default.asp?oID=0&catID=8&pID=MWR206 or by contacting GSA Sales and Service, gsaservice@geosociety.org.

Book editors of earth science journals/publications may request a review copy by contacting Jeanette Hammann, jhammann@geosociety.org.

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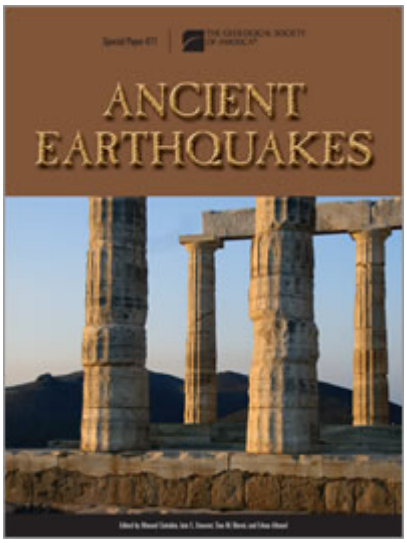
A history of Earth's convulsions

jueves, 18 de noviembre de 2010 Geological Society of America, The



- **Título de publicación:** Ancient Earthquakes
- **Autor:** Manuel Sintubin, Iain S. Stewart, Tina M. Niemi, and Erhan Altunel (editors)
- **Clase de publicación:** Libro (en rústica)
- **Fecha de publicación:** viernes, 19 de noviembre de 2010
- **Número de páginas:** 280
- **Número ISBN:** 978-0-8137-2471-3
- **Precio:** 85,00 USD Dólares estadounidenses

Boulder, CO, USA - Ancient earthquakes are pre-instrumental earthquakes that can only be identified through indirect evidence in the archaeological (archaeoseismology) and geological (palaeoseismology) record. New GSA Special Paper 471 includes a selection of cases which illustrate ways that the archaeological record is being used in earthquake studies. *Ancient Earthquakes* will be of interest to the broad community of earth scientists, seismologists, historians, and archaeologists active in and around archaeological sites threatened by seismic hazards throughout the world.

The volume frames the International Geoscience Programme IGCP 567, “Earthquake Archaeology: Archaeoseismology along the Alpine-Himalayan Seismic Zone.” The first series of papers focuses on the relationship between human prehistory and tectonically active environments, and the wide range of societal responses to historically known earthquakes. Papers primarily concern archaeoseismology. They show the diversity of disciplines and approaches involved, and each one’s potential to contribute to a better understanding of earthquake history.

The second series of papers focuses on societal impacts and discusses issues in political, social and economic contexts. These works further review whether earthquakes have had a negative effect on society.

“We hope this volume offers a taste of the complexity with which archaeoseismologists are confronted,” say the editors.

Editors include Manuel Sintubin (Katholieke Universiteit Lueven, Lueven Belguim), Iaian S. Stewart (University of Plymouth, Devon, UK), Tina M Niemi (University of Missouri-Kansas City, Kansas) and Erhan Altunel (Eskisehir Osmangazi University, Turkey).

Individual copies of the volume may be purchased through the Geological Society of America online bookstore, http://rock.geosociety.org/Bookstore/default.asp?oID=0&catID=9&pID=SPE471, or by contacting GSA Sales and Service, gsaservice@geosociety.org.

Book editors of earth science journals/publications may request a review copy by contacting Jeanette Hammann, jhammann@geosociety.org.

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Online map of maternal health to inform and influence world leaders

jueves, 18 de noviembre de 2010 Southampton, University of

Researchers from the University of Southampton have helped construct an online interactive world map which gives stark facts and figures about the health of women during pregnancy, childbirth and following the birth of their child.

Social scientists Professor Zoë Matthews and Dr Sarah Neal are working in collaboration with the White Ribbon Alliance for Safe Motherhood and the University of Aberdeen on a joint project worth in excess of £160,000 called 'The Atlas of Birth', which also includes a book, short film and flyers.

"We are using data from the United Nations and the World Health Organization to give a comprehensive picture of maternal health from around the world. Part of the project involves presenting the information in an easy-to-use online map, to help get key facts direct to policymakers," comments Professor Matthews of the University's Centre for Global Health, Population, Poverty and Policy.

Funded by the Partnership for Maternal, Newborn and Child Health and the Norwegian government, the project includes statistics on a wide range of issues including maternal deaths, pregnancies to very young girls and midwife contact.

Latest figures from the WHO show more than 99 percent of maternal deaths occur in developing countries and most of these in a handful of nations. Most of the very high rates of death are seen in sub-Saharan Africa,

but India has the highest number of deaths, with 63,000 women dying every year.

Women in developing countries often become a mother very young, experience many closely spaced births, and run a risk as high as one in 11 of dying in childbirth across their lifetimes. In particular, girls under the age of 15 are five times more likely to die giving birth than women in their 20s.

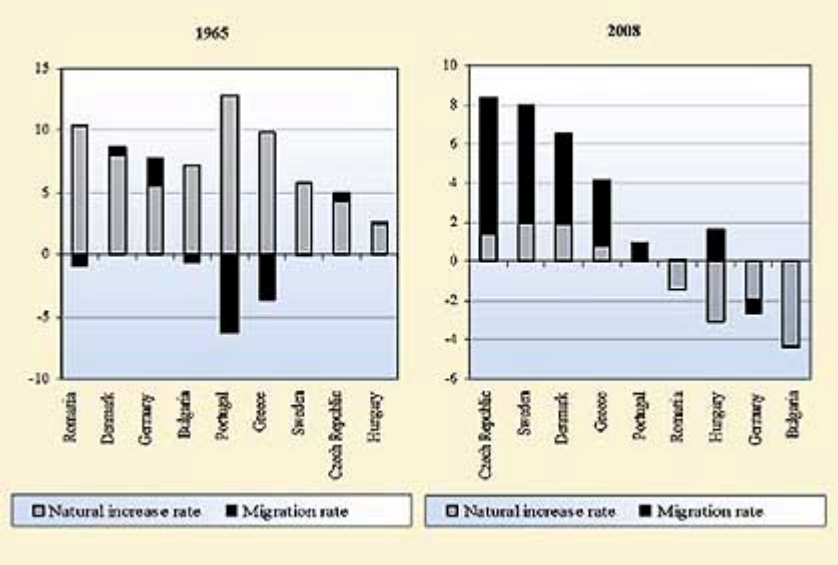
Care from a midwife or professional with midwifery skills during birth is key to saving lives of both mothers and newborns. Despite this, the figures show two thirds of women in the poorest countries deliver without a midwife or other health worker.

"This interactive map will enable advocates across the world to quickly and effectively lobby governments, influence policymakers and inform the media, as public pressure grows to end the tragic and almost always preventable deaths of girls and women in childbirth," comments Brigid McConville, Director of the WRA in the UK.

The new online world map was unveiled at the PMNCH Partner's Forum in Delhi, India (Nov 2010). To view the online version of the 'Atlas of Birth', please go to this address: www.atlasofbirth.com/index.php

http://www.alphagalileo.org/ViewItem.aspx?ItemId=90170&CultureCode=en

Population reproduction pattern in Bulgaria and its impact on labour force supply (2005-2030)



Bulgarian Academy of Sciences

The analysis focused on the impact of below-replacement population reproduction over the last few decades and the consequences of non-alteration or change in the recent levels of fertility, migrations and economic activity on labour force supply in the projection period. Eight European countries were chosen in order to illustrate the range of various possible scenarios of labour force development in the projection period.

Future trends of potential labour force development in Bulgaria towards 2030 as well as the long-term changes of its main demographic characteristics were studied in this project. The analysis focused on the impact of below-replacement population reproduction over the last few decades and the consequences of non-alteration or change in the recent levels of fertility, migrations and economic activity on labour force supply in the projection period. Eight European countries were chosen in order to illustrate the range of various possible scenarios of labour force development in the projection period. An international comparative analysis of population reproduction patterns and the relevant economic activity levels was made covering the reference and projection periods of time. Two scenarios of labour force evolution in Bulgaria were drafted: at constant and increasing levels of economic activity.

The main results obtained in the presented research project are as follows.

1. It was established that, by the end of the reference period, all the selected countries had a below-replacement population reproduction, with external migrations having a growing significance for it since the end of 1980s (Fig. 1). A substantial contiguity in the trends of change in the labour force demographic characteristics was also found in the selected countries. The countries were divided into two groups: with growing and reducing labour force numbers (Fig. 2). Due to the significant rise of the economic activity among women there was contingence in the sizes of economically active men and women by the end of the reference period. A process of rapid labour force ageing could be seen unfolding in all the selected countries (except Greece).

2. Since 1980, substantial changes have been occurring both in the population reproduction pattern and in the age-specific economic activity rates. However, the analysis results show that the impact of demographic factors on the total economic activity rate in the selected countries was relatively low. The changes in age-specific economic activity rates, which are closely related to the economic development and labour market conditions, had a preponderant influence.

3. It was proved that the common approaches for labour force projection are not appropriate for countries like Bulgaria which pass through an unparalleled socio-economic transition period. A transformation of the projection approach is suggested which was already put to an evaluation and gave very good outputs in the long-term 10-year labour force projection for Bulgaria made in 1996.

4. The two scenarios of development elaborated were used as a research tool for studying the probable consequences of the demographic reproduction pattern to the labour force evolution in the country. In the first scenario, the economic activity levels remain almost constant and the projected labour force changes are driven by the impact of the demographic processes. The results of this projection show large reduction of potential labour force of the country (Fig. 3), more rapid ageing thereof and deterioration of indices for labour force demographic and economic burden.

5. In the second scenario, the population reproduction pattern is not changed and the impact of increasing economic activity levels on the labour force is analysed. The projection output gave evidence of a labour force drop stop, ageing process being hindered and a significant improvement in labour force burden indices (Fig. 4).

6. Practical suggestions aimed at governmental bodies in the country were elaborated for the steps and actions needed to avoid any long-term consequences of the population reproduction pattern in Bulgaria on labour force supply.

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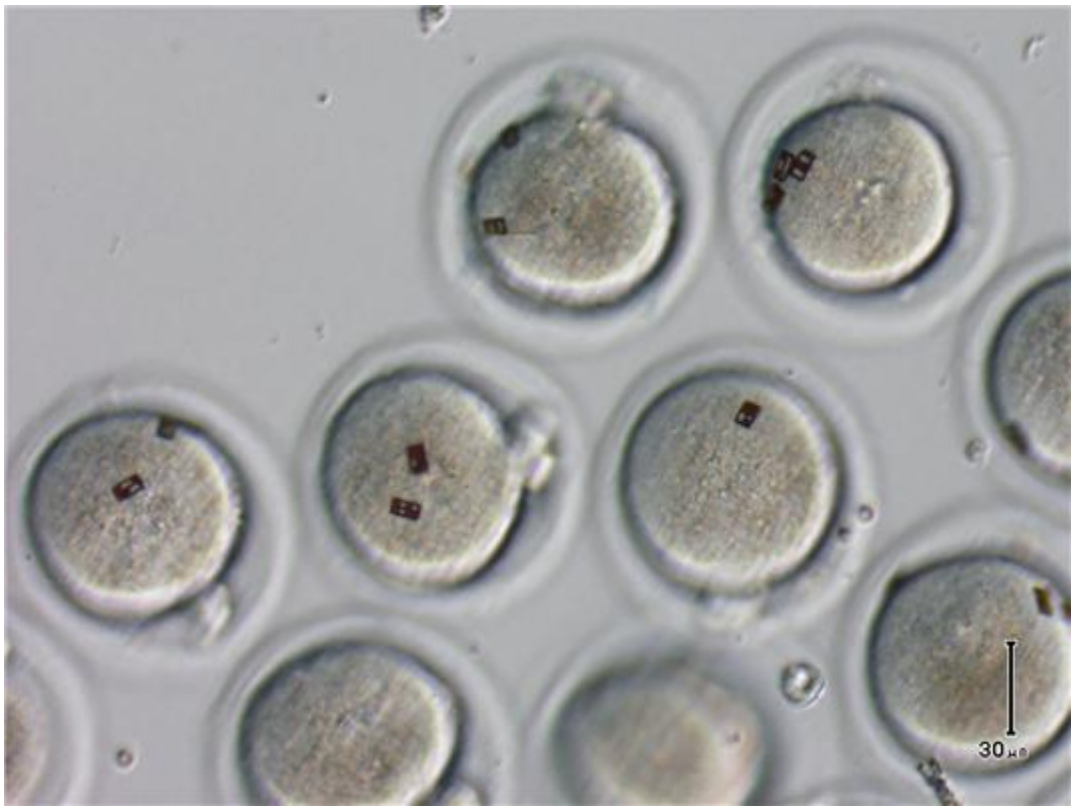
Researchers insert identification codes into mouse embryos

jueves, 18 de noviembre de 2010 Universitat Autònoma de Barcelona



Researchers from the Department of Cell Biology, Physiology and Immunology at Universitat Autònoma de Barcelona (UAB), in collaboration with researchers from the Institute of Microelectronics of Barcelona (IMB-CNM) of the Spanish National Research Council (CSIC), have developed an identification system for oocytes and embryos in which each can be individually tagged using silicon barcodes. Researchers are now working to perfect the system and soon will test it with human oocytes and embryos.

The research, published online in *Human Reproduction*, represents a first step towards designing a direct labelling system of oocytes and embryos. The objective was to develop a system which minimises risks when identifying female gametes and embryos during in vitro fertilisation and embryo transfer procedures, to reduce the phases of the clinical process requiring control and supervision by two embryologists.

Microscopic silicon codes, fabricated using microelectronic techniques, were employed in the research. In previous tests, researchers verified the innocuousness of silicon particles in human cells, particularly in macrophages. In the present study, the codes were microinjected into the perivitelline space of mouse embryos, located between the cell membrane and the zona pellucida, a cover which surrounds the plasma membrane of the embryo. Since the embryo exits the zona pellucida before its implantation in the uterus, this approximation should allow the embryo to free itself of the identification codes when leaving the zona pellucida.

This research shows that labelled embryos develop normally in culture up to the blastocyst stage, the phase of development which precedes implantation. Researchers also studied the retention of the codes throughout the culture process, the easiness in reading the codes in a standard microscope, and their elimination when embryos free themselves from the zona pellucida. The research also verified the efficacy of the system when freezing and thawing the embryos.

To make the system more viable, researchers are now working on improving the embryo's process of freeing itself from the identification code. This is the only stage of the research which presented limitations. They are currently studying whether the modification of the codes' surface could allow their direct attachment to the outer side of the zona pellucida, avoiding their microinjection into the perivitelline space. They also aim to develop an automatic code reading system.

Researchers recently received authorisation from the Department of Health of the Government of Catalonia to begin testing the system with human oocytes and embryos from several fertility clinics in Spain.

The research was carried out with the participation of Elena Ibáñez, Sergi Novo, Leonardo Barrios, Josep Santaló and Carme Nogués from the UAB Department of Cell Biology, Physiology and Immunology; and Rodrigo Gómez-Martínez, Marta Duch, Jaume Esteve and José Antonio Plaza from the Institute of Microelectronics of Barcelona, a CSIC member centre, at the UAB Research Park.

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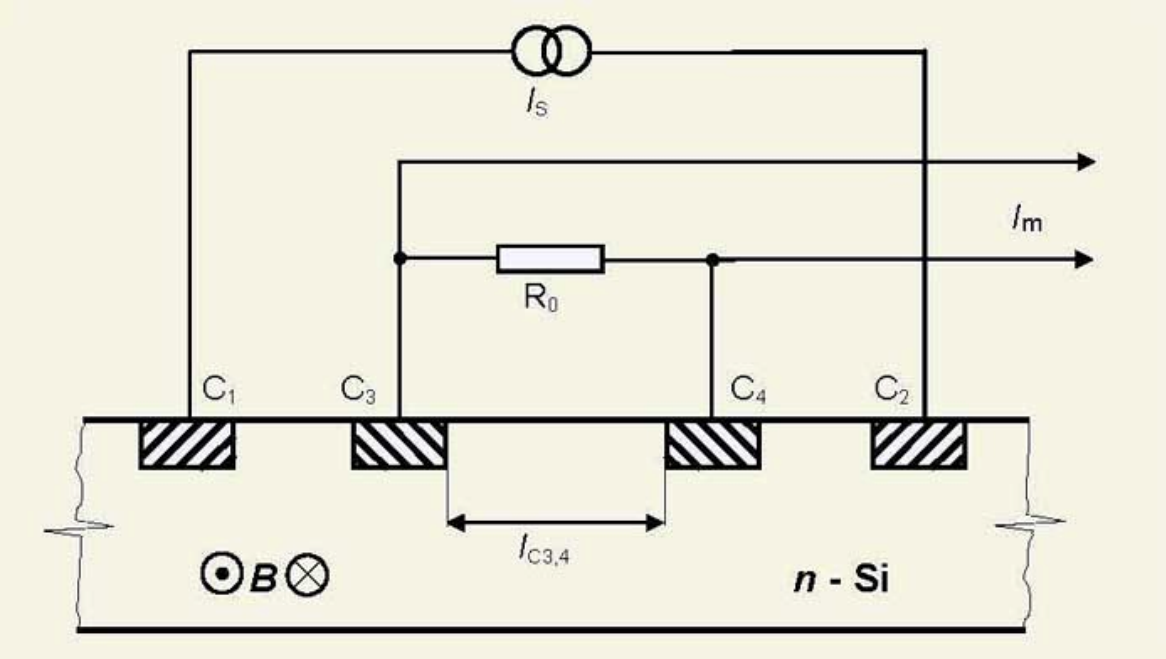
Experimental evidence of a novel magneto-sensitive effect in conducting materials

Bulgarian Academy of Sciences



The principle of operation of all semiconductor magneto-sensitive sensors and microsensors is based mainly on the well-known Hall Effect discovered in 1879.

The Hall effect is the generation of an electrical transverse voltage V_H across a parallelepiped conductor sample carrying an electric current Is and exposed to an external perpendicular magnetic field B. The magnitude of the voltage VH, known also as Hall voltage, is given by: $V_H = (1/qn)(I_S.B)(1/d)$, where *q* is the charge of the electrons or halls (depend on the type of conductivity of the material – *n* or *p*), n is the concentration of the charge carriers in material (mainly semiconductor), *d* is the thickness of the sample towards the external perpendicutablishedlar magnetic field B. Change in the polarity of the current I_S or of the magnetic field B causes change of the sign of the signal V_H. In 1983, in BAS, Ch.

Roumenin generalized the Hall phenomenon for structures with arbitrary shape and arbitrary orientations of current and magnetic field, and experimentally confirmed presence of Hall voltage in such structures. The so-called parallel magnetic-field Hall effect appears to be very promising for the purposes of microelectronics, in cases when all contacts are planar and the field B is parallel to the silicone chip plane. The invention of the distinguished American scientist Edwin Hall in 1879 was intended to prove experimentally that magnetic field interacted with moving charge carriers, i.e. when electrical current flowed through the sample, but not with the conductor material itself, as the famous James Maxwell considered. Regardless of the kind of the experimental setup intended for Hall effect investigations, two opposite or planar contacts are always formed, where the voltage V_H was generated.

Namely the Hall effect is the fundamental physical phenomenon which, due to its clear linear dependence of the output V_H on the current I_S and field B, produced simultaneously exact responses about the sign of the

charge carriers (negative electrons and positive halls), about the concentration of the free charges n or p and about their mobility μ. About the Hall effect, "harmonious" and as though experimentally concurring theory is developed, which have been working successfully in the solid electronics and sensorics for more than 60 years. Moreover, in 1980, this theory was enriched by the exceptionally important quantum Hall effect, discovered by the Nobel laureate Klaus von Klitzing. The milestone in the classical Hall effect theory is the Lorentz force F_L deflecting laterally the moving charge carriers.

The Lorentz force F_L always presents in materials carrying an electric current I_S and exposed to a perpendicular magnetic field B. The Lorentz force's contribution to the modern civilization is immense, as it is in the basis of all electro-motors, generators, sound-reproducing systems, measurement modules, etc. The Lorentz force F_L deflects to the corresponding boundary surface the charge carriers and on the opposite boundary of the material structure non-moving (static) charges appear. The electrical field E_H generated by such charges compensates the deflecting action of the Lorentz force F_L, $-eE_H = F_L$. Namely the electrical field E_H generates the Hall voltage V_H.

But the authors did not agree completely with such formulation of the Hall effect theory as settled static electrical charges in the both boundaries of the structure. Almost all of the materials with finite dimensions are similar to capacitors! This sounds absurdly and non-seriously. For long time, our resignation has been keeping by the fact that such theory "has been working". It seems to be paradoxically, but we were not troubled to assert that we did not understand the Hall effect interpretation very well.

At one moment, we decided to forget about the "harmonious" model of the Hall effect. Our reasoning was approximately as follows: the electrical charges concentrated into one of the sample boundaries by the Lorentz force FL must not be immobile. They equally in rights participated in the charge transport process with the other charges in sample volume, increasing the conductivity in the sample boundary, as their concentration there is increased in magnetic field. The concentration of mobile current charges in the opposite boundary of the sample decreased and corresponding conductivity decreased respectively. At stationary conditions, in magnetic field B, the density of the current I_s flowing into one of the boundaries increased but into opposite boundary decreased. Therefore, together with Hall voltage V_H, the surface current Im should change in magnetic field B. Such change should be alternative and independent manifestation of the Lorentz force F_L. We developed proper model related to existence of such magneto inducted change of the surface current Im. The most impressing in this saga was the experiment.

In fig. 1, the experimental benchmark used for the registration of the novel magneto-sensitive effect, is shown. On the upper surface of a silicone plate, four ohmic contacts are formed – two outer C_1 and C_2, and two inner C_3 and C_4. Through the contacts C_1 and C_2, the supply current $I_s = I_{C1,2}$ is switched. The innovation is that the both inner contacts C_3 и C_4 are connected to a measurement device for current. In practice, this was realized by connecting to point C_3 and point C_4 low-resistance etalon resistor R_0, which value was considerably lower by comparison with the resistance $R_{C3,4}$ between contacts C_3 and C_4, $R_0 < R_{C3,4}$. The resistor R_0 shunted the boundary zone lC3,4 and this way, the magneto-induced surface current Im, formed in the zones $l_{C1,3}$ and $l_{C4,2}$, flow trough the measurement circuit. The external magnetic field B was applied perpendicularly to the vertical section of the material structure. The samples were realized by means of standard planar technology. The resistivity of the silicone plates were $\rho \sim 7.5\ \Omega$ cm; the deepness of the ohmic contacts C_1, C_2, C_3 and C_4 was about 1 μ. Some of the experiments were realized in room temperature T = 300 K, other of them were realized in cryogenic temperature T = 77 K. The research was carried out in the Magnetic measurements laboratory of the Institute of System Engineering and Robotics.

In fig. 2, 3 and 4, the typical dependences of the measured between inner contacts C_3 and C_4 signal $I_{C3,4}(B) \equiv Im$ on the external magnetic B are shown. Generating in the structures of changes in the surface current in magnetic field $I_m(B)$ was registered in all of the experiments when $I_s \neq 0$. The new effect exists in

wide temperature interval 300 K≤T≤77 K. As is evident from the obtained experimental results, it manifests the following important feature: linear dependence on supply current Is and induction B, analogically to the Hall phenomenon. It is necessary to point out that simultaneously with existence of the current $I_m(B)$, on both of the contacts C_3 and C_4, a voltage V_H was generated due to existence of the well-known parallel-field Hall effect. Such voltage may be measured using Lozanova's method. Therefore the current $I_m(B)$ is independent on the classical VH. But both of the effects were caused by the Lorentz force and due to this reason they manifested related features regarding input parameters B and I_s.

The experimentally proved magneto-sensitive phenomenon in materials (in our case, semiconductors are considered) plays the same part as the goal of Hall Effect did many years ago. A practical applicability of the new galvanomagnetic phenomenon is in the field of investigating of the quality of surface of material structures. From here, very important conclusions may be formulated. Do not forget that the interface, Si-SiO_2 for example, is rather electronic element with unique properties, but not usual physical limit. In our opinion, the new phenomenon is applicable in micro- and nano structures. The quantum format of the new phenomenon is of interest.

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Organ Procurement Air Transportation Displays Poor Safety Record

Wiley - Blackwell

Industry-Wide Standards Needed to Improve Security of Transplant Teams

The transplant community was largely unaware of sub-standard transportation practices for donor organs until a number of fatal air crashes took the lives of transplant personnel, calling attention to procurement aviation safety. A new report highlighting the need for improved safety measures in organ procurement travel appears in the December issue of Liver Transplantation, a peer-reviewed journal published by Wiley-Blackwell on behalf of the American Association for the Study of Liver Diseases (AASLD).

In the U.S., the Organ Procurement and Transplantation Network (OPTN) is responsible for maintaining the national transplant waiting list which currently has more than 72,000 patients on the active wait list and only 8,477 donors. Given the scarcity of donor organs the need to quickly expedite their recovery and delivery to intended transplant patients is apparent. Many times procurement by air transport is necessary and at times dangerous due to nonstandard practices as John Renz, M.D., Ph.D., from the University of Chicago points out in his report.

Dr. Renz evaluated fatal and non-fatal procurement air accidents in the U.S. which were reported to the National Transportation Safety Board (NTSB). He found in one incident, a surgeon who was not licensed to fly at night attempted to do so and crashed on take-off, killing himself and a physician's assistant. Other accidents involved pilot error such as runway overrun, mismanagement of an abnormal flight control situation, and lack of flight crew coordination. "No accident was associated with the processes of procurement," said Dr. Renz. "It was the tolerance of dangerous operational practices, not found in commercial airline service, which contributed to the incidents."

A prior study by Englesbe and Merion calculated that the procurement air travel fatality rate is 1000 times higher than commercial aircraft, speculating the "riskiest job in medicine" belongs to transplant surgeons involved in procurement transport. In his editorial also published in this month's issue, Dr. Robert Merion, Professor of Surgery at the University of Michigan Health Systems and President of Arbor Research Collaborative for Health, adds, "We need better data on organ procurement travel and a commitment to zero

tolerance policy for procurement-related travel accidents." Dr. Merion, who lost four colleagues in a 2007 procurement flight crash which also claimed the lives of the two pilots, suggests the outcome of each procurement flight or ground transport be reported to the OPTN.

In his report, Dr. Renz also presents measures to create a "culture of safety" among those involved with organ transportation. He cites the use of quality aircraft, two-pilot crews, and aviation safety consultants as methods to improve safety. "Mandating turbine-powered, fixed wing aircraft, operated by reference to instruments under commercial flight regulations, to airports with continuous radar surveillance by two qualified pilots would ensure a level of competence and safety we expect with scheduled airline service," concluded Dr. Renz.

While both the study and editorial stress a need for procurement travel standards, the two doctors disagree on feasibility and cost of implementation. The authors do agree that further evaluation is necessary and should ultimately result in national procurement transportation standards that will ensure the safety of those involved in the travel and continued service for transplantation patients awaiting donor organs.

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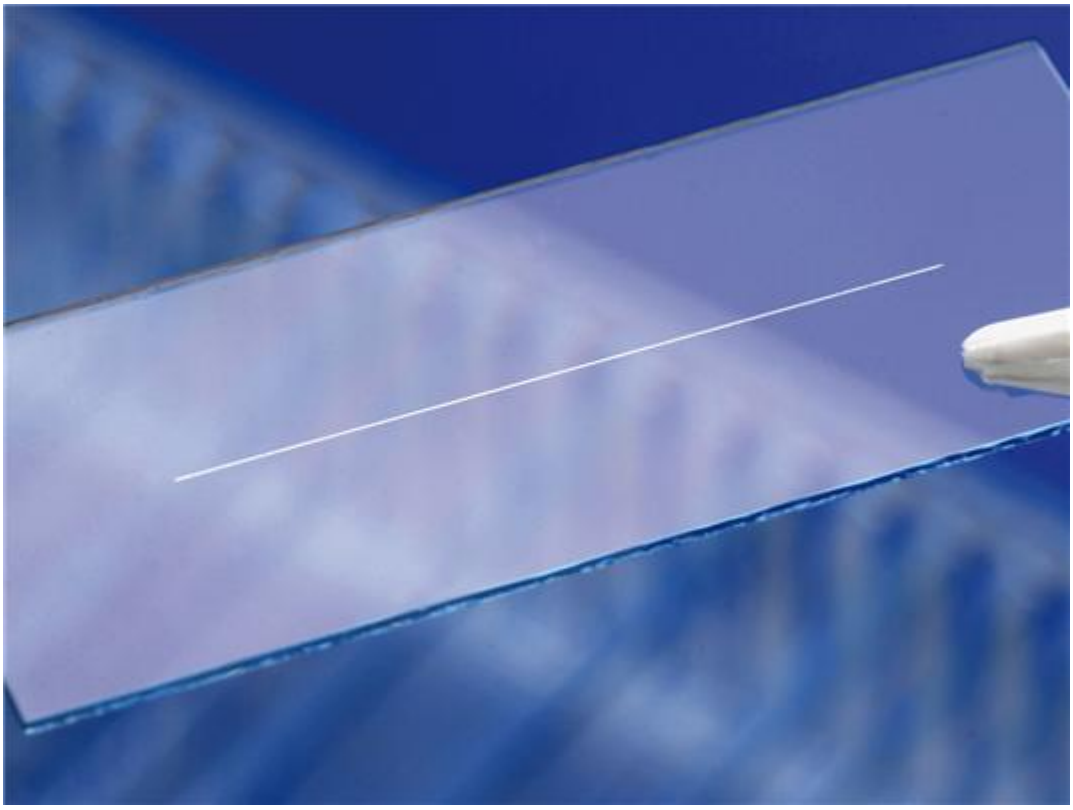
Conductor paths for marvelous light



Fraunhofer-Gesellschaft

Organic light-emitting diodes are seen as the basis for a new generation of lamps: Large-area lamps that can be randomly shaped and flexibly integrated into interior design. But the “illuminated glass” is still very expensive. Researchers want to optimize the lamps of the future and reduce the price by a new manufacturing process.

A short push on the light switch – and the whole ceiling lights up in a uniform and pleasant color. This “illuminated sky” is not available as yet, but researchers from all over the world are working on it flat out. The technology behind this marvel is based on organic light-emitting diodes, or OLEDs for short. These diodes use special molecules to emit light as soon as current passes through them. Although the first OLEDs have only recently become available, they are small and expensive. A flat disk with a diameter of eight centimeters costs around Euro 250. Experts of the Fraunhofer Institute for Laser Technology ILT in Aachen, Germany are working together with Philips to develop a process for making these lamps distinctly bigger and cheaper – and thus suitable for mass market.

These new lamps are expensive primarily due to the costly manufacturing process. An OLED consists of a sandwich layer structure: a flat electrode at the bottom, several intermediate layers on top as well as the actual luminescent layer consisting of organic molecules. The final layer is a second electrode made of a special material called ITO (indium tin oxide). Together with the lower electrode, the ITO layer has the job of supplying the OLED molecules with current and causing them to light up. The problem is, however, that the

ITO electrode is not conductive enough to distribute the current uniformly across a larger surface. The consequence: Instead of a homogeneous fluorescent pattern, the brightness visibly decreases in the center of the surface luminaire. “In order to compensate, additional conductor paths are attached to the ITO layer,“ says Christian Vedder, project manager at the Fraunhofer Institute for Laser Technology. ”These conductor paths consist of metal and distribute the current uniformly across the surface so that the lamp is lit homogenously.”

Normally the conductor paths are applied by energy-intensive evaporation and structuring processes, while only a maximum of ten percent of the luminous area may be covered by conductor paths. “The large remainder including the chemical etchant has to be recycled in a complicated process,“ explains Christian Vedder. This is different in the new process from the researchers from the Fraunhofer Institute for Laser Technology. Instead of depositing a lot of material by evaporation and removing most of it again, the scientists only apply precisely the amount of metal required. First of all they lay a mask foie on the surface of the ITO electrode. The mask has micrometer slits where later the conductive paths are supposed to be. On this mask the researchers deposit a thin film of metal made of aluminum, copper or silver – the metal the conductor path is supposed to be made of. Subsequently a laser passes over the conductor path pattern at a speed of several meters per second. The metal melts and evaporates while the vapor pressure makes sure that the melt drops are pressed through the fine slits in the masks on to the ITO electrode. The result are extremely fine conductor paths. At up to 40 micrometers, they are distinctly narrower than the 100 micrometer conductor paths which can be produced with conventional technology. “We have already been able to demonstrate that our methods works in the laboratory,” says Christian Vedder. “The next step is implementing this method in industrial practice together with our partner Philips and developing a plant technology for inexpensively applying the conductor paths on a large scale.” The new laser process could be ready for practical application in two to three years.

http://www.fraunhofer.de/en/press/research-news/2010/11/conductor-paths-for-marvelous-light.jsp

http://www.alphagalileo.org/ViewItem.aspx?ItemId=90122&CultureCode=en

Spearheading British eco-homes

Leicester, University of

Eco-homes built on four different continents have inspired a University of Leicester researcher to campaign for a change in planning and building of UK homes.

Dr Jenny Pickerill, a Senior Lecturer from the Department of Geography at the University of Leicester, has recently returned from an intrepid solo three month Winston Churchill Travelling Fellowship exploring how to make affordable eco-homes a reality.

Dr Pickerill visited over thirty examples of low cost eco-housing in often remote parts of Spain, Thailand, Argentina and USA. She stayed in a huge variety of eco-communities and with those who have self-built eco-houses, often novel places not previously researched, in order to find out the best practice for building eco-homes. She has now brought her findings back to the UK to prompt the building of more British eco-homes.

Through her Fellowship she was able to understand what social, political and economic conditions encourage or hinder low cost eco-housing, finding that many people, in diverse places across the world, have found inventive and replicable ways of building cheaply while also producing beautiful and safe homes. Those places without planning laws and building regulations, in particular, produced successful and innovative eco-housing.

Now that she has returned to Britain Dr Pickerill intends to use this knowledge to advocate for changes in the way the UK currently plans and constructs housing. She said:"While the numbers of eco-houses has steadily increased in Britain in recent years it is important to ensure that environmentally friendly designs do not become the privilege of the wealthy, but can also be available to those on a lower income.

"There is a real danger that the rise in popularity of eco-homes will cause more inequality and heighten the rich-poor divide. As environmental issues become more and more topical, we need to keep in mind the economic pressures people face. In the rush to find environmental solutions, we shouldn't forget social justice."

Also see her travel and research blog on the link below. Jenny also has a large selection of quality of photographs of the eco-housing she visited during her trip.

http://naturalbuild.wordpress.com/

http://www.alphagalileo.org/ViewItem.aspx?ItemId=90125&CultureCode=en