## UCLA scientists make paralyzed rats walk again after spinal-cord injury

UCLA researchers have discovered that a combination of drugs, electrical stimulation and regular exercise can enable paralyzed rats to walk and even run again while supporting their full weight on a treadmill.

Published Nov. 20 in the online edition of Nature Neuroscience, the findings suggest that the regeneration of severed nerve fibers is not required for paraplegic rats to learn to walk again. The finding may hold implications for human rehabilitation after spinal cord injuries.

"The spinal cord contains nerve circuits that can generate rhythmic activity without input from the brain to drive the hind leg muscles in a way that resembles walking called 'stepping,'" explained principal investigator Reggie Edgerton, a professor of neurobiology and physiological sciences at the David Geffen School of Medicine at UCLA.

"Previous studies have tried to tap into this circuitry to help victims of spinal cord injury," he added. "While other researchers have elicited similar leg movements in people with complete spinal injuries, they have not achieved full weight-bearing and sustained stepping as we have in our study."

Edgerton's team tested rats with complete spinal injuries that left no voluntary movement in their hind legs. After setting the paralyzed rats on a moving treadmill belt, the scientists administered drugs that act on the neurotransmitter serotonin and applied low levels of electrical currents to the spinal cord below the point of injury.

The combination of stimulation and sensation derived from the rats' limbs moving on a treadmill belt triggered the spinal rhythm-generating circuitry and prompted walking motion in the rats' paralyzed hind legs.

Daily treadmill training over several weeks eventually enabled the rats to regain full weight-bearing walking, including backwards, sideways and at running speed. However, the injury still interrupted the brain's connection to the spinal cord-based rhythmic walking circuitry, leaving the rats unable to walk of their own accord.

Neuro-prosthetic devices may bridge human spinal cord injuries to some extent, however, so activating the spinal cord rhythmic circuitry as the UCLA team did may help in rehabilitation after spinal cord injuries.

*The study was funded by the Christopher and Dana Reeve Foundation, Craig Nielsen Foundation, National Institute of Neurological Disorders and Stroke, U.S. Civilian Research and Development Foundation, International Paraplegic Foundation, Swiss National Science Foundation and the Russian Foundation for Basic Research Grants.*

## Scientists find that individuals in vegetative states can learn

### *Research gives insight into possible rehabilitation of some patients*

Scientists have found that some individuals in the vegetative and minimally conscious states, despite lacking the means of reporting awareness themselves, can learn and thereby demonstrate at least a partial consciousness. Their findings are reported in today's (20 September) online edition of Nature Neuroscience.

It is the first time that scientists have tested whether patients in vegetative and minimally conscious states can learn. By establishing that they can, it is believed that this simple test will enable practitioners to assess the patient's consciousness without the need of imaging.

This study was done as a collaborative effort between the University of Buenos Aires (Argentina), the University of Cambridge (UK) and the Institute of Cognitive Neurology (Argentina). By using classical Pavlonian conditioning, the researchers played a tone immediately prior to blowing air into a patient's eye. After some time training, the patients would start to blink when the tone played but before the air puff to the eye.

This learning requires conscious awareness of the relation between stimuli - the tone precedes and predicts the puff of air to the eye. This type of learning was not seen in the control subjects, volunteers who had been under anaesthesia. The researchers believe that the fact that these patients can learn associations shows that they can form memories and that they may benefit from rehabilitation.

Lead author Dr Tristan Bekinschtein, from the University of Cambridge's Wolfson Brain Imaging Unit, said: "This test will hopefully become a useful, simple tool to test for consciousness without the need for imaging or instructions. Additionally, this research suggests that if the patient shows learning, then they are likely to recover to some degree."

In 2006, the Cambridge Impaired Consciousness Group at the Wolfson Brain Imaging Unit showed, using functional imaging, showed that patients in vegetative states (as defined by behavioural assessment in the clinic) can in fact be conscious despite being unable to show consistent voluntary movements.

***Notes to editors:*** *1. The paper 'Classical conditioning in the vegetative and minimally conscious state' will be published in the Advanced Online Publication of Nature Neuroscience on 20 September 2009.*

*2. This study was funded by an Antorchas Foundation grant (T.A.B.), a Marie Curie IIF grant (T.A.B.), a StartUp grant (F.F.M.), the Human Frontiers Science Program (M.S.) and a Medical Research Council Acute Brain Injury Collaborative grant.*

## Radiological treatment method spares patients surgery and offers 89 percent cost savings

Pericardial effusion, the collection of fluid around the heart, typically occurs in patients following heart surgery and is usually treated using an invasive surgical drainage technique. However researchers have discovered that a minimally invasive procedure called CT-guided tube pericardiostomy is just as effective - requiring no recovery time, fewer resources, and provides an 89 percent cost savings over the surgical drainage technique, according to a study published in the October issue of the American Journal of Roentgenology (AJR).

The study, performed at the University of Southern California Keck School of Medicine, included 39 CT-guided tube pericardiostomy procedures that were all performed successfully.

"Patients having the procedure required only local anesthesia and no post-treatment recovery time," said Suzanne L. Palmer, MD, lead author of the study. "Comparison of procedure charges at our institution showed an 89 percent cost savings with CT-guided tube pericardiostomy instead of surgical drainage. We found that the total charge for a CT-guided procedure was only $769.15; the total charge for a surgical drainage procedure was $6,952.52," she said.

"Pericardial effusion occurs in as many as 85 percent of patients following cardiovascular surgery. CT-guided tube pericardiostomy is an attractive first-line therapeutic option for these patients, especially in the postoperative period because it spares them from having another invasive surgery," she said.

"Aside from being cost competitive it also makes the treatment option less risky for patients. The procedure does not require general anesthesia and a catheter is inserted into the excess fluid for drainage - allowing physicians to avoid working around major organs and vascular structures," said Dr. Palmer.

*This study appears in the October issue of the American Journal of Roentgenology. For a copy of the full study, please contact Heather Curry via email at hcurry@acr-arrs.org or at 703-390-9822.*

## Breathing technique can reduce frequency, severity of asthma attacks

### *SMU researchers expand study that shows promise*

As the health care reform debate turns to cutting costs and improving treatment outcomes, two professors at Southern Methodist University in Dallas are expanding a study that shows promise for reducing both the expense and suffering associated with chronic asthma.

Thomas Ritz and Alicia Meuret, both in SMU's Psychology Department, have developed a four-week program to teach asthmatics how to better control their condition by changing the way they breathe.

With the help of a four-year, $1.4 million grant from the National Institutes of Health, they plan to engage 120 Dallas County patients in four weeks of breathing training by the study's projected end in July 2011. Their co-investigators include David Rosenfield, also of SMU's Psychology Department, and Mark Millard, M.D., of Baylor University Medical Center in Dallas.

More than 22 million Americans suffer from asthma at an estimated annual economic cost of more than $19 billion, according to the American Lung Association. The number of cases doubled between 1980 and 1995, prompting the U.S. Department of Health and Human Services to classify the disease as an epidemic in 2000.

During an attack, sufferers tend to hyperventilate, breathing fast and deep against constricted airways to fight an overwhelming feeling of oxygen deprivation.

Unfortunately, this makes the problem worse by lowering the body's carbon dioxide levels, which restricts blood flow to the brain and can further irritate already hypersensitive bronchial passages.

Patients who "overbreathe" on a sustained basis risk chronic CO2 deficiencies that make them even more vulnerable to future attacks. Rescue medications that relieve asthma symptoms do nothing to correct breathing difficulties associated with hyperventilation.

As part of SMU's "Stress, Anxiety and Chronic Disease Research Program," Ritz and Meuret use their biofeedback-based Capnometry-Assisted Respiratory Training (CART) to teach asthma patients to normalize and reverse chronic overbreathing. A hand-held device called a capnometer measures the amount of CO2 exhaled. Using this device, patients learn how to breathe more slowly, shallowly and regularly.

CART techniques could have a positive impact on quality of asthma treatment even as they reduce the need for acute care, Ritz says.

"The research shows that this kind of respiratory therapy can limit both the severity and frequency of asthma attacks," he says. "That means fewer doctor visits and less frequent use of rescue medications, with the associated savings of both time and money."

And for those who count any year without a trip to the emergency room as a year with a good treatment outcome, that means a higher quality of life, says Meuret, who lives with asthma herself.

"The training gives patients new ways to deal with acute symptoms, and that helps them to feel more in control," she says.

## New species discovered on whale skeletons

When a whale dies, it sinks to the seafloor and becomes food for an entire ecosystem. Researchers at the University of Gothenburg, Sweden, have discovered previously unknown species that feed only on dead whales - and use DNA technology to show that the species diversity in our oceans may be higher than previously thought.

Dead whales constitute an unpredictable food source - it is impossible to know when and where a whale is going to die, and when it does, the food source does not last forever. Nevertheless, some marine species have specialised in feeding on whale cadavers.

**Big source of nutrients**

This is shown by researchers at the University of Gothenburg who have studied the ecosystem around dead whales using underwater cameras. A dead whale is an enormous source of nutrients. In fact, one cadaver offers the same amount of nutrients that normally sinks from the surface to the seafloor in 2000 years, and this is of great benefit to innumerable species: First the meat is eaten by for example sharks and hagfish, then tremendous amounts of various organisms come to feast on the skeleton.

**Specialised worms**

One group of animals commonly found on whale skeletons is bristleworms, which are related to the earthworm. Some bristleworm species are so specialised in eating dead whales they would have problems surviving elsewhere. One example is Osedax, which uses its root system to penetrate the whale bones when searching for food. Other species specialise in eating the thick layers of bacteria that quickly form around the bones.

**Nine new species** A dissertation from the Department of Zoology at the University of Gothenburg describes no fewer than nine previously unknown species of these bacteria-grazing bristleworms.

**Cryptic species**

Four of the new species were found on whale cadavers placed at a depth of 125 metres in the new national park Kosterhavet off the coast of Strömstad, Sweden. The other five species feed on whale bones in the deep waters off the coast of California, USA. The family tree of bristleworms was explored using molecular data. The DNA analyses show that there are several so-called cryptic bristleworm species, meaning species that despite looking identical differ very much genetically.

**Significant findings**

The analyses show that the adaptation to a life on whale cadavers has occurred in species from different evolutionary paths and at several points in time. The study also shows that some species that are assumed to inhabit many different areas globally, so-called cosmopolitan species, may in fact be cryptic species. This finding may be very significant for our understanding of how animals spread around the world and of how many different species dwell on our planet.

*The dissertation Evolution of annelid diversity at whale-falls and other marine ephemeral habitats will be publicly defended on 25 September.*

## Echoes of phlogiston in stem cell biology

Before it was learned that matter burns by taking up oxygen, most chemists sought to explain combustion as the release of a mysterious substance, which they named "phlogiston". Phlogiston theory was a conceptual breakthrough that helped chemists conduct experiments and share ideas. Only when it came to pinning down the distinctive physical properties of phlogiston did it become clear that no such thing exists. Now an opinion piece by Arthur Lander, published in BioMed Central's open access Journal of Biology, argues that the idea of stem cells - a major conceptual breakthrough in biology - is running into similar troubles as investigators try to pin it down to a set of distinctive molecular characteristics.

Professor Lander, Director of the Center for Complex Biological Systems at the University of California, Irvine, USA, argues that neither of the two properties that define 'stem cells' as they are popularly discussed, potency and self-renewal, can be ascribed an exclusive molecular basis, and that both are seen in cell types not usually described as stem cells. He said, "It is curious that, after 45 years, we are unable to place the notion of 'stemness' on a purely molecular footing. Of course, the fact that a goal has not been achieved after a long time does not mean that the answer is not around the corner. But it does give one cause to wonder whether something we are doing needs to change, either in the question we are asking or the way we are approaching it".

Lander writes that 'stemness' should be considered a property of systems, rather than individual cells, describing how a system with stemness is one that can achieve a controlled size, maintain itself homeostatically, and regenerate when necessary. He argues that such behaviors naturally emerge as a consequence of basic engineering principles of feedback control. This is more than a minor semantic quibble - just one practical

consequence of an inaccurate understanding of the precise nature of stem cells may be the assumption that specific chemotherapeutic targeting of 'cancer stem cells' will necessarily stop tumors in their tracks. As Lander writes, "If feedback and lineage progression continue to take place in cancerous tissues, we might observe that under different conditions - different stages of tumorigensis, different parts of a tumor, different amounts of tumor cells - that different cell types will assume the role of cancer stem cell".

He concludes, "Like phlogiston, the term 'stem cell' is a scientific concept. Just as investigating the concept of phlogiston allowed the discovery of oxygen and the process of oxidation, it may be that by refashioning our thinking about stem cells - with systems relationships and dynamics taking the place of molecular signatures and simple gene regulatory circuits - the concept of stemness will continue to light the path toward understanding".

## Experimental drug lets B cells live and lymphoma cells die

An investigative drug deprived non-Hodgkin lymphoma cells of their ability to survive too long and multiply too fast, according to an early study published recently in the journal Experimental Hematology.

To function normally, the cells that make up bodily tissues must "decide" when to divide and multiply (proliferate) and when to die. Cell death restricts the human cell population as a counterbalance to growth, and billions of cells must die each year just to hold the number constant. Cell growth and death are carefully regulated by signaling networks, which either encourage or discourage survival. When this counterpoise mistakenly shifts too far in favor of growth, tumors result.

One such network revolves around neurotrophins, which "tell" nerve cells not to die, and to keep multiplying, as part of normal function. The same neurotrophic signals are known to cause cancers of the central nervous system when unbalanced by carcinogens. The current study found that neurotrophins also cause key immune cells to resist cell death and proliferate as part of the most deadly of lymphomas, and that an experimental compound, the fungal chemical called K252a, restored their ability to die.

Non-Hodgkin Lymphoma (NHL) is the umbrella for more than 30 cancer types that develop in an important type of white blood cell, the lymphocyte. Lymphocytes include B cells, workhorses of the immune system that attach to invaders (e.g. bacteria, viruses) and produce an army of antibodies designed to attack the specific pathogen at hand. In NHL, B cells in the lymphatic system grow abnormally, and most patients are diagnosed too late to benefit from conventional chemotherapy.

"New approaches to the treatment of non-Hodgkin Lymphoma are urgently needed, and the results of this study outline one with unusual promise," said Sanjay Maggirwar, Ph.D., associate professor in the Department of Microbiology & Immunology at the University of Rochester Medical Center, and corresponding author of the study. "We believe we have found a subtle, precise mechanism that shortens the lifespan of many kinds of cancer cells while enabling normal B cells to live on."

**Survivor: Cell Edition**

Cell death (apoptosis) is controlled by an intricate network of signals, including toxins, hormones and growth factors like the neurotrophins, which have their effect by interacting with specifically shaped proteins called Trk receptors on cell surfaces. When they dock into their receptors, like ships coming into port, neurotrophins changes the shape of the dock such that chain reactions pass on messages inside the cell. The current study supports the theory that cancerous B lymphocytes secrete neurotrophins that interact with Trk receptors on their surfaces. The results offer the first proof that a self-regulating (autocrine) neurotrophic mechanism drives abnormal survival and proliferation in the most aggressive NHL cell lines.

Among the signaling pathways triggered when a neurotrophin binds to its Trk receptor is that for the nuclear factor kappa B (NFkappaB) protein complex, which turns on genes that vary with the cell type. In cancerous B cells, NFkappaB signaling codes for the building of interleukin 6, a signaling molecule established in past studies to extend the lifespan of B cells.

The intuitive next step would be to block NFkappaB signaling, and more than 900 compounds have been found that do so. None has prevailed in the clinic, however, because this signaling pathway is essential to the function of healthy human cells as well as tumor growth. A successful drug would have to block part of the NFkappaB pathway, but leave other aspects intact. A currently available NFkappaB blocker, Velcade, has achieved some success as chemotherapy because its interference with the pathway is indirect and mild.

The excitement surrounding the study drug, K252a, comes from its evidence that its impact on NFkappaB signaling is also precisely targeted, mild and easily reversed. In cell culture studies, Maggirwar's results suggest that K252a causes one part of the NFkappaB complex, a protein called RelA, to cluster within structures called nucleoli. Once there, RelA can no longer interact with the gene-containing chromosomes that it would otherwise influence (e.g. the one for interleukin 6).

The beauty of the study drug's proposed "RelA redistribution" mechanism would be that it allows other parts of the NFkappaB complex, like RelA relative CRel, to continue signaling. RelA and CRel work interchangeably in many pathways, but only RelA drives the expression of the gene that codes for IL6, encouraging B cell longevity. In experiments, exposure to K252a caused five times as many activated B cells, which closely resemble cancerous B cells, to undergo cell death than normal, resting B cells. Furthermore, experiments revealed that K252a keeps lymphoma-like cells from dividing and multiplying.

To extend their findings to other cancer types, the team then analyzed expression of Trk and neurotrophins in cell lines derived from breast cancer, Burkitt's lymphoma and multiple myeloma, as well as the effect of K252a on them. They found the same autocrine neutrophin signaling cascade to exist in these other cancer cells, which again encouraged abnormal survival, and which K252a countered.

In the next step, the team will test the effect of K252a in live mice with NHL in partnership with oncologists within the James P. Wilmot Cancer Center at the Medical Center, who in September 2008 won a SPORE grant from the National Cancer Institute to support the expansion of lymphoma research and clinical trials.

Along with Maggirwar, the study was led by Lynn Sniderhan, Ph.D., Tatiana Garcia-Bates, Ph.D., Michael Burgart and Richard Phipps, Ph.D., in the Department of Microbiology & Immunology, and by Steven Bernstein, M.D., co-director of Wilmot's Lymphoma Biology Program. The work was supported by the grants from the National Institutes of Health.

"The current study results provide strong evidence for the existence of vicious cycle in Non-Hodgkin Lymphoma, a loop where B cells keep secrete too many neutrophins, which interact with too many Trk receptors on their surfaces, which drive abnormal survival of these cells," Maggirwar said. "We believe the study drug broke this deadly loop in lymphoma cells."

## End of an era: New ruling decides the boundaries of Earth's history

After decades of debate and four years of investigation an international body of earth scientists has formally agreed to move the boundary dates for the prehistoric Quaternary age by 800,000 years, reports the Journal of Quaternary Science.

The decision has been made by the International Commission on Stratigraphy (ICS), the authority for geological science which has acted to end decades of controversy by formally declaring when the Quaternary Period, which covers both the ice age and moment early man first started to use tools, began.

In the 18th Century the earth's history was split into four epochs, Primary, Secondary, Tertiary, and Quaternary. Although the first two have been renamed Palaeozoic and Mesozoic respectively, the second two have remained in use by scientists for more than 150 years. There has been a protracted debate over the position and status of Quaternary in the geological time scale and the intervals of time it represents.

"It has long been agreed that the boundary of the Quaternary Period should be placed at the first sign of global climate cooling," said Professor Philip Gibbard. "What we have achieved is the definition of the boundary of the Quaternary to an internationally recognised and fixed point that represents a natural event, the beginning of the ice ages on a global scale."

Controversy over when exactly the Quaternary Period began has raged for decades, with attempts in 1948 and 1983 to define the era. In 1983 the boundary was fixed at 1.8 million years, a decision which sparked argument within the earth science community as this point was not a 'natural boundary' and had no particular geological significance. Up to now it has been widely felt within the scientific community that the boundary should be located earlier, at a time of greater change in the earth-climate system.

"For practical reasons such boundaries should ideally be made as easy as possible to identify all around the world. The new boundary of 2.6 million years is just that," concluded Gibbard, "hence we are delighted at finally achieving our goal of removing the boundary to this earlier point."

"The decision is a very important one for the scientific community working in the field," said Journal Editor Professor Chris Caseldine. "It provides us with a point in geological time when we effectively did move into a climatic era recognisably similar to the geological present."

## Torturing 'does not get truth'

***Torture techniques used on suspected terrorists by the Bush administration may have failed to get to the truth, researchers say.***

Professor Shane O'Mara of Trinity College, Dublin, said the interrogation techniques had a detrimental effect on brain functions related to memory. He listed 10 methods of what he called torture used by the US, including stress positions and waterboarding. His review is published in the journal, Trends in Cognitive Science.

**'Lack of control'**

Professor O'Mara said US Department of Justice memos released in April showed that the Americans believed that prolonged periods of shock, anxiety, disorientation and lack of control were more effective than

standard interrogation in extracting the truth.

He said: "This is based on the assumption that subjects will be motivated to reveal truthful information to end interrogation, and that extreme stress, shock and anxiety do not impact on memory. "However this model of the impact of extreme stress on memory and the brain is utterly unsupported by scientific evidence."

He said studies of extreme stress with special forces soldiers had found that their recall of previously learned information was impaired afterwards. "Waterboarding in particular is an extreme stressor and has the potential to elicit widespread stress-induced changes in the brain."

Professor O'Mara said contemporary neuroscientific models of human memory showed that the hippocampus and prefrontal cortices of the brain were very important. The stress hormone, cortisol, binds to receptors in the hippocampus and prefrontal cortex increasing neuronal excitability which compromises the normal functioning of the brain if it is sustained. And other stress hormones called catecholamines could lead to an increase in blood pressure and heart rate which could cause long-term damage to the brain and body if they were maintained at a high level for a long time.

**Conditioning**

Professor O'Mara said a common argument in favour of torture was that it would reliably elicit truthful information from the captive's long-term memory.

But psychological studies had suggested that during extreme stress and anxiety, the captive would be conditioned to associate speaking with periods of safety. And because torture was stressful for the torturers the fact that the captive was speaking also provided a safety signal to the captor.

"Making the captive talk may become the end - not the truth of what the captive is revealing. "These techniques cause severe, repeated and prolonged stress, which compromises brain tissue supporting memory and executive function. "The fact that the detrimental effects of these techniques on the brain are not visible to the naked eye makes them no less real."

**Memory disruption**

Dr David Harper, a clinical psychologist from the University of East London, said the study appeared to be consistent with previous research on memory and trauma and with evidence of previous torture survivors and those in the intelligence community critical of psychological torture techniques.

| Techniques used by US |
|---|
| Walling - captive is placed with heels touching the wall and is pulled away and pushed back into it with force |
| Wall standing - captive stands four to five feet from wall with fingertips supporting all the body weight to induce muscle fatigue |
| Cramped confinement - captive place in small box in darkness for up to two hours, in a larger box for up to 18 hours |
| Sleep deprivation - captive is deprived of sleep for up to 11 days |
| Stress positions - captive sits on floor with legs straight out in front and arms raised above head or is made to kneel on the floor while leaning back at a 45 degree angle |
| Waterboarding - captive is bound head down on an inclined bench with a cloth over the eyes. Water is applied to the cloth for 20 to 40 seconds at a time inducing fast breathing and perception of drowning |

"Believers in coercive interrogation tend to believe that people will 'tell the truth' as a result but much evidence suggests that people will, in fact, tell those conducting the torture what they think will make the torture stop. "This has been noted as a danger by commentators from the Spanish Inquisition, through the Moscow Show Trials of the 1930s to the present day."

Dr Stuart Turner of the Centre for the Study of Emotion and Law said: "There is now very strong evidence that torture and harsh interrogation techniques may disrupt normal memory processes.

"With this in mind, it is also unreasonable to expect torture survivors to be able to give consistent and complete accounts of their experiences. "This is highly relevant, for example, to the process of decision making for asylum seekers, arriving in the UK seeking refuge and for whom credibility is often a central issue.

"It appears that O'Mara's review paper supports the contention that to expect consistent memories in asylum applicants is unreasonable and therefore that inconsistencies should certainly not automatically be interpreted as evidence of fabrication."

## Hummer owners claim moral high ground to excuse overconsumption

Hummer drivers believe they are defending America's frontier lifestyle against anti-American critics, according to a new study in the Journal of Consumer Research.

Authors Marius K. Luedicke (University of Innsbruck, Austria), Craig J. Thompson (University of Wisconsin–Madison), and Markus Giesler (York University, Toronto) researched attitudes toward owning and driving Hummers, which have become symbols to many of American greed and wastefulness.

The researchers first investigated anti-consumption sentiments expressed by people who oppose chains like Starbucks and believe they are making a moral choice by shunning consumerism. To these critics, Hummers represent the ills of contemporary society. As one extreme example, on www.fuh2.com, people have posted thousands of photographs of middle fingers directed at Hummer vehicles.

They investigated various Internet expressions of anti-Hummer sentiment, but they were equally interested in the ways Hummer owners framed themselves as "moral protagonists" in the ongoing debate over consumer values. They conducted in-depth interviews with twenty U.S.-born and raised Hummer owners and found among these consumers an equally strong current of moralism.

"As we studied American Hummer owners and their ideological beliefs, we found that they consider Hummer driving a highly moral consumption choice," write the authors. "For Hummer owners it is possible to claim the moral high ground."

The authors explain that Hummer owners employ the ideology of American foundational myths, such as the "rugged individual," and the "boundless frontier" to construct themselves as moral protagonists. They often believe they represent a bastion again anti-American discourses evoked by their critics.

"Our analysis of the underlying American identity discourses revealed that being under siege by (moral) critics is an historically established feature of being an American," write the authors. "The moralistic critique of their consumption choices readily inspired Hummer owners to adopt the role of the moral protagonist who defends American national ideals."

*Marius K. Luedicke, Craig J. Thompson, and Markus Giesler. "Consumer Identity Work as Moral Protagonism: How Myth and Ideology Animate a Brand- Mediated Moral Conflict." Journal of Consumer Research: April 2010 (published online September 18, 2009).*

## What are you getting? Consumer behavior in restaurants

Consumers follow a predictable pattern when it comes to ordering food and drinks, according new study in the Journal of Consumer Research. It seems people in groups tend to seek variety when making initial orders, then gravitate toward similar choices, and then, as the group consensus grows, to move away from popular choices.

"Our study shows empirically that consumers are susceptible to both conformist and variety-seeking tendencies," write authors Pascale Quester (University of Adelaide, Australia) and Alexandre Steyer (Sorbonne-Assas, Paris, France). "They like to differentiate themselves from a growing minority or an overwhelming majority, but tend to conform in between."

The authors conducted a study on candy bars in a lab, and then moved on to a real-life setting of a restaurant called Flam's in Paris. They sought out a situation where a drink was included in a package (Flam's Plus) that included an appetizer, a main course, and a dessert. In this situation, price would not be a factor, since the drinks were included, and people were unlikely to share drinks, as they might share food in a Chinese restaurant.

"We decided that consumers' choice of pre-meal drinks within a Flam's Plus order would provide the best and most reliable context for determining whether and how individuals' choices were influenced by other's choices, in a condition when individual orders would be made public by the order process."

They analyzed the data from 70 tables with two or more patrons where everyone ordered the Flam's Plus. The tables ranged from two to 18 customers. The results of the restaurant study showed people sought variety as long as others' choice of the same item did not achieve a threshold level of group unanimity. "However, when others' choice of an alternative reaches 30 percent or so, variety seeking weakens," the authors explain. "Beyond 60 or 70 percent, variety-seeking has been reversed and becomes conformism···When an alternative becomes very dominant (with over 80 to 90 percent of other selecting it), variety-seeking reappears."

*Pascale Quester (University of Adelaide, Australia) and Alexandre Steyer. "Revisiting Individual Choices in Group Settings: The Long and Winding (Less- Traveled) Road." Journal of Consumer Research: April 2010 (will be published online soon).*

## Experimental approach may reverse rheumatoid arthritis and osteoporosis

Researchers have identified a mechanism that may keep a well known signaling molecule from eroding bone and inflaming joints, according to an early study published online today in the Journal of Clinical Investigation.

Bone is continually recycled to maintain its strength through the competing action of osteoclasts, cells that break down aging bone, and osteoblasts, which build new bone. Osteoclasts also play a central role in common diseases that erode bone, where two signaling molecules, TNFα and RANKL, cause too much bone breakdown. Both are known to turn on the nuclear factor kappa B complex (NF-κB), which turns on genes that cause the stem cell precursors of osteoclasts to mature and start eating bone. While both TNF $\alpha$ and RANKL encourage bone loss, the current study argues that TNFα and RANKL have different effects on levels of a key inhibitory protein within the NF-κB pathway called NF-κB p100, with important consequences for drug design.

The NF-κB pathway as a whole signals for more active osteoclasts, but NF-κB p100 (p100) interferes with the ability of that same pathway to pass on the bone loss signal. While both TNFα and RANKL activate NF-κB signaling, RANKL efficiently converts p100 into a form that no longer blocks NF-κB pathway signaling and that leads to bone loss. In contrast, the current study is the first to show that TNFα lets p100 build up. Thus, TNFα both causes bone loss through NF-κB signaling and limits it via p100 accumulation.

Experiments found further that mice genetically engineered to lack NF-κB2p100 suffered more severe joint erosion and inflammation than their normal littermates in the face of TNFα. TNFα, but not RANKL, also increased levels of a protein in osteoclast precursors called TNF receptor-associated factor 3 (TRAF 3), which may help NF-κB p100 block osteoclast formation and inflammation.

"While further studies will be required to confirm and detail this mechanism, our results argue strongly that increasing levels of either TRAF3 or NF-κB p100 could represent a powerful new way to limit bone destruction and inflammation-induced bone loss seen in osteoporosis and rheumatoid arthritis," said Brendan Boyce, M.D., professor within the Department of Pathology and Laboratory Medicine at the University of Rochester Medical Center, and the study's corresponding author. "NF-κB p100 levels may vary with each person's genes, making some more susceptible to TNFα-driven disease. Future solutions may be local delivery of p100 into diseased joints via gene therapy, or to target with a drug the enzyme, NIK, which otherwise limits the p100 supply."

**At the Center of Bone Loss and Inflammation**

Drugs that block the function of TNFα are blockbusters (e.g. Enbrel, Humira and Remicade) because they effectively prevent bone loss and inflammation in most patients with rheumatoid arthritis. They have also been shown to reduce bone loss in women early after menopause. Other studies, however, have suggested that TNFα cannot cause precursor cells to become osteoclasts unless RANKL first "primes" them. The debate has been spirited because it goes to which molecule should be targeted in near-future attempts to design more precise drugs.

The current results show that TNFα can signal for bone loss without RANKL, providing NF-κB p100 is also absent. By engineering mice with neither RANKL nor NF-κB p100, Boyce and colleagues found that TNFα had greatly increased ability to signal for osteoclast maturation and bone loss in this scenario.

Another unexpected result was measured in changes in gene expression, the process by which information encoded in DNA chains is used to build proteins that make up the body's structures and carry it messages. The team found that mice engineered to over-express TNFα, but also to lack NF-κB p100, had significantly increased inflammation in their joints when compared to mice with high TNFα levels, but with p100 present to counter it.

*Along with Boyce, the study was led by Zhenqiang Yao and Lianping Xing in the Department of Pathology and Laboratory Medicine at the University of Rochester Medical Center. The study was funded in part by the National Institutes of Health.*

"We believe NF-κB p100 limits not only osteoclast maturation, but also the number of inflammatory cells attracted to the joints in response to TNFα," Boyce said. "If confirmed, it would mean that p100 has more than one role in more than one major bone disease, and thus would create new opportunities to reverse disease by manipulating p100 levels."

## Cancer Predisposition From Gene Variant Shows Strong Gender Bias

CINCINNATI - Cancer predisposition resulting from the presence of a specific gene variant shows a strong gender bias, researchers at the University of Cincinnati (UC) have demonstrated.

In addition, the research indicates that the risk for development of cancer in individuals harboring the gene variant can be further increased as a result of environmental exposure.

Peter Stambrook, PhD, a professor in the department of molecular genetics, biochemistry and microbiology, and colleagues report their findings this week in Proceedings of the National Academy of Sciences (PNAS). Co-authors include researchers from Wright State University and the Laboratory for Health Protection Research, National Institute of Public Health and the Environment, the Netherlands.

Stambrook says the gene CHEK2 is part of a DNA damage response pathway that can have an impact on whether or not cancers develop. A CHEK2 variant, CHEK2*1100delC, is associated with increased risk of cancer. “Women who carry this particular gene variant are predisposed to developing breast or ovarian cancer,” says Stambrook, “while men have a higher risk of developing prostate cancer.”

Stambrook’s team has produced a mouse model in which the CHEK2 gene was replaced by the variant and found that the overwhelming majority of mice that developed cancer were female - about 80 percent, as opposed to slightly more than 15 percent for males. This contrasts sharply with the incidence of cancer in wild-type mice (those with the normal CHEK2 gene), in which male and female mice developed cancer to about the same extent but at a much lower frequency.

Stambrook says his team will be exploring possible reasons behind the difference, looking at hormonal involvement and possible interactions between the gene variant and estrogen receptors or estrogen itself.

By using a known carcinogen, dimethyl benzanthracene, the researchers also determined that mice that harbor the variant are more susceptible to an environmental challenge than those that don’t. The compound was administered orally to female mice.

“When they delivered the compound, the lifespan of the mice was reduced significantly - they developed breast cancer as well as other types of cancers,” Stambrook says. “In addition, the mice that harbored this variant were more susceptible - in other words, they developed tumors more quickly than wild-type mice.”

Stambrook says that by learning more about the signaling pathway of the CHEK2 gene, researchers can explore ways to “rescue” it and identify potential therapeutic targets. “It’s an interesting gene,” says Stambrook, “and there are a lot of interesting directions that this finding will take us.”

*The work was supported in part by grants from the National Institutes of Health and UC’s Center for Environmental Genetics.*

## Bashed your head? You needed a stiff drink

* 21:00 21 September 2009 **by Andy Coghlan**

Crazy as it sounds, alcohol may one day be given to people with brain injuries to help them recover.

The idea has arisen from a study of 38,000 people with head injuries, which found that those with alcohol in their blood were more likely to survive. For every 100 people who died when stone-cold sober, only 88 died with ethanol – the kind of alcohol in drinks – in their veins.

"The finding raises the intriguing possibility that administering ethanol to patients with brain injuries may improve outcome," conclude the investigators. Lead researcher Ali Salim of the Cedars-Sinai Medical Center in Los Angeles said he hoped a trial could be mounted, but more information is needed first. "We need a better understanding of the exact mechanism, the appropriate dose and specific timing of treatment before we can embark on clinical trials," he told New Scientist.

**Brain teaser**

Salim said that several previous studies have found similar beneficial effects – although others do not. Animal experiments, meanwhile, suggest that relatively low doses of alcohol protect the brain from injury, but high doses increase the risk of death.

More research is also needed to establish how alcohol protects the brain, but Salim says it may work by blunting the amount of adrenalin reaching the brain, which reduces inflammation.

Despite alcohol's potential for helping patients survive brain injury, Salim stressed that it is to blame for half of all injury cases. "Alcohol is and will always continue to be bad, since it contributes to over 40 per cent of traffic-related fatalities," he says. The study also found that drinkers suffered more complications and more severe injuries than non-drinkers, even though the overall survival rate was higher.

**Therapeutic time window**

David Hovda, director of the Brain Injury Research Center at the University of California at Los Angeles, agreed that more research is needed before a clinical trial could take place.

"One would have to know the therapeutic time window and, of course, the dose," he says. "But the mechanisms of action involving the neurobiology of traumatic brain injury have different timeframes and regional profiles which would make ethanol therapy difficult to manage correctly."

Hovda also points out that brain injuries can be very diverse, so ethanol might work for some but not others. "Severity and type really make a difference when deciding on therapeutic options," he says.

*Journal reference: Archives of Surgery, vol 144, p 865*

## A Trillion Triangles

Mathematicians from North America, Europe, Australia, and South America have resolved the first one trillion cases of an ancient mathematics problem. The advance was made possible by a clever technique for multiplying large numbers. The numbers involved are so enormous that if their digits were written out by hand they would stretch to the moon and back. The biggest challenge was that these numbers could not even fit into the main memory of the available computers, so the researchers had to make extensive use of the computers' hard drives.

According to Brian Conrey, Director of the American Institute of Mathematics, "Old problems like this may seem obscure, but they generate a lot of interesting and useful research as people develop new ways to attack them."

The problem, which was first posed more than a thousand years ago, concerns the areas of right-angled triangles. The surprisingly difficult problem is to determine which whole numbers can be the area of a right-angled triangle whose sides are whole numbers or fractions. The area of such a triangle is called a "congruent number." For example, the 3-4-5 right triangle which students see in geometry has area $1/2 \times 3 \times 4 = 6$, so 6 is a congruent number. The smallest congruent number is 5, which is the area of the right triangle with sides 3/2, 20/3, and 41/6.

The first few congruent numbers are 5, 6, 7, 13, 14, 15, 20, and 21. Many congruent numbers were known prior to the new calculation. For example, every number in the sequence 5, 13, 21, 29, 37, ..., is a congruent

number. But other similar looking sequences, like 3, 11, 19, 27, 35, ...., are more mysterious and each number has to be checked individually.

The calculation found 3,148,379,694 of these more mysterious congruent numbers up to a trillion.

**Consequences, and future plans**

Team member Bill Hart noted, "The difficult part was developing a fast general library of computer code for doing these kinds of calculations. Once we had that, it didn't take long to write the specialized program needed for this particular computation." The software used for the calculation is freely available, and anyone with a larger computer can use it to break the team's record or do other similar calculations.

In addition to the practical advances required for this result, the answer also has theoretical implications. According to mathematician Michael Rubinstein from the University of Waterloo, "A few years ago we combined ideas from number theory and physics to predict how congruent numbers behave statistically. I was very pleased to see that our prediction was quite accurate." It was Rubinstein who challenged the team to attempt this calculation. Rubinstein's method predicts around 800 billion of the more mysterious congruent numbers up to a quadrillion, a prediction that could be checked if computers with a sufficiently large hard drive were available.

***Al-Fakhri fi'l-jabr wa'l-muqabala, by al-Karaji.***

**History of the problem**

The congruent number problem was first stated by the Persian mathematician al-Karaji (c.953 - c.1029). His version did not involve triangles, but instead was stated in terms of the square numbers, the numbers that are squares of integers: 1, 4 9, 16, 25, 36, 49, ..., or squares of rational numbers: 25/9, 49/100, 144/25, etc. He asked: for which whole numbers n does there exist a square a2 so that a2-n and a2+n are also squares? When this happens, n is called a congruent number. The name comes from the fact that there are three squares which are congruent modulo n. A major influence on al-Karaji was the Arabic translations of the works of the Greek mathematician Diophantus (c.210 - c.290) who posed similar problems.

A small amount of progress was made in the next thousand years. In 1225, Fibonacci (of "Fibonacci numbers" fame) showed that 5 and 7 were congruent numbers, and he stated, but did not prove, that 1 is not a congruent number. That proof was supplied by Fermat (of "Fermat's last theorem" fame) in 1659. By 1915 the congruent numbers less than 100 had been determined, and in 1952 Kurt Heegner introduced deep mathematical techniques into the subject and proved that all the prime numbers in the sequence 5, 13, 21, 29,... are congruent. But by 1980 there were still cases smaller than 1000 that had not been resolved.

**Modern results**

In 1982 Jerrold Tunnell of Rutgers University made significant progress by exploiting the connection (first used by Heegner) between congruent numbers and elliptic curves, mathematical objects for which there is a well-established theory. He found a simple formula for determining whether or not a number is a congruent number. This allowed the first several thousand cases to be resolved very quickly. One issue is that the complete validity of his formula (therefore also the new computational result) depends on the truth of a particular case of one of the outstanding problems in mathematics known as the Birch and Swinnerton-Dyer Conjecture. That conjecture is one of the seven Millennium Prize Problems posed by the Clay Math Institute with a prize of one million dollars.

**The computations**

Results such as these are sometimes viewed with skepticism because of the complexity of carrying out such a large calculation and the potential for bugs in either the computer or the programming. The researchers took particular care to verify their results, doing the calculation twice, on different computers, using different algorithms, written by two independent groups. The team of Bill Hart (Warwick University, in England) and Gonzalo Tornaria (Universidad de la Republica, in Uruguay) used the computer Selmer at the University of Warwick. Selmer is funded by the Engineering and Physical Sciences Research Council in the UK. Most of their code was written during a workshop at the University of Washington in June 2008.

*The team of Mark Watkins (University of Sydney, in Australia), David Harvey (Courant Institute, NYU, in New York) and Robert Bradshaw (University of Washington, in Seattle) used the computer Sage at the University of Washington. Sage is funded by the National Science Foundation in the US. The team's code was developed during a workshop at the Centro de Ciencias de Benasque Pedro Pascual in Benasque, Spain, in July 2009. Both workshops were supported by the American Institute of Mathematics through a Focused Research Group grant from the National Science Foundation.*

## Targeted heat therapy offers new standard treatment option for soft tissue sarcoma

Berlin, Germany: Patients with soft-tissue sarcomas at high risk of spreading were 30% more likely to be alive and cancer free almost three years after starting treatment if their tumours were heated at the time they received chemotherapy, according to new research. The finding bolsters the case for intensifying exploration of the strategy in other types of cancer.

The study, which found that the addition of the innovative heat technique more than doubled the proportion of patients whose tumours responded to chemotherapy without increasing toxicity, is also the first to show that any treatment other than surgery followed by radiation can prolong survival of this type of patient.

"These findings provide a new standard treatment option and we believe they are likely to change the way many specialists treat these tumours," said the study's leader, Professor Rolf Issels, a professor of medical oncology at Klinikum Grosshadern Medical Center at the University of Munich in Germany, who presented the results today (Tuesday 22 September) in Berlin at Europe's largest cancer congress, ECCO 15 – ESMO 34 [1].

"But the implications of these findings are more far-reaching," Prof Issels said. "This is also the first clear evidence that targeted heat therapy adds to chemotherapy. We expect our findings will encourage other researchers to test the approach in other locally advanced cancers. Targeted heat therapy has already shown promise in recurrent breast and locally advanced cervical cancer in combination with radiation and studies combining it with chemotherapy in other localised tumours such as those in the pancreas and rectum are ongoing."

Soft tissue sarcomas involve cancer that starts in the soft, supporting tissues of the body, such as muscle, fat, blood vessels, nerves, tendons, tissue around the joints and deep layers of the skin. They are relatively rare, accounting for about three percent of all cancers, but are more common in children and young adults. Surgery is the primary treatment, but sometimes these tumours are difficult to remove completely, so they are often also treated with radiotherapy and sometimes chemotherapy. However, in cases where the disease is localised, the benefits of chemotherapy have been shown to be limited. In high-risk patients, any relapse usually occurs within two or three years. Survival varies widely depending on the location and severity of the tumour, with abdominal sarcomas being the most deadly.

The phase III study involved 341 patients being treated at several centres in Europe and the United States between July 1997 and November 2006 for locally advanced soft tissue sarcomas that were at high risk of recurrence and spread. More than half of the tumours were located in the abdomen, while the rest were in the arms and legs. All patients were given chemotherapy before and after surgery and radiotherapy.

Half were randomly given targeted heat treatment along with the chemotherapy. The technique, known as regional hyperthermia, uses focused electromagnetic energy to warm the tissue in and around the tumour to between 40 and 43 degrees Celsius (104 – 109.4 degrees Fahrenheit). The heat not only kills cancer cells, but it also seems to make chemotherapy work better by making cancer cells more sensitive. It also improves blood flow, which allows chemotherapy to be more effective.

After an average follow-up of 34 months, only 153 patients (44.9%) in total had died. The improvement in overall survival was not statistically meaningful when all patients were analysed, but an analysis of the 269 who completed the full treatment of either four cycles of initial chemotherapy alone or four chemotherapy cycles and eight heat treatments found that those who got the heat therapy were 44% less likely to die during the follow-up period than those who got chemotherapy alone.

"The patients receiving the targeted heat therapy fared better on all outcome measurements," Prof Issels said. "Almost three years after starting treatment, they were 42% less likely to experience a recurrence of their cancer at the same site or to die than those who were getting chemotherapy alone, surviving an estimated 120 months before local progression of their disease, compared with an estimated 75 months. Similarly, the average length of time that patients remained disease free was 32 months in the group that got both treatments, compared with 18 months in the group that got chemotherapy alone – an improvement of 30%."

At two years, 76 percent of the patients in the heat therapy group were still alive without local progression of their cancer, compared with 61 percent in the chemotherapy alone group. The proportion of patients who experienced tumour shrinkage rose from 12.7% in the chemotherapy alone group to 28.8%, while the proportion of patients who saw their tumour grow was 6.8% in the heat therapy group, compared with 20% in the chemotherapy alone group.

The most frequent side effect of the heat therapy was mild to moderate discomfort, reported in 45% of patients. The most serious side effect was severe burns, seen in one patient (0.6%). Blisters occurred in 17.8%.

"This strategy has been in development for about 20 years, with about 150 leading groups studying it, but the clear results of this trial show that the field has now matured to the point where we must step up efforts to explore its potential to offer an entirely new way of treating locally advanced disease in several major cancers,"

Prof Issels said. "That will take investment from public funders to underwrite trials that investigate, for instance, whether it will be possible to reduce the dose of chemotherapy drugs by boosting their effectiveness with targeted heat therapy and whether the technique can enhance the effectiveness of newer targeted drugs."

Other questions remaining include whether targeted heat therapy can play a role in stimulating the immune system to more effectively attack cancer, Prof Issels said, adding that studies of heat shock protein therapy indicate that they may activate the immune system against the disease.

*The study was funded by the German cancer foundation Deutsche Krebshilfe and the Helmholtz Association, Germany's largest scientific organisation.*

## New report shows rising tide of fractures in Asia

Gathering data from 14 Asian countries, regions or territories, 'The Asian Audit' is a landmark report examining epidemiology, costs and burden in individual countries as well as collectively across the region.

A new audit report issued by the International Osteoporosis Foundation (IOF) today shows that osteoporosis is a serious and growing problem throughout Asia.

Gathering data from 14 Asian countries, regions or territories, 'The Asian Audit' is a landmark report examining epidemiology, costs and burden in individual countries as well as collectively across the region. The report's key findings include:

**A major increase in fractures is predicted for Asia as a whole**

Already hip fracture incidence has risen 2-to 3-fold in most Asian countries over the past 30 years. Furthermore, it is expected that due to expanding populations and increasing longevity, half of the world's fractures will occur in Asia by 2050.

**The prevalence of osteoporosis and fractures is severely underestimated**

The belief that osteoporosis is rare in Asia as compared to Western countries has been exposed as a myth. Vertebral fractures are as common in Asians as in Caucasian populations, and as in Western countries, very few of these fractures are diagnosed. Over the past four decades the number of hip fractures increased by 300% in Hong Kong, and by 500% in Singapore. In Japan the number of fractures in people over 75 increased dramatically over the span of 12 years. In mainland China, formerly considered a 'low risk' area, almost 70 million people over the age of 50 suffer from osteoporosis, resulting in some 687,000 hip fractures per year.

**Vitamin D deficiency and low calcium intake is widespread**

Widespread vitamin D deficiency and low calcium intake may be in part responsible for the alarming increase in osteoporosis. Nearly all Asian countries outlined in the report are far below the FAO/WHO recommendations for calcium intake ranging from 1000-1300 mg/day for adults. The average dietary calcium intake for the adult Asian population is approximately 450 mg/day.

**Fractures represent a huge personal, social and economic burden**

A cost explosion related to the treatment of fractures has been observed in Asia. In China the average length of hospital stay for a hip fracture is greater than that for breast cancer, ovarian cancer, prostate cancer or heart disease. In Hong Kong, China, it is estimated that the acute hospital care cost of hip fracture may amount to 2% of the total hospital budget.

**Osteoporosis remains a neglected disease, with great urban-rural disparity**

Notwithstanding the burden of fragility fractures, osteoporosis remains greatly under diagnosed and under treated, and both health professional training and public awareness is sub optimal in most countries. With few exceptions, there is a serious lack of solid epidemiological data and research. In addition, DXA technology, considered the gold standard for measurement of bone mineral density, is not widely available or easily accessible in most developing Asian countries. At present most treatments, prevention and education efforts are limited to urban areas, whereas people in rural areas have little knowledge of osteoporosis or access to prevention programs, and diagnostic and treatment facilities. In the most populous countries like China and India, the majority of the population lives in rural areas (60% in China), where hip fractures are often treated conservatively at home instead of surgically in hospitals.

The result: premature death for as many as one in five, immense personal suffering, lost productivity and long-term dependence on family members. Despite the severity of the problem, osteoporosis is being dangerously ignored as it competes with other diseases for scarce healthcare resources and recognition.

Together with local osteoporosis societies in the region, IOF urges immediate government action to prevent the rising tide of fractures which will have a profound socio-economic impact on millions of people and communities throughout Asia.

*The Asian Audit was supported by an unrestricted grant from Fonterra.*

*The Asian Audit: Epidemiology, costs and burden of osteoporosis in Asia 2009 is published by the International Osteoporosis Foundation.*

*Authored by Dr. Ambrish Mithal (India) with Dr Vibha Dhingra (India) and Dr Edith Lau (Hong Kong, China) with contributions from representatives of IOF member societies in People's Republic of China; Hong Kong, China; Taiwan, China; India; Indonesia; Japan; Republic of Korea; Malaysia; Pakistan; Philippines; Thailand; Singapore; Sri Lanka; and Viet Nam. The report can be downloaded free of charge from the IOF website at www.iofbonehealth.org*

## Naked mole rats may help cure cancer

THEY might be bald and ugly, but naked mole rats never get cancer. If their trick can be copied it could help humans resist cancer too.

It's almost impossible to culture naked mole rat cells in the lab, which made Andrei Seluanov and Vera Gorbunova from Rochester University, New York, wonder if this might be linked to their ability to resist cancer.

They found that a dilute solution of naked mole rat skin cells did start to proliferate, but stopped once the cells reached a certain, relatively low density. Such "contact inhibition" is also used by human cells to inhibit growth, but cancer bypasses this mechanism so cells keep growing.

The researchers also found that contact inhibition in naked mole rats is controlled by two genes, p16 and p27, while in humans it is primarily controlled by p27. "Naked mole rats have an additional barrier in the way of tumour progression," says Seluanov, who presented the results at the Strategies for Engineered Negligible Senescence meeting in Cambridge, UK, last week. If this check could be stimulated in humans, it could halt the growth of cancerous tumours.

**Really?**

## The Claim: Lack of Sleep Increases the Risk of Catching a Cold.

**By ANAHAD O'CONNOR**

**THE FACTS** As cold season approaches, many Americans stock up on their vitamin C and echinacea. But heeding the age-old advice about catching up on sleep might be more important.

**Leif Parsons**

Studies have demonstrated that poor sleep and susceptibility to colds go hand in hand, and scientists think it could be a reflection of the role sleep plays in maintaining the body's defenses.

In a recent study for The Archives of Internal Medicine, scientists followed 153 men and women for two weeks, keeping track of their quality and duration of sleep. Then, during a five-day period, they quarantined the subjects and exposed them to cold viruses. Those who slept an average of fewer than seven hours a night, it turned out, were three times as likely to get sick as those who averaged at least eight hours.

Sleep and immunity, it seems, are tightly linked. Studies have found that mammals that require the most sleep also produce greater levels of disease-fighting white blood cells - but not red blood cells, even though both are produced in bone marrow and stem from the same precursor. And researchers at the Max Planck Institute for Evolutionary Anthropology have shown that species that sleep more have greater resistance against pathogens.

"Species that have evolved longer sleep durations," the Planck scientists wrote, "appear to be able to increase investment in their immune systems and be better protected."

**THE BOTTOM LINE** Research suggests that poor sleep can increase susceptibility to colds.

## Killer fungus breaks chemical stalemate

* 10:14 22 September 2009 **by Debora MacKenzie**

A killer fungus may break the chemical stalemate that is hampering anti-malaria efforts.

Mosquitoes that carry malaria are becoming increasingly resistant to insecticides. In theory, spraying two different types of insecticide at once postpones resistance, as bugs that resist one type are killed by the other. But so far, this strategy hasn't worked as the enzymes mosquitoes use to disable one class of chemicals tend to cripple other classes too.

Entomologist Bart Knols and colleagues at Wageningen University in the Netherlands wondered if the same problem would mean insecticide-resistant mosquitoes would be able to fend off a fungus. This was not the case: the fungus killed mosquitoes resistant to the three classes of chemicals commonly used in Africa.

"As a bonus," Knols says, "fungal infection makes insects that resist pyrethroids susceptible again." Fungal infection might weaken the insect and its resistance mechanisms. In addition, a smaller dose of chemicals will kill fungi-infected mosquitoes, good news as one of the chemicals is DDT, which persists in the environment.

*Journal reference: Proceedings of the National Academy of Sciences, DOI: 10.1073/pnas.0908530106 (in press)*

## Tie to Pets Has Germ Jumping to and Fro

**By BRENDA GOODMAN**

For decades, the drug-resistant germ called MRSA was almost exclusively a concern of humans, usually in hospitals and other health care settings. But in recent years, the germ has become a growing problem for veterinarians, with an increasing number of infections turning up in birds, cats, dogs, horses, pigs, rabbits and rodents. And that, infectious-disease experts say, is becoming a hazard to humans who own or spend time with

these animals. “What’s happened for the first time that we’ve noticed is that you’re getting flip back and forth,” said Scott Shaw, head of the infection control committee at the Cummings School of Veterinary Medicine at Tufts University.

It is unknown how often pets play a role in human infections by methicillin-resistant Staphylococcus aureus and vice versa; physicians and veterinarians do not routinely trace such infections to their source. When such scientific sleuthing is conducted, however - usually in the case of multiple or recurring infections - the results suggest a strong link. In 2008, for example, an elephant calf and 20 of its caretakers at the San Diego Zoo contracted MRSA skin infections. An investigation by the zoo and state health officials determined that the calf, which was eventually euthanized, had probably been infected by a keeper who unknowingly carried the bacteria. (The case was reported in The Morbidity and Mortality Weekly Report.)

Still, experts are not recommending routine testing of pets and their humans. Instead, they call for the same kinds of precautions that apply to other pathogens, especially frequent washing or sanitizing of hands before and after playing with a pet.

The first cases of MRSA in pets, about five years ago, appeared to be in therapy dogs and other animals exposed to patients or health care workers. Those animals are still thought to be at greatest risk, but the pattern might be changing.

In a study this summer in The American Journal of Infection Control, Elizabeth A. Scott and her colleagues at the Center for Hygiene and Health in Home and Community at Simmons College in Boston swabbed household surfaces like kitchen and bathtub drains, faucet handles, toilets, high chairs, trash cans and kitchen sponges at 35 randomly selected addresses to see what germs they would find. They found MRSA in nearly half of the homes they sampled. When they tried to figure out what might make it more likely to have the bacteria at home, they ruled out many supposed risk factors, including working out at a gym, having children who attended day care, having a recent infection or recent antibiotic use, and even working in a health care facility.

The one variable that overwhelmingly predicted the presence of the germ was the presence of a cat. Cat owners were eight times more likely than others to have MRSA at home. “There are a number of papers coming out now showing that pets pick up MRSA from us,” Dr. Scott said, “and that they shed it back into the environment again.”

Dr. Scott’s next study will screen patients scheduled for elective surgeries. When she finds MRSA, she will also test their pets to determine how common that transmission might be.

“This is a burgeoning epidemic,” said Dr. Richard L. Oehler, an infectious disease specialist at the University of South Florida College of Medicine in Tampa, who reviewed case reports of MRSA’s jumping between people and animals. Dr. Oehler’s paper appeared in July in The Lancet. Dr. Oehler recounted the case of a diabetic man with recurrent MRSA skin infections that were eventually traced to his dog, a Dalmatian who carried the bacteria but was not ill. “He would sleep with the couple in the bed and lick them in the face,” said Dr. Farrin A. Manian, chief of infectious diseases at St. John’s Mercy Medical Center in St. Louis.

Dr. Manian believes the dog was infected by its owner, but then served as a reservoir for the bacteria, reinfecting his patient. “Only after we treated all three members of the family were we able to get rid of the infections,” Dr. Manian said.

Then there was the case of the 15-year-old girl and her calico cat; both developed MRSA infections. DNA fingerprinting confirmed that the bacteria in wounds on the girl’s arm and near the cat’s tail were the same.

J. Scott Weese, a veterinary internist and microbiologist at the University of Guelph in Ontario, believes MRSA infections transmitted between people and animals are relatively rare.

His tests of randomly selected dogs, for example, have shown that at any given time only 2 to 3 percent carry MRSA on their fur or skin or in their saliva. And even if a pet becomes colonized, meaning that the bacteria take up residence and reproduce, veterinarians say most healthy animals should be rid of it in a matter of weeks.

For protection, Dr. Oehler recommends hand washing or using hand gels before and after playing with a pet, not letting a pet lick people around the face, and not washing pet food or water bowls in the same sink that food is prepared. People should also wear gloves when attending to pets that have open wounds, he said, and should keep any of their own broken skin bandaged.

And Dr. Oehler advised owners to be more attentive to their pets’ health in general. “In many of these cases, there was a lack of awareness that the animal was ill,” he said. “If a pet has a wound, they need that evaluated.”

Dr. Weese, who estimated that relatively few animals were infected, nevertheless agreed that attentiveness was in order. “In the grand scheme of things with MRSA, pets are a pretty minor thing,” he said. “But when you consider how many MRSA infections are occurring in North America at the moment, if they’re a minor component of a major disease, that’s still something we need to be aware of.”

And pets may pose a particular hazard because their relationships with people can be very close.

“If you think about the individuals with whom you have the closest contact in terms of duration, intensity, intimacy, in most people, it’s going to be the spouse, then small children, then pets,” Dr. Weese said. “For some people, pets are No. 1 on the list.”

## New research provides new insight into age-related muscle decline

***Research published in the journal Genetics suggests new ways to stop byproducts from the air we breathe from harming our muscles***

If you think the air outside is polluted, a new research report in the September 2009 issue of the journal Genetics (http://www.genetics.org) might make you to think twice about the air inside our bodies too. That's because researchers show how about 3 percent of the air we breathe gets converted into harmful superoxides, which ultimately harm our muscles. Specifically, these superoxides lead to the creation of a toxic molecule called "reactive oxygen species" or ROS, which is shown to be particularly harmful to muscle tissue, and may lead to problems ranging from aging and frailty to Parkinson's disease and cancer.

"At a minimum, we hope this research leads to new ways of addressing inevitable declining physical performance and other age-dependent infirmities among the elderly," said Atanu Duttaroy, associate professor of biology at Howard University in Washington, D.C. and one of the researchers involved in the work.

To make their discovery, Duttaroy and colleagues built on their previous research showing that ROS-induced cellular damage happens in the same way in fruit flies and in mice. They started with fruit flies that lack mitochondrial superoxide dismutase enzyme (SOD), which provides the primary line of defense against ROS by capturing the superoxides and converting them to water. This lack of SOD caused the fruit flies to die within a day after hatching. Then, through genetic manipulation, the researchers "turned on" the production of SOD separately in nerves and muscles. SOD in nerves did not appear to make a significant difference in prolonging the fruit flies' lives, but it did make a difference when it was activated in their muscles. The survival of fruit flies with SOD "turned on" in their muscles increased, and for several days, they remained as active as their normal counterparts. Measurement of their muscle activity also showed that SOD helped the muscle work normally, helping survival.

"It's long been known that the oxygen we breath can be toxic, and this work provides a concrete example of that with real consequences." said Mark Johnston, Editor-in-Chief of the journal Genetics. "As baby boomers get older, the need to help older people stay mobile and fit has never been greater in our lifetimes. This study helps address this need by providing insight into what causes physical decline, and in turn, bringing us a step closer toward finding ways to stop or reverse it."

*DETAILS: Tanja Godenschwege, Renée Forde, Claudette P. Davis, Anirban Paul, Kristopher Beckwith, and Atanu Duttaroy Mitochondrial Superoxide Radicals Differentially Affect Muscle Activity and Neural Function Genetics 2009 183: 175-184. http://www.genetics.org/cgi/content/abstract/183/1/175*

## Stem cell hope for childhood motor neuron disease

* 22:00 22 September 2009 **by Andy Coghlan**

A form of motor neuron disease that affects children has been treated in mice with injections of stem cells into the spinal cord. The treatment extended the lives of the mice beyond and kept them more mobile, giving hope that similar approaches might help people.

The treated mice were bred to have a form of motor neuron disease called spinal muscular atrophy with respiratory distress type 1, or SMARD 1, which affects 1 or 2 in every 100,000 children.

Diaphragms of infant children with the disease stop working, so they need mechanical ventilators to stay alive. Nerves in muscles of the extremities are also affected, gradually limiting movement of hands and feet.

"At present there is no cure for this disorder, besides ventilation and prevention of infections," says Giacomo Comi of the University of Milan, Italy, who led the research.

**Healthy glow**

For reasons not yet understood, cells in the spinal cords of children with the disease rapidly die. So Comi extracted stem cells that grow into neurons from the spinal cords of mouse embryos. The cells were normal except that they had been genetically engineered to make green fluorescent protein, a substance from jellyfish that glows bright green under ultraviolet light. This enabled the researchers to see what happened to the 10,000 cells transplanted into the spinal cords of each mouse with the mouse form of SMARD1.

The results show that the mice treated with the cells alone lived 30 per cent longer than untreated mice. Untreated mice lost 60 per cent of their neurons during the experiment, but cell-treated rats gained neurons, with donated cells and increased numbers of native neurons each making up a quarter of the total.

The results were even better in a group of mice that received the stem cells plus a cocktail of drugs to help neurons grow and develop axons, so forming connections with muscles. They lived 40 per cent longer than the controls, with donated and new native cells each making up a third of the total number of neurons.

The treated mice also retained the mobility that untreated mice began to lose rapidly at around 5 weeks of life. By week eight, both sets of treated rats could still perform the "rotorod" test, a standard test of mobility similar to a human treadmill, except that the mice place their front paws on a revolving drum.

**From mouse to child**

"For the first time in an animal model of a human motor neuron disease, there was functional restoration opening up new possibilities for therapeutic interventions with transplanted motor neurons," says Comi.

"This is very promising work," says Brian Dickie, director of research at the British Motor Neurone Disease Association. "Not only have the researchers managed to direct transplanted motor neurons to connect with their target muscles in appreciable numbers, but they've also been able to demonstrate an improvement in motor function and survival," he says.

But Dickie warned that there's a world of difference between treating mice and humans. "Establishing new neuromuscular connections over distances of a couple of centimetres in a young mouse is very different from attempting the same in human motor neuron diseases, especially in adults where the transplanted neurons may have to grow up to a metre to reach their target," he says. "That is a substantial hurdle that we still need to overcome."

Comi agreed that there are many hurdles ahead, including selection of the most suitable type of cell for treating humans. "At the moment, we're not planning to start a trial," he said. But hopes are also arising from stem cell successes in treating other neurodegenerative diseases, such as multiple sclerosis in people and memory loss in mice. *Journal reference: The Journal of Neuroscience, DOI: 10.1523/jneurosci.2734-09.2009*

## Found: 62 meteor showers new to science

* 02:35 23 September 2009 **by Jeff Hecht**

Every now and again, biologists turn up a bonanza of new species deep in the ocean or in remote corners of the Earth. But astronomers usually have to make do with a trickle of new discoveries, spotting a rare supernova here or a couple of backwards planets there.

Now, researchers in Canada report finding an incredible 62 new meteor showers, displays of 'shooting stars' that recur every year when Earth passes through the trail of debris left behind by a comet or asteroid.

"I was surprised to find so many new ones," says team leader Peter Brown of the University of Western Ontario.

He credits the wealth of discoveries to the nature of his survey, which detects incoming debris about 10 times as small as can generally be seen by eye, catching objects about 0.1 millimetres across. The survey, based near London, Ontario, uses radar to detect the trail of ionised gases produced as the debris particles slam into the atmosphere at blistering speeds.

**Established meteor showers** **Sorting order:** IAU No | Sol. Lon. | R.A.

| No | Name | No | Name | No | Name |
|---|---|---|---|---|---|
| 1 | alpha Capricornids | 61 | tau Herculids | 208 | Sept. epsilon Perseids |
| 2 | South. Taurids | 63 | Corvids | 212 | Dayt. kappa Leonids |
| 3 | South. iota Aquariids | 102 | alpha Centaurids | 221 | Dayt. Sextantids |
| 4 | Geminids | 110 | alpha Antliids | 233 | October Capricornids |
| 5 | South. delta Aquariids | 137 | pi Puppids | 246 | alpha Monocerotids |
| 6 | April Lyrids | 144 | Dayt. April Piscids | 250 | Nov. Orionids |
| 7 | Perseids | 145 | eta Lyrids | 254 | Phoenicids |
| 8 | Orionids | 152 | North. Dayt. omega Cetids | 281 | October Camelopardalids |
| 9 | October Draconids | 153 | South. Dayt. omega Cetids | 319 | January Leonids |
| 10 | Quadrantids | 156 | South. Dayt. May Arietids | 320 | omega Serpentids |
| 12 | kappa Cygnids | 164 | North. June Aquilids | 321 | theta Coronae Borealids |
| 13 | Leonids | 165 | South. June Aquilids | 322 | lambda Bootids |
| 15 | Ursids | 170 | June Bootids | 323 | xi Coronae Borealids |
| 16 | sigma Hydrids | 171 | Dayt. Arietids | 324 | epsilon Perseids |
| 17 | North. Taurids | 172 | Dayt. zeta Perseids | 325 | Dayt. lambda Taurids |
| 18 | Andromedids | 173 | Dayt. beta Taurids | 326 | epsilon Pegasids |
| 19 | Dec. Monocerotids | 183 | Piscis Austrinids | 327 | beta Equuleids |
| 20 | Dec. Comae Berenicids | 187 | psi Cassiopeiids | 328 | alpha Lacertids |
| 22 | Leonis Minorids | 188 | Dayt. xi Orionids | 330 | sigma Serpentids |
| 27 | kappa Serpentids | 191 | eta Eridanids | 331 | alpha Hydrids |
| 31 | eta Aquariids | 198 | beta Hydrusids | | |
| 33 | North. iota Aquariids | 206 | Aurigids | | |

***On the whole:*** *64 showers.*

The survey measures the paths of the debris particles, allowing researchers to trace their orbits around the sun – and potentially track down their parent bodies. "The central reason for looking at these streams is to trace them back to their origins," Brown told New Scientist.

**'Archaeological record'**

Over seven years of observations, the project has identified 117 annual meteor showers, of which 62 have never been reported before.

Interestingly, the team found that about half of the 117 observed streams follow orbits similar to those from other meteor showers. That bolsters previous research suggesting that the parent objects – mostly comets – likely broke up into smaller bodies that also shed debris trails – a break-up process that can occur over and over.

"In some cases, we can still trace [the trails] back to some parent objects; in others, we can't see an obvious parent," says Brown. For example, his team found half a dozen streams linked to Comet Encke, the parent body of the well-known Taurid meteor shower.

The 62 newly proposed showers join nearly 300 others that are awaiting confirmation by the International Astronomical Union (IAU), which to date has officially recognised 64 meteor showers.

Peter Jenniskens of the SETI Institute in California, who heads up the IAU group tasked with naming meteor showers, says the new finds will be a boon to science: "Each shower is an archaeological record of some comet's past activity."

## Private umbilical cord banking not cost-effective, UCSF research shows

Private cord blood banking is not cost-effective because it costs an additional $1,374,246 per life-year gained, according to a new analysis by UCSF researchers. The research team also concluded that private cord blood banking is cost-effective only for families with a child with a very high likelihood of needing a stem cell transplant.

The researchers used a technique called decision analysis that tracks hypothetical groups of people and allows comparison of expected costs and health benefits of two alternative strategies (in this case, private cord blood banking versus no cord blood banking). Results of the study appear in the October 2009 issue of the journal “Obstetrics & Gynecology.”

Cord blood is collected from the umbilical cord shortly after a baby’s birth and has the potential to treat a variety of medical conditions ranging from leukemia to metabolic disorders to cerebral palsy. Public cord blood banks store cord blood at no cost and make the blood available to anyone needing treatment, or for research purposes. Private cord banks charge a fee to store a baby’s cord blood for his/her own possible future use or for a family member’s possible future use.

“While there are plausible medical advantages of umbilical cord blood stem cells, many of these benefits are primarily theoretical at this point,” said Aaron Caughey, MD, PhD, co-author of the paper, a UCSF associate professor of obstetrics, gynecology and reproductive sciences, and director of the UCSF Center for Clinical and Policy Perinatal Research. “Expectant parents need to understand the true likelihood of their family benefitting from private cord blood banking in order to make an informed decision about this expensive process.”

Private umbilical cord blood banking companies in the United States market directly to consumers, at times describing cord blood as a “biologic insurance” for their unborn child, the researchers note. However, a survey of private cord blood banks by the American Society for Blood and Marrow Transplantation found that of the approximately 460,000 cord blood units banked, only 99 were confirmed as being shipped for use in treatment.

The decision-analytic model used by the research team included four baseline assumptions: a cost of $3,620, the lowest price quoted from major blood banking company web sites, for umbilical cord blood banking and storage for 20 years; a .04 percent chance of requiring an autologous (self) or stem cell transplant; a .07 percent chance of a sibling requiring an allogenic (from another person) stem cell transplant; and a 50 percent reduction in risk of graft-versus-host disease if a sibling receives a transplant of banked umbilical cord blood cells. The UCSF team concluded that if the cost of umbilical cord blood banking is less than $262 or the likelihood of a child needing a stem cell transplant is greater than one out of 110, then private umbilical cord blood banking becomes cost-effective.

The American Academy of Pediatrics (AAP) encourages cord blood donation when the cord blood is stored in a bank for public use and discourages storing cord blood as “biological insurance” because there currently are no scientific data to support autologous transplantation. The AAP does encourage private cord blood banking when there is knowledge of a full sibling in the family with a medical condition (malignant or genetic) who potentially could benefit from cord blood transplantation.

“The discrepancy between the benefits of private cord blood banking perceived by families and the lack of benefit seen in this analysis, and in the opinions of professional societies, has important implications for how doctors counsel patients,” said Anjali Kaimal, MD, MAS, lead author of the study and a recent graduate of the

UCSF Maternal-Fetal Medicine fellowship which is directed by Caughey. Kaimal's work on the study was done while at UCSF; she currently is a physician at Massachusetts General Hospital.

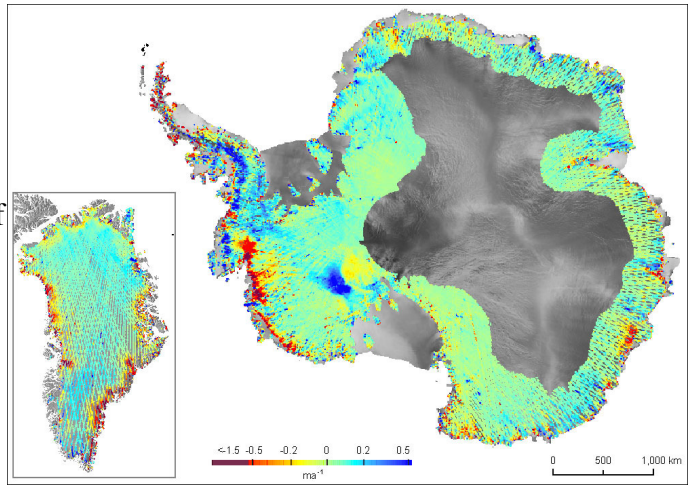
*Co-authors of the study are Catherine Smith, MD; Russell K. Laros, Jr, MD; and Yvonne W. Cheng, MD, MPH, all from UCSF. Caughey's work is supported in part by a grant from the Robert Wood Johnson Foundation Physician Faculty Scholars Program.*

## Lasers from space show thinning of Greenland and Antarctic ice sheets

The most comprehensive picture of the rapidly thinning glaciers along the coastline of both the Antarctic and Greenland ice sheets has been created using satellite lasers. The findings are an important step forward in the quest to make more accurate predictions for future sea level rise.

Reporting this week in the journal Nature researchers from British Antarctic Survey and the University of Bristol describe how analysis of millions of NASA satellite measurements* from both of these vast ice sheets shows that the most profound ice loss is a result of glaciers speeding up where they flow into the sea.

The authors conclude that this 'dynamic thinning' of glaciers now reaches all latitudes in Greenland, has intensified on key Antarctic coastlines, is penetrating far into the ice sheets' interior and is spreading as ice shelves thin by ocean-driven melt. Ice shelf collapse has triggered particularly strong thinning that has endured for decades.




***New comprehensive maps of Greenland and Antarctica show extent of glacier thinning* - copyright ICESat, NASA**

Lead author Dr Hamish Pritchard from British Antarctic Survey (BAS) says, "We were surprised to see such a strong pattern of thinning glaciers across such large areas of coastline - it's widespread and in some cases thinning extends hundreds of kilometres inland. We think that warm ocean currents reaching the coast and melting the glacier front is the most likely cause of faster glacier flow. This kind of ice loss is so poorly understood that it remains the most unpredictable part of future sea level rise."

The scientists compared the rates of change in elevation of both fast-flowing and slow-flowing ice. In Greenland for example they studied 111 fast-moving glaciers and found 81 thinning at rates twice that of slow-flowing ice at the same altitude. They found that ice loss from many glaciers in both Antarctica and Greenland is greater than the rate of snowfall further inland.

In Antarctica some of the fastest thinning glaciers are in West Antarctica (Amundsen Sea Embayment) where Pine Island Glacier and neighbouring Smith and Thwaites Glacier are thinning by up to 9 metres per year.

## New research reveals the ancestral populations of India and their relationships to modern groups

### *International effort is the first genome-scale analysis of diverse Indian groups*

In a study published in the September 24th issue of Nature, an international team describes how they harnessed modern genomic technology to explore the ancient history of India, the world's second most populous nation.

The new research reveals that nearly all Indians carry genomic contributions from two distinct ancestral populations. Following this ancient mixture, many groups experienced periods of genetic isolation from each other for thousands of years. The study, which has medical implications for people of Indian descent, was led by scientists at the Centre for Cellular and Molecular Biology (CCMB) in Hyderabad, India together with US researchers at Harvard Medical School, the Harvard School of Public Health and the Broad Institute of Harvard and MIT.

"This work is an outstanding example of the power of international collaboration," said Lalji Singh, senior author of the Nature paper, who is a Bhatnagar Fellow and the former director of CCMB. "Scientists in India and the United States have together made discoveries that would have been impossible for either group working alone."

Although the genome sequences of any two unrelated people differ by just 0.1%, that tiny slice of genetic material is a rich source of information. It provides clues that can help reconstruct the historical origins of modern populations. It also points to genetic variations that heighten the risk of certain diseases. In recent years, maps of human genetic variation have opened a window onto the diversity of populations across the world, yet India has been largely unrepresented until now.

To shed light on genetic variability across the Indian subcontinent, the research team analyzed more than 500,000 genetic markers across the genomes of 132 individuals from 25 diverse groups, representing 13 states, all six language families, traditionally "upper" and "lower" castes, and tribal groups.

These genomic analyses revealed two ancestral populations. "Different Indian groups have inherited forty to eighty percent of their ancestry from a population that we call the Ancestral North Indians who are related to western Eurasians, and the rest from the Ancestral South Indians, who are not related to any group outside India," said co-author David Reich, an associate professor of genetics at Harvard Medical School and an associate member of the Broad Institute of Harvard and MIT.

The finding that nearly all Indian groups descend from mixtures of two ancestral populations applies to traditional "tribes" as well as "castes." Kumarasamy Thangaraj, a senior research scientist at CCMB in Hyderabad and a co-author said, "It is impossible to distinguish castes from tribes using the data. The genetics proves that they are not systematically different. This supports the view that castes grew directly out of tribal-like organizations during the formation of Indian society."

The one exception to the finding that all Indian groups are mixed is the indigenous people of the Andaman Islands, an archipelago in the Indian Ocean with a census of only a few hundred today. The Andamanese appear to be related exclusively to the Ancestral South Indian lineage and therefore lack Ancestral North Indian ancestry.

"The Andamanese are unique," said co-author Nick Patterson, a mathematician and researcher at the Broad Institute. "Understanding their origins provides a window onto the history of the Ancestral South Indians, and the period tens of thousands of years ago when they diverged from other Eurasians." Added Singh, "Our project to sample the disappearing tribes of the Andaman Islands has been more successful than we could have hoped, as the Andamanese are the only surviving remnant of the ancient colonizers of South Asia."


***A map showing the groups across India included in the Nature study.*** **Photo courtesy of D. Reich, K. Thangaraj, N. Patterson, A. Price and L. Singh**

The researchers' work also has surprising and important medical implications. They discovered that many groups in modern India descend from a small number of founding individuals, and have since been genetically isolated from other groups. In scientific parlance this is called a "founder event."

"The finding that a large proportion of modern Indians descend from founder events means that India is genetically not a single large population, but instead is best described as many smaller isolated populations," said Singh. Thangaraj continued, "The widespread history of founder events helps explain why the incidence of genetic diseases among Indians is different from the rest of the world."

Founder events in other groups, such as Finns and Ashkenazi Jews, are well known to increase the incidence of recessive genetic diseases, and the new study predicts that the same will be true for many groups in India. "It is important to carry out a systematic survey of Indian groups to identify which ones descend from the strongest founder events," said Reich. "Further studies of these groups should lead to the rapid discovery of genes that cause devastating diseases, and will help in the clinical care of individuals and their families who are at risk."

"Just as important as these findings are the statistical approaches that led to them," said Alkes Price, an assistant professor of epidemiology at the Harvard School of Public Health and a co-author of the Nature study. "In studying Indian genetic variation we also developed a novel toolkit for understanding the relationships among groups and the history of mixture. We believe that these tools can drive future studies not only of Indian history but of groups worldwide."

*Paper cited: Reich D, Thangaraj K, Patterson N, Price AL, Singh L (2009) Reconstructing Indian population history. Nature DOI:10.1038/nature08365*

## Ratchet-like genetic mutations make evolution irreversible

***By resurrecting ancient proteins, University of Oregon researchers find that evolution can only go forward***

A University of Oregon research team has found that evolution can never go backwards, because the paths to the genes once present in our ancestors are forever blocked. The findings -- the result of the first rigorous study of reverse evolution at the molecular level -- appear in the Sept. 24 issue of Nature.

The team used computational reconstruction of ancestral gene sequences, DNA synthesis, protein engineering and X-ray crystallography to resurrect and manipulate the gene for a key hormone receptor as it existed in our earliest vertebrate ancestors more than 400 million years ago. They found that over a rapid period of time, five random mutations made subtle modifications in the protein's structure that were utterly incompatible with the receptor's primordial form.

The discovery of evolutionary bridge burning implies that today's versions of life on Earth may be neither ideal nor inevitable, said Joe Thornton, a professor in the UO's Center for Ecology and Evolutionary Biology and the Howard Hughes Medical Institute.

"Evolutionary biologists have long been fascinated by whether evolution can go backwards," Thornton said, "but the issue has remained unresolved because we seldom know exactly what features our ancestors had, or the mechanisms by which they evolved into their modern forms. We solved those problems by studying the problem at the molecular level, where we can resurrect ancestral proteins as they existed long ago and use molecular manipulations to dissect the evolutionary process in both forward and reverse directions."

Thornton's team, which included UO research scientist Jamie Bridgham and collaborator Eric A. Ortlund, a biochemist at Atlanta's Emory University, focused on the evolution of a protein called the glucocorticoid receptor (GR), which binds the hormone cortisol and regulates the stress response, immunity, metabolism and behavior in humans and other vertebrates.

"This fascinating study highlights the value of studying evolutionary processes," said Irene Eckstrand, who oversees evolution grants at the National Institutes of Health's National Institute of General Medical Sciences. "By showing how molecular structures are finely tuned by evolution, Dr. Thornton's research will have a broad impact on basic and applied sciences, including the design of drugs that target specific proteins."

In previous work, Thornton's group showed that the first GR evolved more than 400 millions ago from an ancestral protein that was also sensitive to the hormone aldosterone. They then identified seven ancient mutations that together caused the receptor to evolve its new specificity for cortisol.

Once Thornton's team knew how the GR's modern function evolved, they wondered if it could be returned to its ancestral function. So they resurrected the GR as it existed soon after cortisol specificity first evolved - in the common ancestor of humans and all other vertebrates with bones - and then reversed the seven key mutations by manipulating its DNA sequence.

'We expected to get a promiscuous receptor just like the GR's ancestor, but instead we got a completely dead, non-functional protein," Thornton said. "Apparently other mutations that occurred during early GR evolution acted as a sort of evolutionary ratchet, rendering the protein unable to tolerate the ancestral features that had existed just a short time earlier."

To identify the mutations, Thornton's team prepared crystals of resurrected ancient GR proteins and took them to the particle accelerator at the Advanced Photon Source outside Chicago, where they used powerful X-rays to determine the protein's atomic structure before and after the shift in function. By comparing the precise atomic maps of each protein, they identified five specific mutations in the later version of the GR that clashed with the architecture of the earlier protein.

"Suppose you're redecorating your bedroom - first you move the bed, then you put the dresser where the bed used to be," Thornton said. "If you decide you want to move the bed back, you can't do it unless you get that dresser out of the way first. The restrictive mutations in the GR prevented evolutionary reversal in the same way." When Thornton's group set the five mutations back to their ancestral state, the protein could now tolerate having the seven key changes reversed, which then transformed it into a promiscuous receptor just like the its ancestor.

Despite their powerful role as a ratchet preventing reversal, the five restrictive mutations had little or no direct effect on the protein's function when they occurred. And although they must be reversed before the protein can tolerate the ancestral state, reversing them first does absolutely nothing to enhance the ancestral function. "This means that even if the ancestral function were suddenly to become optimal again, there's no way natural selection could drive the protein directly back to its ancestral form," Thornton said.

GR's evolutionary irreversibility suggests that the molecules that drive our biology today may not be inevitable products of the evolutionary process. "In the GR's case, restrictive mutations erased the conditions

that previously opened up the ancestral form as an evolutionary possibility. It's likely that throughout history other kinds of restrictive mutations have taken place, closing off innumerable trajectories that evolution might otherwise have taken," Thornton speculated.

"If we could wind back the clock and allow history to unfold again, different sets of mutations, apparently inconsequential at the time, would almost certainly occur, opening up some potential paths and blocking others - including the one that leads to the present that actually evolved in our world," he said. "If what we observed in GR evolution is a general phenomenon, then the biology we have is just one of many possible rolls of the evolutionary dice."

*The National Institutes of Health, the National Science Foundation and the Howard Hughes Medical Institute supported the research.*

## Study reveals 2/3 of prostate cancer patients do not need treatment

In the largest study of its kind, the international team of pathologists studied an initial 4,000 prostate cancer patients over a period of 15 years to further understanding into the natural progression of the disease and how it should be managed. The research, published in the British Journal of Cancer, could be used to develop a blood test to distinguish between aggressive and non-aggressive forms of prostate cancer.

Globally, prostate cancer is the fifth most common malignancy and accounts for 13% of male deaths in the UK. Studies have shown that men with non-aggressive prostate cancer can live with the disease untreated for many years, but aggressive cancer requires immediate treatment.

Pathologists found that the presence of a protein, called Hsp-27, in cancer cells was an indicator that the disease will progress and require treatment. The study showed, however, that in more than 60% of cases the protein was not expressed and the cancer could be managed by careful monitoring, rather than with active invention methods, such as drug treatment or surgery.

The protein normally has a positive function in the body, helping healthy cells survive when they are placed under 'stressful' conditions, such as disease or injury. If the protein is expressed in cancer, however, it can prevent the diseased cells from dying, allowing the cancer to progress. The team, supported by Cancer Research UK (CRUK) and in collaboration with scientists in London and New York, found that the protein can be used to predict how the disease will behave and could help doctors advise patients on how the disease could affect their daily lives.

Professor Chris Foster, Head of the University's Division of Pathology, explains: "Cancer of any kind is a very distressing disease and has the ability to impact on every aspect of a person's life. Chemotherapy and surgery can also have a significant effect on health and wellbeing and that is why it is important that we first understand the biological nature of the disease and how it will behave in each individual patient, before determining if and when a person needs a particular type of treatment.

"By studying the disease in a large number of men throughout the UK and over a long period of time, we have been able to get a more complete picture of how to manage the disease successfully, whilst limiting the negative impact it can have on a patient's life. The study also demonstrates the role of modern of Pathology, not only in establishing diagnoses but in determining if the subsequent management of individual patients is biologically appropriate for their particular condition.

"The protein – or biomarker – we have identified provides us with a signal that the disease will continue to progress. We know that at the point this marker is expressed, medics need to administer treatment to kill the cancer cells. We have shown that in the majority of cases, however, this marker is not expressed and therefore patients do not necessarily need to go through treatment to lead a normal life."

## Saying sorry really does cost nothing

Economists have finally proved what most of us have suspected for a long time – when it comes to apologising, talk is cheap. According to new research, firms that simply say sorry to disgruntled customers fare better than those that offer financial compensation. The ploy works even though the recipient of the apology seldom gets it from the person who made it necessary in the first place.

The study was carried out by the Nottingham School of Economics' Centre for Decision Research and Experimental Economics.

Academics set out to show whether customers who have been let down continue to do business after being offered an apology. They found people are more than twice as likely to forgive a company that says sorry than one that instead offers them cash.

NSE research fellow and study co-author Dr Johannes Abeler said the results proved apologies were both powerful and cheap. He said: "We know firms often employ professional apologists whose job is to say sorry to customers who have a grievance.

"You might think that if the apology is costless then customers would ignore it as nothing but cheap talk - which is what it is. But this research shows apologies really do influence customers' behaviour – surprisingly, much more so than a cash sweetener.

"People don't seem to realise they're dealing with an expert apologist rather than an individual who feels genuine shame. "It might be that saying sorry triggers in the customer an instinct to forgive – an instinct that's hard to overcome rationally."

Researchers worked with a firm responsible for around 10,000 sales a month on eBay, controlling its reaction to neutral or negative feedback. Some customers were offered an apology in return for withdrawing their comments, while others were offered €2.5 or €5.

The simple apology blamed the manufacturer for a delay in delivery, adding: "We are very sorry and want to apologise for this." Customers offered money were told: "As a goodwill gesture, we can offer you €5 if you would consider withdrawing your evaluation."

Because customers had no idea they were taking part in the experiment, their behaviour was completely natural and unaffected. Some 45% of participants withdrew their evaluation in light of the apology, while only 23% agreed in return for compensation.

The study also discovered that a higher purchase price further reduced the number of customers willing to forgive for cash. Yet the size of the initial outlay had no effect on the willingness of participants to settle for simply reading the magic words: "I'm sorry."

Dr Abeler, an expert in behavioural economics, said: "It's interesting to note our setting should have made it hard for an apology to work. "The apology was delivered by a large, anonymous firm and wasn't face-to-face, and the firm had a clear incentive to apologise. "All of this meant the apology should have been regarded by the customers as calculated, insincere and just cheap talk. Yet it still yielded much better outcomes than offering cash compensation – and our results might even underestimate its effects."

*The Nottingham School of Economics, based at the University of Nottingham, is regarded as one of the UK's leading research departments. Its economists have advised organisations including the Treasury, the World Bank, the IMF and the Department for Work and Pensions.*

## Research Team Finds First Evolutionary Branching for Bilateral Animals

***In the most computationally intensive phylogenetic analysis to date, an international research team led by Brown University has found the first evolutionary branching for bilateral animals. The researchers determined that the flatworm group Acoelomorpha is a product of the deepest split within the bilateral creatures - multicelled organisms that, like humans, have symmetrical body forms. Results appear online in Proceedings of the Royal Society B.***

PROVIDENCE, R.I. [Brown University] - When it comes to understanding a critical junction in animal evolution, some short, simple flatworms have been a real thorn in scientists' sides. Specialists have jousted over the proper taxonomic placement of a group of worms called Acoelomorpha. This collection of worms, which comprises roughly 350 species, is part of a much larger group called bilateral animals, organisms that have symmetrical body forms, including humans, insects and worms. The question about acoelomorpha, was: Where do they fit in? To scientists, acoelomorpha, has been enigmatic, a "rogue animal," said Casey Dunn, an evolutionary biologist at Brown University. "It has been wandering throughout the animal tree of life."

The worm wanders no more. Through a laborious genetic sequencing analysis, Dunn and an international team of scientists have settled the long-standing debate and determined that acoelomorpha belongs as a sister clade to other bilateral animals The finding is significant, Dunn said, because it shows the worm is a product of the deepest split within the bilateral animals, the first evolutionary divergence within the group. Because of that, scientists have gained a key insight into the most recent common ancestor to bilaterians, a species that remains unknown. The worm is "as distant as an animal can be in bilateria and still be a bilaterian," said Dunn, assistant professor of biology. "So, now we have two perspectives to (find out about) this common ancestor, the acoelomorphs and all the other bilateral animals."

The results appear online this week in the Proceedings of the Royal Society B.

***Flatworm with a home An international research team led by Brown University has determined that the flatworm Acoelomorpha belongs as a sister clade to other bilateral animals. The finding means the worm is a product of the deepest split within the bilateral animals, the first evolutionary divergence within the group. Credit: Eric Rottinger/Kahikai.org***

The team, composed of 17 scientists from the United States, France Germany, Sweden, Spain and the United Kingdom, had two more interesting findings:

* The debate appears to be over for Xenoturbella, a type of marine worm whose ancestral affiliation had been tossed between worms and mollusks. The researchers reported their genetic analysis shows diminishing evidence for placing xenoturbella within Deuterostomia, one of the major groups within the animal kingdom. Coincidentally, it also shows that xenoturbella may be a close relative to acoelomorpha.

* Cycliophora, a single species discovered in 1994 that lives on the bristles surrounding the mouth of the Norway lobster Nephrops norvegicus, has found a home with Entoprocta and Ectoprocta. The researchers base their findings on an analysis that reached further into the genetic makeup of cycliophora than previous studies had done.

The team used a genetic sequencing technique called expressed sequence tags to carry out the phylogenetic studies. The aim of this approach, discussed in a study led by Dunn that appeared in Nature last year, is to analyze a large number of genes from a large number of animals. For this paper, the researchers looked at 1,487 genes, a 10-fold increase in the number of genes analyzed in previous studies. In all, the researchers logged 2.25 million processor hours on a supercomputer in California to obtain the results. Dunn called the effort the most computationally intensive phylogenetic analysis to date.

*Other scientists who contributed to the research are Andreas Hejnol, Mark Martindale and Elaine Seaver, University of Hawaii; Matthias Obst, Goteborg University, Sweden; Alexandros Stamatakis and Michael Ott, Technical University of Munich, Germany; Greg Rouse, Scripps Institution of Oceanography; Gregory Edgecombe, Natural History Museum, London; Pedro Martinez and Jaume Baguna, Universitat de Barcelona, Spain; Xavier Bailly, Station Biologique de Roscoff, France; Ulf Jondelius, Swedish Museum of Natural History; Matthias Wiens and Werner Muller, Johannes-Gutenberg-University Mainz, Germany; Ward Wheeler, American Museum of Natural History; and Gonzalo Giribet, Harvard University.*

*The research was funded by the National Science Foundation and the San Diego Supercomputing Center.*

## HIV vaccine 'reduces infection'

***An experimental HIV vaccine has for the first time cut the risk of infection, researchers say.***

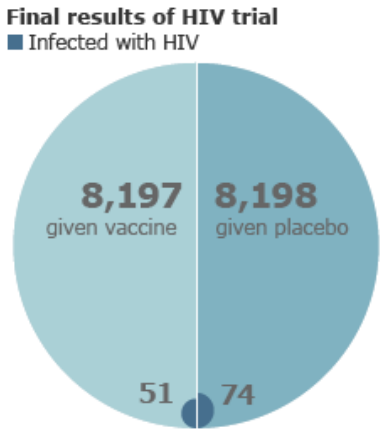
The vaccine - a combination of two earlier experimental vaccines - was given to 16,000 people in Thailand, in the largest ever such vaccine trial. Researchers found that it reduced by nearly a third the risk of contracting HIV, the virus that leads to Aids. It has been hailed as a significant, scientific breakthrough, but a global vaccine is still some way off.

The study was carried out by the US army and the Thai government over seven years on volunteers - all HIV-negative men and women aged between 18 and 30 - in parts of Thailand.

The vaccine was a combination of two older vaccines that on their own had not cut infection rates.

Half of the volunteers were given the vaccine, while the other half were given a placebo - and all were given counselling on HIV/Aids prevention. Participants were tested for HIV infection every six months for three years.

The results found that the chances of catching HIV were 31.2% less for those who had taken the vaccine - with 74 people who did not get the vaccine infected and 51 of the vaccinated group infected. The vaccine is based on B and E strains of HIV that most commonly circulate in Thailand not the C strain which predominates in Africa.




**'Encouraging'**

"This result is tantalisingly encouraging. The numbers are small and the difference may have been due to chance, but this finding is the first positive news in the Aids vaccine field for a decade," said Dr Richard Horton, editor of the Lancet medical journal. "We should be cautious, but hopeful. The discovery needs urgent replication and investigation."

Dr Anthony Fauci, director of the US National Institute of Allergy and Infectious Diseases said: "For the first time, an investigational HIV vaccine has demonstrated some ability to prevent HIV infection among vaccinated individuals.

"Additional research is needed to better understand how this vaccine regimen reduced the risk of HIV infection, but this is certainly an encouraging advance for the HIV vaccine field."

The findings were hailed by the World Health Organization (WHO) and the Joint United Nations Programme on HIV/Aids (UN/Aids). They said while the results were "characterised as modestly protective... [they] have instilled new hope in the HIV vaccine research field". Some 33 million people around the world have HIV.

## Pancreatic cancer: Researchers find drug that reverses resistance to chemotherapy

Berlin, Germany: For the first time researchers have shown that by inhibiting the action of an enzyme called TAK-1, it is possible to make pancreatic cancer cells sensitive to chemotherapy, opening the way for the development of a new drug to treat the disease.

Dr Davide Melisi told Europe's largest cancer congress, ECCO 15 – ESMO 34 [1], in Berlin today (Thursday 24 September) that resistance to chemotherapy was the greatest challenge to treating pancreatic cancer.

"Pancreatic cancer is an incurable malignancy, resistant to every anti-cancer treatment. Targeting TAK-1 could be a strategy to revert this resistance, increasing the efficacy of chemotherapy," said Dr Melisi, who until the start of September was a Fellow at the M.D. Anderson Center in Houston (Texas, USA); he has now moved to a staff position at the National Cancer Institute in Naples (Italy). "During the past few years we have been studying the role played by a cytokine or regulatory protein called Transforming Growth Factor beta (TGFbeta) in the development of pancreatic cancer. Recently we focused our attention on a unique enzyme activated by TGFbeta, TAK-1, as a mediator for this extreme drug resistance."

Dr Melisi and his colleagues investigated the expression of TAK-1 (TGFbeta-Activated Kinase-1) in pancreatic cell lines and developed a drug that was capable of inhibiting TAK-1. They tested the activity of the TAK-1 inhibitor on its own and in combination with the anti-cancer drugs gemcitabine, oxaliplatin and SN-38 (a metabolite of the anti-cancer drug irinotecan) in cell lines, and the activity of the TAK-1 inhibitor combined with gemcitabine against pancreatic cancer in mice.

"The use of this TAK-1 inhibitor increased the sensitivity of pancreatic cells to all three chemotherapeutic drugs. By combining it with classic anti-cancer drugs, we were able to use doses of drugs up to 70 times lower in comparison with the control to kill the same number of cancer cells. In mice, we were able to reduce significantly the tumour volume, to prolong the mice survival, and to reduce the toxicity by combining the TAK-1 inhibitor with very low doses of a classic chemotherapeutic drug, gemcitabine, that would have been ineffective otherwise," said Dr Melisi.

The use of gemcitabine on its own against the cancer in mice was ineffective because of the drug resistant nature of the disease. However, once it was combined with the TAK-1 inhibitor, Dr Melisi and his colleagues saw a 78% reduction in tumour volumes. "The median average survival for the control, TAK-1 inhibitor, gemcitabine on its own, or TAK-1 inhibitor combined with gemcitabine was 68, 87, 82 and 122 days respectively," he said.

"This is the first time that TAK-1 has been indicated as a relevant target for the treatment of a solid tumour and that it is a valid approach to reverting the intrinsic drug resistance of pancreatic cancer. The TAK-1 inhibitor used in this study is an exciting drug that warrants further development for the treatment of pancreatic cancer. In the near future, we will study whether it is also able to make other chemotherapeutic agents, such as oxaliplatin, 5-FU or irinotecan, work against pancreatic cancer in mice.

"Our main goal is to translate this combination approach from the bench to the bedside, conducting a clinical trial that could demonstrate the safety of this TAK-1 inhibitor in combination with gemcitabine, and its efficacy, in pancreatic cancer patients."

*Abstract no: 1002, Basic science/translational research session, Thursday 09.00 hrs CEST (Hall 14.2)*

*[1] ECCO 15 – ESMO 34 is the 15th congress of the European CanCer Organisation and the 34th congress of the European Society for Medical Oncology.*

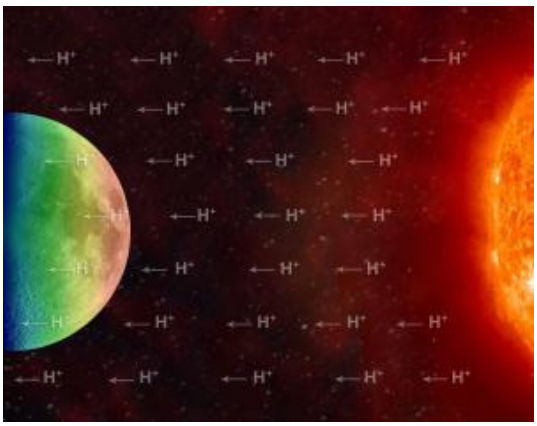
## Widespread water may cling to moon's surface

* 05:15 24 September 2009 **by Rachel Courtland**

A large portion of the moon's surface may be covered with water. That is the surprising finding of a trio of spacecraft that have turned up evidence of trace amounts of the substance in the lunar soil.

Many scientists suspect water ice might lurk in permanently shadowed craters at the moon's poles, which play host to some of the coldest known regions in the solar system.

But new findings suggest that a small amount of water clings to lunar soil across the moon's surface. The first detection was made by India's Chandrayaan-1 probe. The spacecraft, which failed in August after less than 10 months in orbit, was the first lunar orbiter to carry an instrument capable of measuring how much light is absorbed by water-bearing minerals.




***Protons carried by the solar wind could be responsible for creating water molecules across the lunar surface***
**(Illustration: University of Maryland/F. Merlin/McREL)**

"There's nothing else it could be," says Carle Pieters of Brown University in Providence, Rhode Island, leader of the Chandrayaan-1 instrument team that made the detection.

**Spectral fingerprint**

Chandrayaan-1 found hints of water across the lunar surface when it measured a dip in reflected sunlight at a wavelength absorbed only by water and hydroxyl, a molecule that contains one atom of hydrogen and one atom of oxygen. But the team was not convinced they had found water. "We spent literally months digging up anything we could find that could possibly explain this feature, simply because we didn't think it was there on the surface," Pieters says.

To help verify the signature, team members turned to data collected by NASA's Cassini probe, which buzzed the moon in 1999 on its way to Saturn, and NASA's Deep Impact spacecraft, which flew past the moon in June 2009 en route to an encounter with the comet Hartley 2. Both spacecraft also showed evidence of water and hydroxyl, molecules that are likely both present on the moon.

But seemingly not in great quantities. Harvesting water from a baseball-field-sized swathe of soil might yield "a nice glass of water", Pieters told New Scientist. Nonetheless, it might provide a resource for future lunar explorers.

**Unexpected result**

Finding water on the surface changes the bone-dry picture of the moon that had been built up since the days of the Apollo missions. "If you had told anybody three weeks ago that there was even a minuscule amount of water on the moon, they would have laughed at you," says Jennifer Sunshine of the University of Maryland at College Park and the deputy principal investigator for Deep Impact's extended mission.

Chandrayaan-1's measurements suggest that the water sits in the upper few millimetres of the lunar surface. As a result, Pieters and colleagues favour a scenario in which the water is created when hydrogen atoms carried by the solar wind slam into oxygen-rich materials in the lunar surface, combining to form hydroxyl and water.

"It's a fascinating and interesting and useful result," says Paul Spudis of the Lunar and Planetary Institute in Houston, Texas. "Basically it's opened up a whole new field of study ... that has a whole lot more questions than answers."

**Creeping along**

There is also evidence to suggest the water might be on the move. Deep Impact's observations suggest water might be more prevalent during the colder parts of the month-long lunar day, near sunrise and sunset. That indicates the water might be actively created and destroyed, or else may be migrating as sunlight heats it enough to release it from the minerals it was originally stuck to.

If water on the surface is mobile, it could provide a different source of water for the permanently shadowed polar craters, whose main water source is thought to have been water-bearing comets that slammed into the moon. "Even if it takes a couple of hops or a thousand hops or a million hops, ultimately [the water] could accumulate in a nice happy place like these permanently shadowed areas, and once it gets in there it's not going to come out," says Pieters.

**Icy craters?**

But there is active debate on whether water lurks in the moon's dark craters. Radar signals reflected off polar craters have shown some ice-like signals. And neutrons detected by NASA's Lunar Prospector in 1998 suggested the presence of hydrogen, although it was not clear whether the atoms were locked up in water ice or in some other form.

NASA's Lunar Reconnaissance Orbiter, which launched in June, is now hunting for similar signatures.

NASA's LCROSS, which is set to collide with a crater on the moon's south pole on 9 October, could potentially help resolve the question. The spacecraft and the spent rocket stage it is currently shepherding will throw up plumes of debris that the spacecraft, LRO, and telescopes will scrutinise for signs of water ice.

*Journal reference: Science Express (DOI:10.1126/science.1178658, science.1178105, science.1179788)*

## Mars probe watches water-ice fade

**By Jonathan Amos** Science reporter, BBC News

***Large deposits of nearly pure water-ice may lurk just below the Martian surface, much nearer the equator than previously thought, suggest new images.***

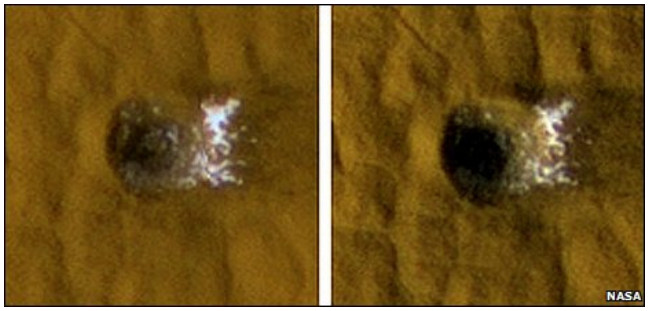
The pictures acquired by a Nasa orbiter show white material exposed by fresh meteorite impacts fading over time - behaviour expected of ice on Mars.

An onboard instrument also detected the tell-tale chemical signature of water. Researchers tell Science magazine that the observations suggest vast sheets of ice may reside in near-surface layers.

To date, exposed water-ice has only been seen at very high latitudes. The US space agency's (Nasa) recent Phoenix probe famously dug into water-ice at its "high Arctic" landing site.

The implication, even with the small set of examples scientists now have, is that broad deposits of ice sit just below the red top-soil of Mars.

"There's a consistent picture starting to emerge now that these broad sheets may be common on Mars," observed Shane Byrne of the University of Arizona, a member of the team running the HiRISE camera on Nasa's Mars Reconnaissance Orbiter (MRO). "The volume of water is probably comparable to the volume that we would have in the Greenland ice sheet on the Earth - in the buried ice deposits that stretch from each pole to mid-latitudes."




***Water-ice is seen to fade over time in this 12m crater within Arcadia Planitia*** **(Nasa/JPL-Caltech/University of Arizona)**

**Clean ice**

MRO has produced "earlier" and "later" images at five fresh impact sites made in 2008. These were all halfway between the north pole and the equator on Mars. The craters were small, just a few metres across, gouged out by incoming space rocks that may have been no more than 10cm in size.

The bright-white deposits uncovered by the impacts were seen to wither over time, something exposed water-ice cannot help but do in the low-pressure Martian atmosphere. It is bound to sublimate - to turn directly from a solid into a vapour. However, the length of time it took to fade was a good indication that the ice was very pure. Had it contained a lot of dirt mixed in with it, the ice would have sublimated much quicker, scientists said.

The identity and purity of the water-ice was further assessed by the team making observations with MRO's Compact Reconnaissance Imaging Spectrometer for Mars (CRISM). The discoveries made by MRO are said to indicate that Mars had a more humid climate in the relatively recent past , within the last 10,000 years.

Scientists suspect much of this ice came out of the atmosphere. Water vapour in the atmosphere will diffuse through the particles of the soil until it gets to a certain depth where it then freezes.

**Viking 'heartbreak'**

The locations of the exposed ice fit with the models used to predict where ground ice might be stable, i.e. from mid up to high latitudes.

"The more humid the Martian atmosphere, the more extensive the area of this stable ice," explained Shane Byrne. "Based on the locations of these craters, we are able to say something about how much water was in the Martian atmosphere recently, and that turns out to be a lot more than is in the atmosphere today - maybe almost double what's in the atmosphere today."


***The Viking-2 lander was probably close to a remarkable discovery***

CRISM team member Selby Cull, from Washington University in St Louis, said there was a "scientifically heart-breaking" consequence of the MRO discoveries.

This is the realisation that had Nasa's Viking-2 lander, which visited the Red Planet in 1976, dug a little deeper into the Martian soil, it would almost certainly have struck the water-ice MRO is now seeing at the base of impact craters. "That would have been a major discovery for our understanding of Mars," she said.

"It was literally just inches away from our robotic fingertips. And instead, it has taken more than 30 years to finally make this discovery."

## New genetic research indicates Jewish priesthood has multiple lineages

Recent research on the Cohen Y chromosome indicates the Jewish priesthood, the Cohanim, was established by several unrelated male lines rather than a single male lineage dating to ancient Hebrew times.

The new research builds on a decade-old study of the Jewish priesthood that traced its patrilineal dynasty and seemed to substantiate the biblical story that Aaron, the first high priest (and brother of Moses), was one of a number of common male ancestors in the Cohanim lineage who lived some 3,200 years ago in the Near East.

The current study was conducted by Michael F. Hammer, a population geneticist in the Arizona Research Laboratory's Division of Biotechnology at the University of Arizona. Hammer's collaborators in the study include Karl Skorecki of the Technion-Israel Institute of Technology and Rambum Medical Center in Haifa and colleagues and collaborating scientists from Tel Aviv University and the Russian Academy of Sciences.

The July 2009 issue of Human Genetics has published the Hammer team's newest findings in their article entitled "Extended Y chromosome haplotypes resolve multiple and unique lineages of the Jewish priesthood."

Hammer and Skorecki were part of the first research group 10 years ago that found the DNA marker signature of the Cohanim, termed the Cohen Modal Haplotype. Today, Hammer and his colleagues are able to use a much larger battery of DNA markers and consequently able to develop a more fully resolved Cohen

Modal Haplotype called the extended Cohen Modal Haplotype. The smaller number of markers used in the original Cohanim studies did not allow for full resolution of the history of the Jewish priesthood.

"These findings should motivate renewed interest in historical reconstructions of the Jewish priesthood as well as additional high resolution DNA marker analyses of other populations and 'lost tribes' claiming ancient Hebrew ancestry," Hammer said.

Using the new data, Hammer and his team were able to pinpoint the geographic distribution of a genetically more resolved Cohen Modal Haplotype and tease apart a multiplicity of male lines that founded the priesthood in ancient Hebrew times. The more fully resolved Cohen Modal haplotype (called the extended Cohen Modal Haplotype) accounts for almost 30 percent of Cohanim Y chromosomes from both Ashkenazi and non-Ashkenazi Jewish communities, is virtually absent in non-Jews, and likely traces to a common male ancestor that lived some 3,200 years ago in the Near East.

Additional Y chromosome lineages that are distinct from that defined by the extended Cohen Modal Haplotype, but also shared among Cohanim from different Jewish communities, reveal that the priesthood was established by several unrelated male lines.

## M. D. Anderson examines use of toad venom in cancer treatment

### *Phase I study shows the traditional Chinese medicine is well-tolerated*

HOUSTON - Huachansu, a Chinese medicine that comes from the dried venom secreted by the skin glands of toads, has tolerable toxicity levels, even at doses eight times those normally administered, and may slow disease progression in some cancer patients, say researchers from The University of Texas M. D. Anderson Cancer Center.

The results from the Phase I clinical study, a collaborative research project between M. D. Anderson and Fudan University Cancer Hospital in Shanghai, are reported in the online Early View feature of the journal Cancer. The study marks the first time a formal clinical trial has examined the relationship between huachansu dose and toxicity, although the drug is common in China and approved by the Chinese Food and Drug Administration.

Huachansu is widely used to treat patients with liver, lung, colon and pancreatic cancer at oncology clinics in China. Chinese clinical trials conducted since the 1970s have demonstrated the anti-cancer properties of huachansu, citing total response rates of 10 percent and 16 percent observed in patients with advanced hepatocellular carcinoma and lung cancer, respectively1,2.

"Studying traditional Chinese medicine such as huachansu is new to American research institutions, which have been skeptical and slow to adopt these complementary treatments. However, it is important to understand its potential role in treating cancer," says Lorenzo Cohen, Ph.D., one of the paper's authors and director of the Integrative Medicine Program at M. D. Anderson. "We wanted to apply a Western medicine-based approach to explore the role of the toad venom compound in cancer patients and test if it is possible to deliver a more potent dose without raising toxicities or side effects."

The clinical trial was conducted at the Fudan University Cancer Hospital while M. D. Anderson provided training and ongoing consultation. The institutions collaboratively designed the trial that was approved by both institutional review boards. M. D. Anderson and Fudan University Cancer Hospital signed a sister institution agreement in 2003, creating a framework for research, educational and clinical collaboration.

The typical dose of huachansu used in China is approximately 15 milliliters of drug per meter squared of body mass (mL/m2). In the study, 15 patients with stage III or IV hepatocellular (liver) carcinoma, nonsmall cell lung cancer or pancreatic cancer received one of five dose levels ranging from 10 mL/ m2 up to 90 mL/m2 from January 2005 through July 2006. The treatment was repeated daily for 14 days followed by seven days off (one cycle). After two cycles, most patients received other treatments. Quality control methods were put in place to ensure huachansu of a uniform and consistent lot.

While the dose was up to eight times higher than conventional doses used in China, researchers observed only low toxicities or side effects. Eleven (73 percent) patients had no toxicities greater than the lowest grade measured. Importantly, no significant cardiac toxicity was observed and no significant changes in cancer-related symptoms occurred. Of the 15 patients who completed the treatment, six hepatocellular carcinoma patients (40 percent) had stable disease for a median of six months. One patient had a 20 percent reduction in tumor mass that lasted for more than 11 months.

"Even though we saw no complete or partial response (reduction of disease by 30 percent or more) it is encouraging that the cancer did not progress in a large set of the hepatocellular carcinoma patients," says Zhiqiang Meng, principal investigator on the trial and an associate professor and deputy chair of the Department of Integrative Oncology at Fudan University Cancer Hospital, "Previous observations from studies conducted in China have shown that huachansu can inhibit tumor cell growth and improve immunologic

function3. These findings, coupled with that knowledge, demonstrate the need for further clinical trials of this promising agent."

A Phase II clinical trial comparing the effects of huachansu combined with gemcitabine (Gemzar®) to gemcitabine and placebo for patients with advanced pancreatic cancer is under way at the Fudan University Cancer Hospital in collaboration with M. D. Anderson.

*Both trials are part of the International Center of Traditional Chinese Medicine for Cancer funded by the National Cancer Institute. Anhui Jinchan Biochemistry Company, Ltd. provided the drug for this trial.*

*In addition to Cohen, other M. D. Anderson faculty contributing to this study include Peiying Yang, MD, the Integrative Medicine Program in the Department of Medical Oncology; David Z. Chang, MD, Department of Gastrointestinal Medical Oncology; Zongxing Liao, MD, Department of Radiation Oncology; and Razelle Kurzrock, MD, Department of Investigational Cancer Therapeutics. In addition to Meng, other Fudan University researchers contributing to this study include Yehua Shen, MD; Wenying Bei, MD; Ying Zhang, MD; Yongqian Ge, MD; and Luming Liu, MD, PhD. Formerly of M. D. Anderson, Robert A. Newman, MD, now of New Chapter Inc. and Bob Thornton, MD, now of Merck & Co, Inc. also contributed to this study.*

***A podcast is available here.***

## Scandinavians are descended from Stone Age immigrants

Today's Scandinavians are not descended from the people who came to Scandinavia at the conclusion of the last ice age but, apparently, from a population that arrived later, concurrently with the introduction of agriculture. This is one conclusion of a new study straddling the borderline between genetics and archaeology, which involved Swedish researchers and which has now been published in the journal Current Biology.

"The hunter-gatherers who inhabited Scandinavia more than 4,000 years ago had a different gene pool than ours," explains Anders Götherström of the Department of Evolutionary Biology at Uppsala University, who headed the project together with Eske Willerslev of the Centre for GeoGenetics at the University of Copenhagen.

The study, a collaboration among research groups in Sweden, Denmark and the UK, involved using DNA from Stone Age remains to investigate whether the practices of cultivating crops and keeping livestock were spread by immigrants or represented innovations on the part of hunter-gatherers.

"Obtaining reliable results from DNA from such ancient human remains involves very complicated work," says Helena Malmström of the Department of Evolutionary Biology at Uppsala University.

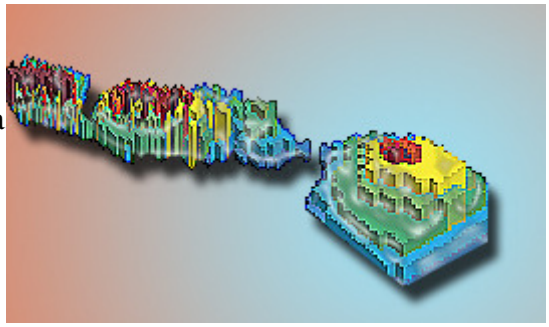
She carried out the initial DNA sequencings of Stone Age material three years ago. Significant time was then required for researchers to confirm that the material really was thousands of years old.

"This is a classic issue within archaeology," says Petra Molnar at the Osteoarchaeological Research Laboratory at Stockholm University. "Our findings show that today's Scandinavians are not the direct descendants of the hunter-gatherers who lived in the region during the Stone Age. This entails the conclusion that some form of migration to Scandinavia took place, probably at the onset of the agricultural Stone Age. The extent of this migration is as of yet impossible to determine."

## Superheavy Element 114 Confirmed: A Stepping Stone to the Island of Stability

**Posted By paulpreuss**

***For decades nuclear scientists have searched for an Island of Stability among notoriously short-lived artificial elements. Now researchers in Berkeley Lab's Nuclear Science Division and UC Berkeley have made a step forward in the quest by confirming the production of the superheavy element 114, ten years after a group in Russia at the Joint Institute for Nuclear Research in Dubna first claimed to have made it.[4]***



**Berkeley, CA** – Scientists at the U.S. Department of Energy's Lawrence Berkeley National Laboratory have been able to confirm the production of the superheavy element 114, ten years after a group in Russia, at the Joint Institute for Nuclear Research in Dubna first claimed to have made it. The search for 114 has long been a key part of the quest for nuclear science's hoped-for Island of Stability.

Heino Nitsche, head of the Heavy Element Nuclear and Radiochemistry Group in Berkeley Lab's Nuclear Science Division (NSD) and a professor of chemistry at the University of California at Berkeley, and Ken Gregorich, a senior staff scientist in NSD, led the team that independently confirmed the production of the new element, which was first published by the Dubna Gas Filled Recoil Separator group.

Using an instrument called the Berkeley Gas-filled Separator (BGS) at Berkeley Lab's 88-Inch Cyclotron, the researchers were able to confirm the creation of two individual nuclei of element 114, each a separate isotope having 114 protons but different numbers of neutrons, and each decaying by a separate pathway.

“By verifying the production of element 114, we have removed any doubts about the validity of the Dubna group’s claims,” says Nitsche. “This proves that the most interesting superheavy elements can in fact be made in the laboratory.”

Verification of element 114 is reported in *Physical Review Letters* in an article available online to subscribers at [5] http://link.aps.org/doi/10.1103/PhysRevLett.103.132502. In addition to Nitsche and Gregorich, the Berkeley Lab team included Liv Stavestra, now at the Institute of Energy Technology in Kjeller, Norway; Berkeley Lab postdoctoral fellow Jan Dvořák; and UC graduate students Mitch Andrē Garcia, Irena Dragojević, and Paul Ellison, with laboratory support from UC Berkeley postdoctoral fellow Zuzana Dvořáková.

**The realm of the superheavy**

Elements heavier than uranium, element 92 – the atomic number refers to the number of protons in the nucleus – are radioactive and decay in a time shorter than the age of Earth; thus they are not found in nature (although traces of transient neptunium and plutonium can sometimes be found in uranium ore). Elements up to 111 and the recently confirmed 112 have been made artificially – those with lower atomic numbers in nuclear reactors and nuclear explosions, the higher ones in accelerators – and typically decay very rapidly, within a few seconds or fractions of a second.

Beginning in the late 1950s, scientists including Gertrude Scharff-Goldhaber at Brookhaven and theorist Wladyslaw Swiatecki, who had recently moved to Berkeley and is a retired member of Berkeley Lab’s NSD, calculated that superheavy elements with certain combinations of protons and neutrons arranged in shells in the nucleus would be relatively stable, eventually reaching an “Island of Stability” where their lifetimes could be measured in minutes or days – or even, some optimists think, in millions of years. Early models suggested that an element with 114 protons and 184 neutrons might be such a stable element. Longtime Berkeley Lab nuclear chemist Glenn Seaborg, then Chairman of the Atomic Energy Commission, encouraged searches for superheavy elements with the necessary “magic numbers” of nucleons.

“People have been dreaming of superheavy elements since the 1960s,” says Gregorich. “But it’s unusual for important results like the Dubna group’s claim to have produced 114 to go unconfirmed for so long. Scientists were beginning to wonder if superheavy elements were real.”[6]

To create a superheavy nucleus requires shooting one kind of atom at a target made of another kind; the total protons in both projectile and target nuclei must at least equal that of the quarry. Confirming the Dubna results meant aiming a beam of $^{48}$Ca ions – calcium whose nuclei have 20 protons and 28 neutrons – at a target containing $^{242}$Pu, the plutonium isotope with 94 protons and 148 neutrons. The 88-Inch Cyclotron’s versatile Advanced Electron Cyclotron Resonance ion source readily created a beam of highly charged calcium ions, atoms lacking 11 electrons, which the 88-Inch Cyclotron then accelerated to the desired energy.

Four plutonium oxide target segments were mounted on a wheel 9.5 centimeters (about 4 inches) in diameter, which spun 12 to 14 times a second to dissipate heat under the bombardment of the cyclotron beam.

“Plutonium is notoriously difficult to manage,” says Nitsche, “and every group makes their targets differently, but long experience has given us at Berkeley a thorough understanding of the process.” (Experience is especially long at Berkeley Lab and UC Berkeley – not least because Glenn Seaborg discovered plutonium here early in 1941.)

When projectile and target nuclei interact in the target, many different kinds of nuclear reaction products fly out the back. Because nuclei of superheavy elements are rare and short-lived, both the Dubna group and the Berkeley group use gas-filled separators, in which dilute gas and tuned magnetic fields sweep the copious debris of beam-target collisions out of the way, ideally leaving only compound nuclei with the desired mass to reach the detector. The Berkeley Gas-filled Separator had to be modified for radioactive containment before radioactive targets could be used.

In sum, says Gregorich, “The high beam intensities from the 88-Inch Cyclotron, together with the efficient background suppression of the BGS, allow us to look for nuclear reaction products with very small cross-sections – that is, very low probabilities of being produced. In the case of element 114, that turned out to be just two nuclei in eight days of running the experiment almost continuously.”

**Tracking the isotopes of 114**

The researchers identified the two isotopes as $^{286}$114 (114 protons and 172 neutrons) and $^{287}$114 (114 protons and 173 neutrons). The former, $^{286}$114, decayed in about a tenth of a second by emitting an alpha particle (2 protons and 2 neutrons, a helium nucleus) – thus becoming a “daughter” nucleus of element 112 – which subsequently spontaneously fissioned into smaller nuclei. The latter,$^{287}$114, decayed in about half a second by emitting an alpha particle to form 112, which also then emitted an alpha particle to form daughter element 110, before spontaneously fissioning into smaller nuclei.

The Berkeley Group's success in finding these two 114 nuclei and tracking their decay depended on sophisticated methods of detection, data collection, and concurrent data analysis. After passing through the BGS, the candidate nucleus enters a detector chamber. If a candidate element 114 atom is detected, and is subsequently seen to decay by alpha-particle emission, the cyclotron beam instantly shuts off so further decay events can be recorded without background interference.

In addition to such automatic methods of enhancing data collection, the data was analyzed by completely independent software programs, one written by Gregorich and refined by team member Liv Stavsetra, another written by team member Jan Dvořák.

"One surprise was that the 114 nuclei had much smaller cross sections – were much less likely to form – than the Dubna group reported," Nitsche says. "We expected to get about six in our eight-day experiment but only got two. Nevertheless, the decay modes, lifetimes, and energies were all consistent with the Dubna reports and amply confirm their achievement."

Says Gregorich, "Based on the ideas of the 1960s, we thought when we got to element 114 we would have reached the Island of Stability. More recent theories suggest enhanced stability at other proton numbers, perhaps 120, perhaps 126. The work we're doing now will help us decide which theories are correct and how we should modify our models."

Nitsche adds, "During the last 20 years, many relatively stable isotopes have been discovered that lie between the known heavy element isotopes and the Island of Stability – essentially they can be considered as 'stepping stones' to this island. The question is, how far does the Island extend – from 114 to perhaps 120 or 126? And how high does it rise out the Sea of Instability."

The accumulated expertise in Berkeley Lab's Nuclear Science Division; the recently upgraded Berkeley Gas-filled Separator that can use radioactive targets; the more powerful and versatile VENUS ion source that will soon come online under the direction of operations program head Daniela Leitner – all add up to Berkeley Lab's 88-Inch Cyclotron remaining highly competitive in the ongoing search for a stable island in the sea of nuclear instability.

*"Independent verification of element 114 production in the $^{48}Ca + ^{242}Pu$ reaction," by L. Stavestra, K. Gregorich, J. Dvořák, P. A. Ellison, I. Dragojević, M. A. Garcia, and H. Nitsche, appears in* Physical Review Letters *103, 132502 and is available online at [5] http://link.aps.org/doi/10.1103/PhysRevLett.103.132502. This work was supported by the U.S. Department of Energy's Office of Science.*

## Feathered dinosaur older than earliest bird

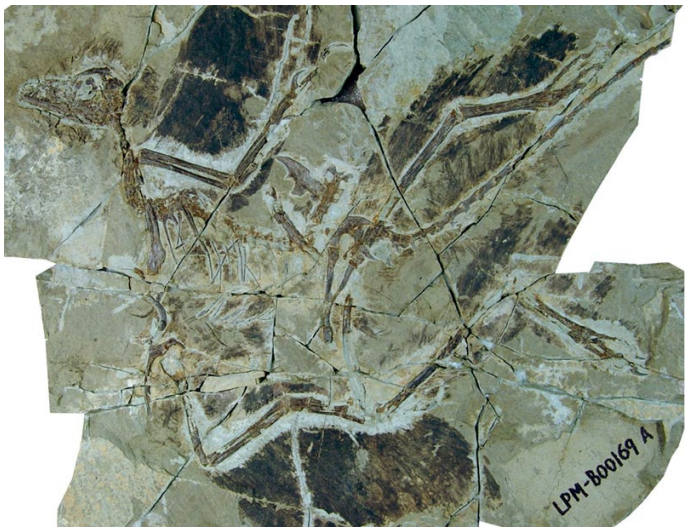
* 12:42 25 September 2009 **by Colin Barras**

The record for the oldest feathered dinosaur, which has stood for almost 150 years since the discovery of Archaeopteryx, has finally fallen to an even older fossil unearthed in China, shedding new light on the origin of birds.

The first full skeleton of Archaeopteryx, "that strange bird" as Darwin described it, was discovered in the Jurassic limestone of Solnhofen, Germany, just two years after the publication of On the Origin of Species. It has remained something of an evolutionary anomaly ever since.

Spectacular feathered dinosaurs discovered in the last decade or so show clearly how a small group of theropod dinosaurs gave rise to the first birds, but these specimens are almost exclusively Cretaceous in origin, at least 20 million years younger than Archaeopteryx. Feathered dinosaurs pre-dating Archaeopteryx have remained elusive, largely because the Jurassic theropod fossil record is so poor.

The closest palaeontologists have come to a feathered dinosaur older than Archaeopteryx is Pedopenna, discovered in Inner Mongolia in 2005. But there's some confusion over exactly how old the Inner Mongolian sediments are, and it's likely that Pedopenna is actually slightly younger than Archaeopteryx.




***Watch the birdie (Image: Hu, et al, Nature)***

**Four wings good**

Not so the new Chinese find Anchiornis huxleyi, the latest of a number of specimens found in the past year and the first to sport feathers. It comes from the Tiaojishan formation of Jianchang county, recently dated to

between 161 and 151 million years old and therefore older than the 150-million-year-old Archaeopteryx-bearing German rocks.

Anchiornis possesses well-developed feathers on all four limbs, a trait that would have seemed bizarre if the fossil had been discovered a decade ago. But palaeontological finds in recent years suggest the four-wing pattern may have been the rule rather than the exception in proto-birds – both Microraptor, discovered in 2003, and Pedopenna have feathered hind limbs.

"Current data suggests that the four-winged condition evolved probably once at the base of the Paraves, a group containing dromaeosaurids [the dinosaur family containing Microraptor], troodontids [the dinosaur family to which Anchiornis belongs], and birds," says Xu Xing of the Institute of Vertebrate Paleontology and Paleoanthropology in Beijing, who discovered Anchiornis.

**Could it fly?**

The new find comes from a "critical stage along the line to birds", Xu adds. "Probably the evolution of longer and stronger fore wings [ultimately] made the hind wings unnecessary."

Anchiornis is the oldest of the three, but its feathers are "smaller, symmetrical, different from typical flight feathers", according to Xu, making it unclear whether the animal could fly. It has unusually long legs suggestive of running, although the long leg feathers may have made rapid movement problematic.

"This is something confusing," says Xu. "Although when you get close to the transition point from dinosaurs to birds, you get very unusual combinations of features."

Alan Feduccia, a palaeo-ornithologist at the University of North Carolina, Chapel Hill, says the new fossil species adds a "dazzling new piece to the complicated puzzle of early bird evolution", showing just how blurred the distinctions are between groups in this area of the dinosaur evolutionary tree.

*Journal reference: Nature, DOI: 10.1038/nature08322*

## Prototype developed to detect dark matter

A team of researchers from the University of Zaragoza (UNIZAR) and the Institut d'Astrophysique Spatiale (IAS, in France) has developed a "scintillating bolometer", a device that the scientists will use in efforts to detect the dark matter of the Universe, and which has been tested at the Canfranc Underground Laboratory in Huesca, Spain.

"One of the biggest challenges in Physics today is to discover the true nature of dark matter, which cannot be directly observed – even though it seems to make up one-quarter of the matter of the Universe. So we have to attempt to detect it using prototypes such as the one we have developed", Eduardo García Abancéns, a researcher from the UNIZAR's Laboratory of Nuclear Physics and Astroparticles, tells SINC.

García Abancéns is one of the scientists working on the ROSEBUD project (an acronym for Rare Objects SEarch with Bolometers UndergrounD), an international collaborative initiative between the Institut d'Astrophysique Spatiale (CNRS-University of Paris-South, in France) and the University of Zaragoza, which is focusing on hunting for dark matter in the Milky Way.

The scientists have been working for the past decade on this mission at the Canfranc Underground Laboratory, in Huesca, where they have developed various cryogenic detectors (which operate at temperatures close to absolute zero: −273.15 °C). The latest is a "scintillating bolometer", a 46-gram device that, in this case, contains a crystal "scintillator", made up of bismuth, germinate and oxygen (BGO: Bi4Ge3O12), which acts as a dark matter detector.

***IMAGE: This is the BGO scintillator crystal (right, blue) and germanium disc (left).*** **IAS / SINC**

"This detection technique is based on the simultaneous measurement of the light and heat produced by the interaction between the detector and the hypothetical WIMPs (Weakly Interacting Massive Particles) which, according to various theoretical models, explain the existence of dark matter", explains García Abancéns.

The researcher explains that the difference in the scintillation of the various particles enables this method to differentiate between the signals that the WIMPs would produce and others produced by various elements of background radiation (such as alpha, beta or gamma particles).

In order to measure the miniscule amount of heat produced, the detector must be cooled to temperatures close to absolute zero, and a cryogenic facility, reinforced with lead and polyethylene bricks and protected from cosmic radiation as it housed under the Tobazo mountain, has been installed at the Canfranc underground laboratory.

"The new scintillating bolometer has performed excellently, proving its viability as a detector in experiments to look for dark matter, and also as a gamma spectrometer (a device that measures this type of radiation) to monitor background radiation in these experiments", says García Abancéns.

The scintillating bolometer is currently at the Orsay University Centre in France, where the team is working to optimise the device's light gathering, and carrying out trials with other BGO crystals.

This study, published recently in the journal Optical Materials, is part of the European EURECA project (European Underground Rare Event Calorimeter Array). This initiative, in which 16 European institutions are taking part (including the University of Zaragoza and the IAS), aims to construct a one-tonne cryogenic detector and use it over the next decade to hunt for the dark matter of the Universe.

**Methods of detecting dark matter**

Direct and indirect detection methods are used to detect dark matter, which cannot be directly observed since it does not emit radiation. The former include simultaneous light and heat detection (such as the technique used by the scintillating bolometers), simultaneous heat and ionisation detection, and simultaneous light and ionisation detection, such as research into distinctive signals (the most famous being the search for an annual modulation in the dark matter signal caused by the orbiting of the Earth).

There are also indirect detection methods, where, instead of directly seeking the dark matter particles, researchers try to identify other particles, (neutrinos, photons, etc.), produced when the Universe's dark matter particles are destroyed.

***References:*** *N. Coron, E. García, J. Gironnet, J. Leblanc, P. de Marcillac, M. Martínez, Y. Ortigoza, A. Ortiz de Solórzano, C. Pobes, J. Puimedón, T. Redon, M.L. Sarsa, L. Torres y J.A. Villar. "A BGO scintillating bolometer as dark matter detector prototype". Optical Materials 31(10): 1393-1397, 2009*

## Insulin boost restores muscle growth in elderly

GALVESTON, Texas - When most people think of insulin, they think of diabetes - a disease that arises when, for one reason or another, insulin can't do the critical job of helping the body process sugar. But the hormone has another, less well-known function. It's also necessary for muscle growth, increasing blood flow through muscle tissue, encouraging nutrients to disperse from blood vessels and itself serving as a biochemical signal to boost muscle protein synthesis and cell proliferation.

Recently, scientists have recognized that loss of responsiveness to insulin plays a major role in the loss of physical strength that occurs as people grow older. Now, University of Texas Medical Branch at Galveston researchers have demonstrated that by increasing insulin levels above the normal range in elderly test subjects, they can restore the impaired muscle-building process responsible for age-related physical weakness.

"Insulin is normally secreted during food intake," said Dr. Elena Volpi, senior author of a paper on the study published in the September issue of Diabetologia. "When you give insulin intravenously and increase the blood insulin levels to the same amount produced after a meal, you see that in young people it stimulates protein synthesis and muscle growth, while in older people it really doesn't. But when we gave seniors double the insulin they would normally produce after eating, their muscles were stimulated like those of young people."

Volpi and her co-authors - postdoctoral fellows Satoshi Fujita and Kyle Timmerman, graduate student Erin Glynn and Professor Blake B. Rasmussen - worked with 14 elderly volunteers to examine the response of thigh muscle to the two different blood insulin levels, established by infusion into the thigh's main artery. Blood samples taken from catheters inserted in the femoral artery and vein of each subject enabled the researchers to calculate blood flow and muscle protein synthesis, and muscle biopsies allowed them to measure levels of signaling molecules involved in muscle protein growth.

All the data pointed in the same direction, showing that a blood insulin level double that produced by a typical meal seems to turn back the clock on elderly thigh muscle.

"While we had called this 'insulin resistance' in the past, we didn't really have evidence that you can get an elderly person's muscle to grow if you give it a lot more insulin, which is what we needed to truly say this is insulin resistance," Volpi said. At the same time, she said, the phenomenon is also quite different from the insulin resistance seen in diabetes. "These were older subjects with perfect glucose tolerance," she said. "So what we have identified is a novel kind of insulin resistance that's not related to sugar control."

Instead, Volpi said, the UTMB researchers attribute this new kind of insulin resistance to age-related changes in the vascular system - in particular, changes in the endothelium, the single-cell-thick layer that lines blood vessels. The endothelium controls blood flow by increasing or decreasing the diameter of capillaries (the smallest blood vessels), and regulates the release of oxygen, nutrients, water and other blood-borne cargo through the capillary walls and into muscles and other body tissues. "Having a capillary dilation induced by insulin is important, because it exposes more muscle to the nutrients and hormones and everything flows better and gets stored away better," Volpi said. "But in even healthy older people, this dilation response doesn't work, because they have this endothelial dysfunction."

The UTMB researchers are now testing whether using drugs to dilate muscle blood vessels during insulin exposure can improve muscle growth in older people. "Preliminary data suggest that this treatment may be

effective, but these data are not yet published," Volpi said. "On the other hand, in a paper we published two years ago in Diabetes, we showed that a single bout of aerobic exercise - a staple of diabetes treatment - may also improve muscle growth in response to insulin in older nondiabetic people."

*Volpi's group is now conducting a larger, NIH-funded clinical trial to determine if aerobic exercise and nutritional supplementation for six months can also boost muscle size and function in sedentary but otherwise healthy seniors. UTMB's Sealy Center on Aging and Claude D. Pepper Older Americans Independence Center are recruiting seniors from the Galveston-Houston area for the study. For more information, call 800-298-7015.*

## Slimy-skinned ships to slip smoothly through the seas

* 26 September 2009 **by Paul Marks**

DESIGNING ships to exude slime from their hulls could cut their fuel consumption by up to 20 per cent. The slime would form a gelatinous skin that continually sloughs off, taking with it the barnacles and other marine life forms that cause energy-sapping drag as they accumulate on the ships' underside.

The idea, which is being tested by Rahul Ganguli of Teledyne Scientific in Thousand Oaks, California, and colleagues is being financed by the US Department of Defense (Smart Materials and Structures, DOI: 10.1088/0964-1726/18/10/104027).

Fouling by marine life is a problem for shipowners, as it requires vessels to be brought into dry dock every couple of years to remove plants and animals from the hull. It has been made worse by the banning last year of antifouling paints based on tributyltin, which is toxic to marine life.

At the root of the fouling problem are micro-organisms such as bacteria and algae, on which larger plants, barnacles and tube worms can grow.

Ganguli's solution is inspired by the skin of the long-finned pilot whale, Globicephala melas, which was investigated by Christoph Baum at Hannover School of Veterinary Medicine, Germany. In a paper published in 2002 Baum's team reported that the surface of the whale's skin is criss-crossed with a network of nanoscale canals too small for any barnacle larvae to gain any purchase (Marine Biology, DOI: 10.1007/s00227-001-0710-8). They also found that the canals are filled with a gel of enzymes that destroy proteins on the surface of bacteria and algae.

Ganguli is now working on a way to make a ship's hull perform a similar self-cleaning trick. His idea is to cover the outer layer of a ship in a metal mesh, beneath which is a regular pattern of holes that exude a sticky, biosafe chemical that becomes more viscous on contact with seawater.

As the secretion oozes out of the pores it fills the gaps in the mesh and pools on top to form a viscous skin coating the entire hull. This skin steadily wears away, taking with it any life that has gained a foothold, and is replaced by new slime from below.

Chemicals ooze through holes in a metal mesh to form a viscous skin coating the entire hull

Ganguli has tested the idea with two chemicals used on oil rigs. One is used to thicken seawater to force open rock formations, while the other firms up acid used to dissolve rocks. "We think they will be safe for marine life," he says. When the chemicals were squirted through holes under a mesh on a piece of a ship's hull, a smooth, slimy skin 700 micrometres thick formed on top.

Tests of the system in tanks of seawater showed that after 11 days there was a 100-fold cut in the number of Pseudomonas carrageenovora colonies that grew on a mock hull plate compared with the plain steel plate used as a control. P. carrageenovora is one of the bacterial species known to form colonies on which larger fouling organisms, such as plants or barnacles, can grow.

The team also showed they could control how fast the skin wears away. They say it may even reduce drag compared with a clean steel hull.

Making the idea work would be lucrative, says naval architect Peilin Zhou at the University of Strathclyde in Glasgow, UK. "If you do not have to bring the vessel to dry dock it would save a lot of money."