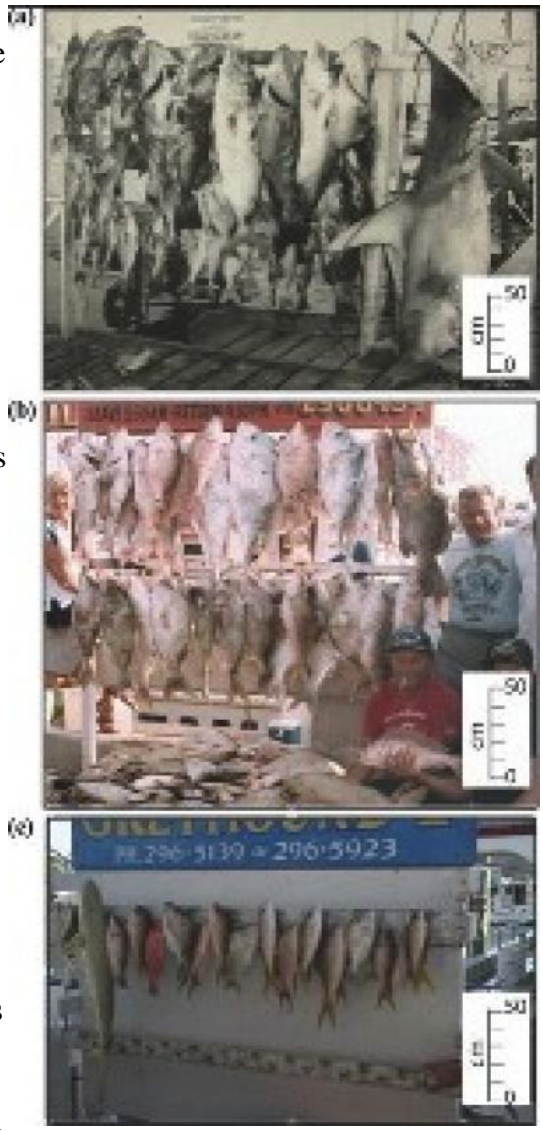
Ocean life in olden days: Researchers upend modern notions of 'natural' animal sizes, abundance

Census of Marine Life historians reconstruct images of past sea life that boggle today's imagination



Before oil hunters in the early 1800s harpooned whales by the score, the ocean around New Zealand teemed with about 27,000 southern right whales - roughly 30 times as many as today - according to one of several astonishing reconstructions of ocean life in olden days to be presented at a Census of Marine Life conference May 26-28.

At about the same time, UK researchers say large pods of blue whales and orcas, blue sharks and thresher sharks darkened the waters off Cornwall, England, herds of harbour porpoise pursued fish upriver, and dolphins regularly played in waters inshore.

Using such diverse sources as old ship logs, literary texts, tax accounts, newly translated legal documents and even mounted trophies, Census researchers are piecing together images - some flickering, others in high definition - of fish of such sizes, abundance and distribution in ages past that they stagger modern imaginations.

They are also documenting the timelines over which those giant marine life populations declined.

For example, Census scientists say the size of freshwater fish caught by Europeans started shrinking in medieval times.

Researchers James Barrett and Jen Harland (Cambridge University, UK), Cluny Johnstone (York University, UK) and Mike Richards (Max Planck Institute, Germany) say a shift from eating locally-caught freshwater to marine fish species occurred around 1000 AD.

That's consistent with analyses of scientifically-dated fish remains and historical data from England and northwestern Europe showing smaller freshwater fish and fewer species availability in early medieval times, likely caused by increased exploitation and pollution.

Maria Lucia De Nicolò of the Università di Bologna, meanwhile, has established that new fishing boats and equipment invented in the 1500s made it possible to venture from coastal to deep sea fishing. The real revolution in marine fishing, she says, happened in the mid-1600s when pairs of boats began dragging a net.

This composite photo illustrates the decline in size, species diversity and abundance of gamefish in the Florida Keys.
HMAP / CoML

Appraising modern marine life through the narrow window of observations during recent decades "skews perceptions," says Andy Rosenberg of the University of New Hampshire, a leader of the Census' History of Marine Animal Population (HMAP) project and chair of the conference.

He says new insights allowed by centuries of information are upending modern notions of "natural" marine life sizes, abundance, habitats and vulnerability, and causing authorities to revisit marine baselines.

In most places human-caused changes to marine ecosystems occurred over millennia while reliable information is often available for just the last few centuries at best. In New Zealand, however, which was first settled by fewer than 300 eastern Pacific islanders around 1280 AD, there is a comparatively short and continuous record of human impacts on the marine environment, including whaling for southern right whales.

This short and well-documented history allows researchers to quantify the full scope of change in at least this one marine ecosystem, from before human presence to the present day, and makes the findings more relevant to policy makers, who plan to use the results as a realistic baseline against which the current and future status of the marine ecosystem can be gauged.

The estimated historic size of New Zealand's southern right whale (Eubalaena australis, www.eol.org/pages/313009) population, for example, is already being incorporated into models of the New Zealand coastal ecosystem to help guide conservation and management.

The Census HMAP team, Jennifer Jackson and Scott Baker (Oregon State University, US), Emma Carroll and Nathalie Patenaude (University of Auckland, New Zealand), and Tim Smith (US National Marine Fisheries Service), estimated the original population through analysis of over 150 whaling logbooks and other records.

And they say with 95% statistical confidence that southern right whales numbered between 22,000 and 32,000 in the early 1800s, declining rapidly once whaling began. By 1925, perhaps as few as 25 reproductive females survived. Today a remnant -- and hopefully recovering - of 1,000 animals is being studied around sub-Antarctic islands south of New Zealand.

Says Alison MacDiarmid, a New Zealand government scientist who organized the work: "These findings point up the need to re-examine the role southern right whales once played both as a grazer of zooplankton and prey, especially during calving close inshore, for killer whales and great white sharks."

Oceans Past II Conference, 2009

International scientists arriving in Vancouver for the second Oceans Past conference (www.hmapcoml.org/oceanspast, May 26-28, hosted by the University of British Columbia), will share such other surprises as these:

* Human fishing and impacts on near-shore and island marine life - including the catching of shellfish, finfish and other marine mammals - apparently began in many parts in the Middle Stone Age - 300,000 to 30,000 years ago - 10 times earlier than previously believed;

* Passages of Latin and Greek verse written in 2nd century CE suggest Romans began trawling with nets;

* In the early to mid 1800s, years of overfishing followed by extreme weather collapsed a European herring fishery. Then, the jellyfish that herring had preyed upon flourished, seriously altering the food web;

* In the mid 1800s, periwinkle snails and rockweed migrated from England to Nova Scotia on the rocks ships carried as ballast - the tip of an "invasion iceberg" of species brought to North America;

* In less than 40 years, Philippine seahorses plunged to just 10% of their original abundance, reckoned in part through fishers' reports of each having caught up to 200 in a night in the early days of that fishery.

A new context for contemporary ocean management

Says Ian Poiner, Chair of the Census Scientific Steering Committee: "Joni Mitchell once famously sang that 'you don't know what you've got 'til it's gone.' But when it comes to marine life, in many cases we're only just starting to fully realize what the planet once had."

"The insights emerging from this research of the past provide a new context for contemporary ocean management. Understanding the magnitude and drivers of change long ago is essential to accurately interpret today's trends and to make future projections."

Dr. Poiner adds that establishing environmental history in mainstream marine science will be one of the Census' enduring legacies.

Scientists involved in the research hail from many disciplines, including palaeontology, archaeology, history, fisheries and ecology.

Using creativity to reveal marine change

Demonstrating one of many novel research techniques, HMAP Caribbean researcher Loren McClenachan of the Scripps Institution of Oceanography, compared photos of 13 groups of "trophy" reef fish landed by Key West-area sport fishermen between 1956 and 2007.

They revealed that average fish size shrank from an estimated 20 kg to 2.3 kg and that the mix of species changed greatly. From 1956 to 1960, large groupers and other large predatory fish dominated the catches, including sharks that averaged nearly two meters long. By contrast, small snappers with an average length of 34.4 cm dominated catches in 2007.

A special focus on changing coastal biodiversity

HMAP researchers are also looking closely into the history near Atlantic shores, assessing changes in coastal biodiversity over time.

To illuminate patterns of change by seeing what used to be, project scientists are subjecting rich historical data from five countries to modern sampling and analysis methods, testing the hypothesis that biodiversity has suffered more at sea than on land.

Lessons also from past recoveries

"Most histories of successful marine recoveries are found among mammals and birds, but cases involving marine reptiles and fish also exist. Only in a few cases, however, did they fully recover their former abundance," says researcher Heike Lotze of Canada's Dalhousie University.

Lotze points to hopeful examples of recoveries - sea otters of western North America, elephant seals of Guadalupe, an island off the coast of Baja California, and the Pacific gray whales that roam the American coast, for example - and the causes behind them.

"In the past, some combination of reduced or banned exploitation, pollution controls or habitat protection, especially of breeding colonies and feeding grounds, propelled recovery" she says.

Recovery potential can depend on the magnitude of depletion, the life history of the animals, and the time since collapse. Long-lived marine animals rebound more slowly than short-lived species. Species diversity and food webs have also been identified as important drivers for recovery. And where species have disappeared, their reintroduction by humans can help, says Lotze.

Seeing important patterns over time

"Forecasting and backcasting are two sides of the same coin," says Jesse Ausubel, Program Director of the Census at the Alfred P. Sloan Foundation. "Analytic tools developed by ecologists to predict future abundance have been adapted to reconstruct histories of marine life."

"HMAP's evidence includes a variety of items such as old restaurant menus, whalebone buttons, logbooks and lore, paintings and pavements, isotopes and ice. HMAP researchers keep extending the limits of knowledge by finding new ways to make the past visible. They help us to lift self-imposed blinders on what constitutes useful source material," he adds.

He notes a text written in Sicily in 1153 describing the seas of the North Atlantic as having "animals of such great size that the inhabitants of the islands use their bones and vertebrae in place of wood to build houses. They make hammers, arrows, spears, knives, seats, steps, and in general every sort of thing elsewhere made of wood."

"The History of Marine Animal Populations project gives a head start of decades and even centuries in anticipating trends - both good and bad. Integration of this information will extend databases to help perceive important patterns over larger areas, longer eras and covering more forms of life more reliably."

Concludes Poul Holm, Professor at Trinity College Dublin and global chair of the HMAP project: "While the history of marine animal populations has been one of the great unknowns, recent advances in scientific and historical methodology have enabled HMAP to expand the realm of the known and the knowable."

"We now know that the distribution and abundance of marine animal populations change dramatically over time. Climate and humanity forces changes and while few marine species have gone extinct, entire marine ecosystems may have been depleted beyond recovery. Understanding historical patterns of resource exploitation and identifying what has actually been lost in the habitat is essential to develop and implement recovery plans for depleted marine ecosystems."

Did the North Atlantic fisheries collapse due to fisheries-induced evolution?

The Atlantic cod has, for many centuries, sustained major fisheries on both sides of the Atlantic. However, the North American fisheries have now largely collapsed. A new paper in the open-access, peer-reviewed journal PLoS ONE from scientists at the University of Iceland and Marine Research Institute in Reykjavik provides insights into possible mechanisms of the collapse of fisheries, due to fisheries-induced evolution.

Cod fishing is of highest intensity in shallow water in Iceland and it selects against genotypes of cod adapted to shallow water. The PLoS ONE paper reports a significant difference in Darwinian fitness (relative survival rate) between shallow-water and deep-water adapted cod. The shallow-water fish have only 8% of the fitness of deep-water fish. This difference can lead to rapid elimination of shallow-water fish in only a few generations with drastic effects on the population and the fishery.

Using molecular population genetics, the authors reports steep changes in the frequency of genotypes at a single genetic locus with depth: a gradient of nearly one half percent drop in frequency per meter. The genotypes at the locus are directly related to behavioral types that select deep vs. shallow water habitat by genotype.

"There is no direct targeting of specific genotypes. Instead the intense selection results from the interaction of fish that select their habitat by genotype and fishermen choosing to fish in the preferred habitat of the fish," said Einar Arnason, professor of population genetics and lead author.

In addition to the molecular results, the study also demonstrates that the length and age at which the fish become mature have decreased. So-called "probabilistic maturation reaction norms" show that the length at which there is a 50% probability of becoming mature, has, on average, decreased nearly one centimeter per year. The changes observed very likely are evolutionary genetic changes and not simply plastic phenotypic responses to the environment. They are comparable to changes that preceded the collapse of northern cod at Newfoundland.

This finding further supports the hypothesis of an imminent collapse of Icelandic cod due to the intense fisheries-induced selection. The cod fishery at Iceland is one of the world's few remaining cod fisheries. The study appears to have met all criteria for concern that this fishery is threatened.

"Can anything be done to avert collapse?" the authors ask. A strategy that would remove selection pressures against shallow-water adapted fish would seem to be the answer. The authors speculate that immediate establishment of large no-take reserves might be the right strategy by relieving selection pressures on all genotypes.

The findings provide general lessons for population and conservation genetics that anthropogenic changes in habitat can lead to intense selection even if the mortality is non-selective in the habitat in which it occurs. The study highlights the importance of applying Darwinian principles and evolutionary thinking to fisheries and conservation science.

Australian team reveals world-first discovery in a 'floppy baby' syndrome

In a world first, West Australian scientists have cured mice of a devastating muscle disease that causes a Floppy Baby Syndrome – a breakthrough that could ultimately help thousands of families across the globe.

The research, published online today in the Journal of Cell Biology, reveals how a team at the Western Australian Institute for Medical Research (WAIMR) has restored muscle function in mice with one type of Floppy Baby Syndrome – a congenital myopathy disorder that causes babies to be born without the ability to properly use their muscles.

The currently incurable genetic diseases render most of the affected children severely paralysed and take the lives of the majority of these children before the age of one.

Dr Kristen Nowak, lead author on the publication, said the team was extremely encouraged that it had been able to cure a group of mice born with the condition.

"The mice with Floppy Baby Syndrome were only expected to live for about nine days, but we managed to cure them so they were born with normal muscle function, allowing them to live naturally and very actively into old age," she said.

"This is an important step towards one day hopefully being able to better the lives of human patients – mice who were cured of the disease lived more than two years, which is very old age for a mouse."

Dr Nowak said the team was able to cure the mice with the recessive form of the genetic condition by replacing missing skeletal muscle actin – a protein integral in allowing muscles to contract – with similar actin found in the heart.

"Earlier in our search to tackle these diseases, we discovered a number of children who, despite having no skeletal muscle actin in their skeletal muscle due to their genetic mutation, were not totally paralysed at birth," she said. "On closer inspection, we found it was because heart actin – another form of the protein – was abnormally "switched on" in their skeletal muscles.

"We had already begun investigating whether we could use heart actin to treat skeletal muscle actin disease, so that discovery spurred us on, and we've now proved it can be done – we can use heart actin to overcome the absence of skeletal muscle actin in mice."

Heart actin is found in cardiac muscle and, during foetal development, it also works in skeletal muscles in the body, but by birth, heart actin has almost completely disappeared within skeletal muscle.

Using genetic techniques, the WAIMR research team has reactivated the heart actin after birth in place of skeletal muscle actin, reversing the effects of the congenital myopathy.

Head of the WAIMR research group Professor Nigel Laing said the team's next step was to apply their findings to human patients.

"We are now screening more than a thousand already-approved medications looking for one that might increase heart actin in skeletal muscles, which could potentially offer a treatment for many patients," he said.

"Current therapies only target the effects of these conditions, not the condition itself – we hope our approach could lead to a much greater improvement for a range of muscle diseases."

This discovery is the latest for the team which has been investigating debilitating muscle diseases for more than 20 years.

The first major breakthrough for actin disease was in 1999, when the team identified that defects in the skeletal muscle actin gene, ACTA1 – responsible for producing skeletal muscle actin, cause multiple muscle diseases. Since then, the team has classified and named a new muscle disease 'Laing Myopathy' – named after Professor Nigel Laing – and helped implement world-wide screening for families at risk of genetic muscle disease.

WAIMR Director Professor Peter Klinken said he was thrilled WAIMR was playing such an integral part in helping tackle devastating muscle diseases.

"The persistence and determination shown by Professor Laing and his team over many, many years is nothing short of inspiring," he said.

"They've asked some big questions in their quest to find a cure for this Floppy Baby Syndrome and have worked tirelessly to find the answers to those questions in the hope of helping families across the world.

"Research institutes like ours exist to help people live healthier lives and I am delighted at the important discoveries we are making in this field."

This research has been funded by the National Health and Medical Research Council, WAIMR and a number of patient support groups including the Association Française contre les Myopathies (French Muscular Dystrophy Association) and the US Muscular Dystrophy Association.

The research project centred at the WAIMR laboratory was a collaborative effort with groups at the Medical Research Council and the University of Oxford in the United Kingdom, Cincinnati Children's Hospital Medical Center as well as the Centre for Microscopy, Characterisation and Analysis at the University of Western Australia and Perth-based Proteomics International which have also assisted the team's work.

Floppy Baby Syndrome

The skeletal muscle actin mutations which cause congenital myopathies can be classified into five individual diseases which affect thousands of families worldwide. Children with recessive muscle actin diseases have no skeletal muscle actin because of mutations in the skeletal muscle actin gene which "knock out" the gene function. In Australia, dozens of families are affected by congenital myopathies which bring high emotional costs and personal suffering, as well as financial and community burdens.

Rooks reveal remarkable tool-use

By Rebecca Morelle Science reporter, BBC News

Rooks have a remarkable aptitude for using tools, scientists have found.

Tests on captive birds revealed that they could craft and employ tools to solve a number of different problems.

The findings, published in the Proceedings of the National Academy of Sciences, came as a surprise as rooks do not use tools in the wild.

Despite this, the UK team said the birds' skills rivalled those of well-known tool users such as chimpanzees and New Caledonian crows.

Dr Nathan Emery, an author of the paper from Queen Mary, University of London, said: "The study shows the creativity and insight that rooks have when they solve problems."

The scientists focused on four captive rooks: Cook, Fry, Connelly and Monroe, and discovered that the birds were able to use tools in a number of ways to solve a variety of problems.

For example, the birds were presented with a vertical tube, running down to a trap-door with an out-of-reach worm perched upon it, as well as a number of different-sized stones placed nearby.

The scientists discovered that the rooks would select the largest stone, which was heavy enough to push open the trap-door, and drop it into the tube to release the snack.

And when given a selection of different-shaped stones, some of which could fit into the tube, some of which could not, the rooks opted for a tool that would give them access to the treat.

Lead author Christopher Bird, from Cambridge University, said: "We have found that they can select the appropriate tools out of a choice of tools and they show flexibility in the types of tools they use."

The researchers also found the rooks could use two tools in succession - something that is described as metatool use.

They gave the birds a large stone, as well as two vertical tubes, one wide, with a small stone perched at the bottom on a trap-door, and another thin, this time containing a worm.

They found that the rooks would first drop the large stone into the wide tube to release the smaller stone, and subsequently drop this small stone into the thin tube to free the tasty treat.

Until now, metatool use has only been seen in great apes and New Caledonian crows.

Perhaps most surprisingly, the team also revealed that rooks could modify and create new tools.

They found that the rooks would bend a piece of straight wire into a hook so that they could retrieve a bucket laden with food from the bottom of the vertical well.

Until now, this novel tool-fashioning behaviour has only been reported for a single New Caledonian crow called Betty. But in this study, three of the four rooks created the hook in their first trial.

Bird brains?

Mr Bird told BBC News: "It was a big surprise to find out that rooks could use tools.

"We've seen this kind of tool use in New Caledonian crows, but the interesting thing about the rooks is that they do not use tools in the wild."

Both rooks and New Caledonian crows belong to the corvids, a bird group that is renowned for intelligent behaviour.

However, until now, it was thought that sophisticated tool-use was limited to New Caledonian crows, a species found on the island of New Caledonia in the Pacific that create tools to pluck grubs from holes.

Mr Bird said: "Tool use is probably very important for these crows because of their ecology - they may get a large proportion of the protein they need from these grubs.

"And it has been suggested that tool-use is a trait unique to that species that might have evolved because of ecological pressures."

But the finding that rooks can also use tools raises questions about how this special ability might have come about. Mr Bird said: "Rooks don't have the same pressures [as New Caledonian crows]. In the wild they don't need tools - they have lots of access to other sources of food, like carrion, human rubbish, and seeds from agriculture, things like that."

The researchers said that this could mean that an ancient ancestor of the corvids might have evolved the capacity to use tools as well as a complex understanding of the physical properties of materials.

Dr Emery told BBC News: "Because they don't use tools in the wild, the question is why should they have evolved the ability to use tools in the lab and understand the properties of those objects as tools?

"Is this a form of general intelligence that has been co-opted for tool use?"

The researchers say the finding raises the possibility that other corvid species may also possess an innate ability to use tools.

Smart and social?

Comprehensive analysis questions link between sociality and brain increase in carnivores

Packs of hunting dogs, troops of baboons, herds of antelope: when people observe social animals, they are often struck by how intelligent they seem, and recent studies suggest that sociality has played a key role in the evolution of larger brain size among several orders of mammals. But new research from two evolutionary biologists, John Finarelli of the University of Michigan and John Flynn of the American Museum of Natural History, calls this hypothesis into question—at least for the Carnivora. After a sweeping analysis of many living and fossil carnivore species that places relative increases in brain size in an evolutionary context, Finarelli and Flynn found that increased brain size is not routinely associated with sociality. Their new research paper is being published in this week's Proceedings of the National Academy of Sciences.

"The universality of the Social Brain Hypothesis does not apply," says Finarelli. "When you look at relative brain size from the point of view of the entire evolutionary history of the clade, the story starts to fall apart—at least in carnivores. This study shows that, almost assuredly, brain size is increasing for different reasons in different groups of carnivores."

Flynn adds "When you analyze carnivores group by group, canids alone are responsible for the pattern seen in the recent analysis of the Social Brain Hypothesis." Flynn is referring to a 2007 paper in Evolution that tested the Social Brain Hypothesis, which proposed that sociality has driven the relative increase in brain size among mammals in three speciose orders: carnivores, primates, and ungulates. The evolution of relative brain size is of broad interest in biology, with important implications for ecology, energetics, and life history, and the previous study found correlations between sociality and relative increase in brain size to body size for all three groups.

As part of their broader study of how brain size evolved throughout the Carnivora, Finarelli and Flynn tested the idea in further detail by analyzing 289 terrestrial carnivores, about half of which were fossil species. The fact that so many fossils were included makes this the first study to reconstruct relative brain size across the full span of the evolutionary tree for this group of mammals. Extant carnivores span 15 families and include bears, weasels, cats, dogs, and related species. For all terrestrial carnivore groups, the authors compiled data on endocranial volume (brain size) and body mass, to estimate relative brain size or encephalization. Encephalization data was then used to map changes in relative brain size within specific clades (known as reconstructing a scaling allometry).

Their detailed analysis of the evolutionary history of carnivores documents at least six separate changes in brain sizes for the group, suggesting that the story of brain size increase is far more complex than previously assumed. Some lineages of carnivores have been remarkably stable in relative brain size (for example, one of the two major groups of living carnivores, the feliforms, except for small cats), while others like the extinct bear-dogs (Amphicyonidae) got progressively smaller brains though time when compared to their ancestors. Dogs, on the other hand, have undergone a relatively recent increase in brain size. Finarelli and Flynn determined that this clade skews the data for the modern carnivores that were analyzed in the previous test of the Social Brain Hypothesis; deleting them from the analysis removes any correlation between brain size and sociality in other carnivores. But even though modern canids have large brains, the reason for the relative increase remains unclear: was larger brain size co-opted for sociality, or did sociality drive the brain size increase? The answer might partly lie in previous research by Finarelli analyzing evolutionary changes among dogs. That 2008 study found that the increase in brain size began around 10 million years ago with the appearance of the first representatives of modern dogs.

The relationship between brain size and sociality is variable among living carnivores as well. If social living is the cause of brain size increase for the carnivore order, or evolution of large brains fosters sociality, then the

large-brained bears, small cats, and weasels should be social—but they are not. Carnivores retaining the ancestral condition also do not fit within the picture that the Social Brain Hypothesis would paint; relatively small brained hyenas and mongooses both have social and nonsocial taxa.
"This is a sophisticated and powerful analysis that integrates fossils with extant species of carnivores," says Flynn. "If you only analyze living forms, you often don't correctly reconstruct the evolutionary transformations. Our research shows another example of this, and indicates that the Social Brain hypothesis does not hold for all Carnivora."

What is the function of lymph nodes?

If we imagine our immune system to be a police force for our bodies, then previous work has suggested that the Lymph nodes would be the best candidate structures within the body to act as police stations – the regions in which the immune response is organised. However, Prof. Burkhard Becher, University of Zurich, suggests in a new paper – published in this week's issue of PLoS Biology – that lymph nodes are not essential in the mouse in marshalling T-cells (a main immune foot soldier) to respond to a breach of the skin barrier. This result is both surprising in itself, and suggests a novel function for the liver as an alternate site for T-cell activation.

When a child falls off its bike and scratches its skin, the body responds via the immune system. Scavenger cells at the site of the wound pick up antigens –tiny particles derived from invading microorganisms and dirt that the body will recognize as foreign. These antigens are delivered to the nearest lymph node. T and B cells (immune cells) carrying the matching antigen-receptors on their surface will be stimulated by the concentrated antigen now present in these lymph nodes. T cells will then go on and orchestrate the defensive response against the invaders, whereas B cells will transform into antibody-producing cells flooding the body with antibodies which act against the hostile microorganisms.

Mice that lack lymph nodes due to a genetic mutation (alymphoplasia) are severely immuno-compromised and struggle in fighting infections and tumors. New work by Melanie Greter, Janin Hofmann and Burkhard Becher from the Institute of experimental Immunology at the University of Zurich reports that the immunodeficiency associated with alymphoplasia is not due to the lack of lymph nodes, but caused by the genetic lesion on immune cells themselves. The new paper shows that in the mouse T cell function is unperturbed in the absence of lymph nodes, whereas B cell activation and antibody secretion is strongly affected. That T cell responses can be launched outside of lymph nodes is highly surprising, because this means that T cells can encounter antigens elsewhere in order to become activated. By tracing the migration of fluorescent particles from the site of antigen invasion (i.e. the wound) the scientists discovered that the liver could serve as a surrogate structure for T cell activation. During embryonic development, the liver is the first organ to provide us with blood and immune cells. Apparently, at least in the mouse the liver continues to serve as an "immune organ" even during adulthood.

This work suggests an explanation for the curious fact that patients receiving a liver transplant sometimes inherit the donor's allergies and immune repertoire, so in keeping with the idea that donor immune information is being transplanted. It also suggests that the liver as an immune organ is an evolutionary remnant from the time before lymph nodes developed in higher birds and mammals. Cold-blooded vertebrates have functioning T and B cells but no lymph nodes. The main achievement of the development of lymph nodes in mammals is a drastic improvement for the production of better antibodies. T cells on the other hand have not changed their function much during evolution and the work by the Zurich group finally provides solid evidence for the versatility and promiscuity of this cell type.

Space rock yields carbon bounty

By Jennifer Carpenter Science reporter, BBC News, Toronto

Formic acid, a molecule implicated in the origins of life, has been found at record levels on a meteorite that fell into a Canadian lake in 2000.

Cold temperatures on Tagish Lake prevented the volatile chemical from dissipating quickly.
An analysis showed four times more formic acid in the fragments than has been recorded on previous meteorites.

The researchers told a meeting of the American Geophysical Union that the formic acid was extraterrestrial.

Formic acid is one of a group of compounds dubbed "organics", because they are rich in carbon.

"We are lucky that the meteorite was untouched by humans hands, avoiding contamination by organic compounds that we have on our fingers," said Dr Christopher Herd, the curator of the University of Alberta's meteorite collection.

Samples of the meteorite totalling 850 grams were collected from Tagish Lake in Canada, purchased in 2006 by a consortium including the Royal Ontario Museum and recently subjected to chemical analysis.

The scientists found levels of formic acid four times higher than had previously been recorded on a meteorite. Studies have until recently focused on the Murchison meteorite that landed in a town of that name in Australia in 1969.

"The interesting thing is that we do see this variability between meteorites, seeming to have increased enrichments of one particular compound over another," said Mark Sephton, a meteorite and geochemistry professor at Imperial College London.

"This has for a while been overlooked as we concentrated predominantly on the Murchison meteorite, but now we've got another fresh sample and we can start to analyse a different portion of the asteroid belt and therefore a different portion of the Solar System."

The Tagish Lake meteorite formed before our Solar System

Primordial kitchen

The particular types, or isotopes, of hydrogen that are found in the formic acid show that it most likely formed in the cold regions of space before our Solar System existed.

On Earth, formic acid is commonly found in the stings of insects such as ants, but Professor Sephton it is likely to have been an important "ingredient in the kitchen" on Earth before life began.

The acid is known to act as a "reducing agent" - acting as a magnet for oxygen atoms during chemical reactions - and facilitate the conversion of some amino acids into others.

It may also be implicated in the transformation of the more primitive RNA into DNA.

Only one of the four "nucleobases" that make up RNA and DNA is different between the two: uracil is present in RNA while thymine takes its place in DNA.

Professor Sephton's team found uracil in the Murchison meteorite, but no measurable amount of thymine. However, formic acid is known to help along the reaction that converts the uracil into thymine.

The reaction, he said, is "one of the ways in which you can take some simple molecules and increase the chemical diversity of the pool of pre-biotic molecules".

Green tea extract shows promise in leukemia trials

ROCHESTER, Minn. -- Mayo Clinic researchers are reporting positive results in early leukemia clinical trials using the chemical epigallocatechin gallate (EGCG), an active ingredient in green tea. The trial determined that patients with chronic lymphocytic leukemia (CLL) can tolerate the chemical fairly well when high doses are administered in capsule form and that lymphocyte count was reduced in one-third of participants. The findings appear today online in the Journal of Clinical Oncology.

"We found not only that patients tolerated the green tea extract at very high doses, but that many of them saw regression to some degree of their chronic lymphocytic leukemia," says Tait Shanafelt, M.D., Mayo Clinic hematologist and lead author of the study. "The majority of individuals who entered the study with enlarged lymph nodes saw a 50 percent or greater decline in their lymph node size."

CLL is the most common subtype of leukemia in the United States. Currently it has no cure. Blood tests have enabled early diagnosis in many instances; however, treatment consists of watchful waiting until the disease progresses. Statistics show that about half of patients with early stage diseases have an aggressive form of CLL that leads to early death. Researchers hope that EGCG can stabilize CLL for early stage patients or perhaps improve the effectiveness of treatment when combined with other therapies.

The research has moved to the second phase of clinical testing in a follow-up trial - already fully enrolled - involving roughly the same number of patients. All will receive the highest dose administered from the previous trial.

These clinical studies are the latest steps in a multiyear bench-to-bedside project that began with tests of the green tea extract on cancer cells in the laboratory of Mayo hematologist Neil Kay, M.D., a co-author on this article. After laboratory research showed dramatic effectiveness in killing leukemia cells, the findings were applied to studies on animal tissues and then on human cells in the lab. (See "Green Tea and Leukemia" in Discovery's Edge magazine.)

In the first clinical trial, 33 patients received variations of eight different oral doses of Polyphenon E, a proprietary compound whose primary active ingredient is EGCG. Doses ranged from 400 milligrams (mg) to 2,000 mg administered twice a day. Researchers determined that they had not reached a maximum tolerated dose, even at 2,000 mg twice per day.

Comment: Get real, drug czars

* 26 May 2009 **by Robin Room**

International drug policy has become absurd: it's time world leaders abandoned their futile pursuit of a drug-free world

International drug policy has become absurd: it's time world leaders abandoned their futile pursuit of a drug-free world

ELEVEN years ago, the UN pledged to win the war on drugs within a decade. It has failed.

At this year's meeting of the UN Commission on Narcotic Drugs, held in Vienna in March, there was a two-day session to evaluate the progress since 1998 In his opening remarks, the head of the UN Office on Drugs and Crime, Antonio Maria Costa, claimed "measurable progress". The drug problem has been "contained", he said, and drug use has "stabilised".

International drug policy has become absurd: it's time world leaders abandoned their futile pursuit of a drug-free world

Costa's position flies in the face of the evidence, and by the end of the meeting he was on the defensive. But he said the goal remains the same, and he reiterated the UN's position: that the choice for the world's nations is either to apply strict prohibition or concede to total legalisation.

Soon after the meeting, the US special envoy for Afghanistan and Pakistan, Richard Holbrooke, acknowledged the failure to stamp out poppy farming in Afghanistan. Of the US expenditure of over $800 million a year on counter-narcotics, Holbrooke said: "We have gotten nothing out of it, nothing."

Those in charge of the world's drug control system seem more committed to maintaining the existing policy than to addressing its failures. International discussions on the subject have become absurd, and nowhere is this more apparent than with cannabis. Although cannabis amounts to perhaps 80 per cent of total global illicit drug use, there was scarcely any mention of it in Vienna.

International prohibition of cannabis was established in 1961 under the UN's Single Convention on Narcotic Drugs, a document drafted in a wholly different era when cannabis use was confined largely to small subcultures. Though huge changes since then have rendered it outdated, the status of cannabis remains unchanged and is apparently not up for negotiation.

In Vienna, the only action on cannabis was a resolution from ultra-prohibitionist Japan on cannabis seeds. Its aim was to clamp down on the growing trend of cannabis cultivation in private homes, which Japan claimed was "a global threat".

It doesn't have to be this way. Last year, the UK-based Beckley Foundation published its Global Cannabis Commission Report, of which I was an author. The report sets out how countries might move to fairer and more effective systems of cannabis control. It offers tools for policy-makers to break the stalemate, such as decriminalisation and depenalisation, and evidence on what happens if they are adopted. As the report points out, "that which is prohibited cannot easily be regulated".

A regulated cannabis market offers more options than prohibition for acting to limit harms from use. We need to move beyond the deadlock on drug policy, to transcend the polarisation, and to give serious consideration to the options for change. Cannabis would be a good place to start.

Robin Room is professor of social alcohol research at the School of Population Health, University of Melbourne, Australia, and director of the AER Centre for Alcohol Policy Research at the Turning Point Alcohol and Drug Centre in Melbourne

Oldest evidence of leprosy found in India

BOONE, N.C. – A biological anthropologist from Appalachian State University working with an undergraduate student from Appalachian, an evolutionary biologist from UNC Greensboro, and a team of archaeologists from Deccan College (Pune, India) recently reported analysis of a 4000-year-old skeleton from India bearing evidence of leprosy. This skeleton represents both the earliest archaeological evidence for human infection with Mycobacterium leprae in the world and the first evidence for the disease in prehistoric India.

The study, published May 27 in the open-access, peer-reviewed journal PLoS ONE, demonstrates that leprosy was present in human populations in India by the end of the mature phase of the Indus Civilization (2000 B.C.) and provides support for one hypothesis about prehistoric transmission routes for the disease. This finding also supports the hypothesis that the Sanskrit Atharva Veda, composed before the first millennium B.C., is the earliest written reference to the disease and that burial traditions in the second millennium B.C. in one northwestern Indian village bear some resemblance to practices in Hindu tradition today.

As infectious diseases go, leprosy is still one of the least well-understood, in part because the Mycobacterium is difficult to culture for research and it has only one other animal host, the nine banded armadillo. An Indian or African origin for the disease has often been assumed based on historical sources that support an initial spread of the disease from Asia to Europe with Alexander the Great's army after 400 B.C. Skeletal evidence for the disease was previously limited to 300-400 B.C. in Egypt and Thailand.

A report on genomics of Mycobacterium published in the magazine Science by Monot and colleagues in 2005, indicated the disease may have originated in Africa during the Late Pleistocene and that M. leprae spread out of Africa sometime after 40,000 years ago, when human population densities were small. A counter hypothesis was proposed in the same volume of Science by Pinhasi and colleagues suggesting that the same data could be interpreted as evidence for a Late Holocene migration of the disease out of India after the development of large urban centers.

Possibly the oldest skeletal evidence of leprosy includes tooth loss and root exposure on this 4,000-year-old mandible.

Dr. Robbins and colleagues report on a case of leprosy in a skeleton buried around 2000 B.C. in Rajasthan, India, at the site of Balathal. From 3700-1800 B.C., Balathal was a large agrarian settlement at the margins of the Indus (or Harappan) Civilization. The mature phase of the Indus Civilization during the latter half of the third millennium B.C., was a period of social complexity characterized by urbanization, a system of writing, standardized weights and measures, monumental architecture, and trade networks that stretched to Mesopotamia and beyond.

The presence of leprosy in India toward the end of this period indicates that M. leprae existed in South Asia at least 4000 years ago. This suggests that there may be some validity to Pinhasi and colleagues hypothesis that the disease spread between Africa and Asia during a period of incipient urbanization, increasing population density, and regular inter-continental trade networks. Dr. Robbins is currently attempting to recover ancient DNA from the skeleton to determine if the strain of M. leprae infecting the individual from Balathal is similar to strains common in Africa, Asia and Europe today. If it is successful, this work could shed additional light on the origin and transmission routes of this disease.

Understanding more about the disease can help clear up some of the many popular misconceptions about leprosy. It is generally associated with outcast and neglected people suffering their contagion on the margins of urban centers in late Biblical or Medieval times. In reality, leprosy is transmitted only through prolonged close contact with nasal droplets or infected regions of the body. It is not highly contagious and the infection can remain latent for decades. In fact, most people infected with Mycobacterium leprae have few or very mild symptoms. Because leprosy is not highly contagious and its survival is likely dependent upon dense populations, the association with urban environments is possibly the only accurate part of the popular perception.

The presence of leprosy at Balathal 4000 years ago also supports translations of the Eber's papyrus in Egypt and a Sanskrit text in India (the Atharva Veda) that refer to the disease as early as 1550 B.C. The Atharva Veda is a set of Sanskrit hymns devoted to describing health problems, their causes and treatments available in ancient India. Translations of leprosy have been questioned because it is difficult to perform a differential diagnosis on descriptions in such ancient texts particularly since diagnosis was not why the conditions were being described. The evidence from Balathal indicates that it is possible that the authors were describing leprosy as the disease was present in the subcontinent in prehistoric times.

Furthermore, in contemporary Hindu tradition burial is uncommon unless an individual is a highly respected member of the community (like an ascetic) or is an individual seen as unfit to be sacrificed through cremation. These latter individuals are buried, including outcastes, pregnant women, children under 5, victims of magic or curses, and lepers. During the second millennium B.C., when there was disintegration of Indus settlements and new, smaller settlements sprang up all over the western half of peninsular India, adult burial becomes rare, children under 5 begin to predominate in the skeletal assemblages, and this early leper was one of only five individuals buried at the site of Balathal (the others were middle-aged women, an ascetic from the Early Historic period, and a fragmentary clavicle found with the leprous skeleton). Thus there is a similarity in terms of the demography of the burial populations from the second millennium and Vedic tradition.

In addition, another feature of this burial that resembles Vedic symbolism is the burial site itself. The leper's skeleton was interred within a large stone enclosure that had been filled with vitrified ash from burned cow dung, the most sacred and purifying of substances in Vedic tradition. The presence of this skeleton at Balathal, the manner in which it was interred, and the preponderance of children in burial assemblages from this time period throughout western India suggest deep time for the origin of these practices still common in Vedic tradition today.

Is vitamin D deficiency linked to Alzheimer's disease and vascular dementia?

Hypothesis explored in the current issue of the Journal of Alzheimer's Disease

Amsterdam, The Netherlands, May 26, 2009 – There are several risk factors for the development of Alzheimer's disease and vascular dementia. Based on an increasing number of studies linking these risk factors with Vitamin D deficiency, an article in the current issue of the Journal of Alzheimer's Disease (May 2009) by William B. Grant, PhD of the Sunlight, Nutrition, and Health Research Center (SUNARC) suggests that further investigation of possible direct or indirect linkages between Vitamin D and these dementias is needed.

Low serum levels of 25-hydroxyvitamin D [25(OH)D] have been associated with increased risk for cardiovascular diseases, diabetes mellitus, depression, dental caries, osteoporosis, and periodontal disease, all of which are either considered risk factors for dementia or have preceded incidence of dementia. In 2008, a number of studies reported that those with higher serum 25(OH)D levels had greatly reduced risk of incidence or death from cardiovascular diseases.

Several studies have correlated tooth loss with development of cognitive impairment and Alzheimer's disease or vascular dementia. There are two primary ways that people lose teeth: dental caries and periodontal disease. Both conditions are linked to low vitamin D levels, with induction of human cathelicidin by 1,25-dihydroxyvitamin D being the mechanism.

There is also laboratory evidence for the role of vitamin D in neuroprotection and reducing inflammation, and ample biological evidence to suggest an important role for vitamin D in brain development and function.

Given these supportive lines of evidence, Dr. Grant suggests that studies of incidence of dementia with respect to prediagnostic serum 25(OH)D or vitamin D supplementation are warranted. In addition, since the elderly are generally vitamin D deficient and since vitamin D has so many health benefits, those over the age of 60 years should consider having their serum 25(OH)D tested, looking for a level of at least 30 ng/mL but preferably over 40 ng/mL, and supplementing with 1000-2000 IU/day of vitamin D3 or increased time in the sun spring, summer, and fall if below those values.

Writing in the article, Dr. Grant states, "There are established criteria for causality in a biological system. The important criteria include strength of association, consistency of findings, determination of the dose-response relation, an understanding of the mechanisms, and experimental verification. To date, the evidence includes observational studies supporting a beneficial role of vitamin D in reducing the risk of diseases linked to dementia such as vascular and metabolic diseases, as well as an understanding of the role of vitamin D in reducing the risk of several mechanisms that lead to dementia."

Carbohydrate restriction may slow prostate tumor growth

DURHAM, N.C. -- Restricting carbohydrates, regardless of weight loss, appears to slow the growth of prostate tumors, according to an animal study being published this week by researchers in the Duke Prostate Center.

"Previous work here and elsewhere has shown that a diet light in carbohydrates could slow tumor growth, but the animals in those studies also lost weight, and because we know that weight loss can restrict the amount of energy feeding tumors, we weren't able to tell just how big an impact the pure carbohydrate restriction was having, until now," said Stephen Freedland, M.D., a urologist in the Duke Prostate Center and lead investigator on this study.

The researchers believe that insulin and insulin-like growth factor contribute to the growth and proliferation of prostate cancer, and that a diet devoid of carbohydrates lowers serum insulin levels in the bodies of the mice, thereby slowing tumor growth, Freedland said.

The findings appear in the May 26, 2009 online edition of the journal Cancer Prevention Research. Funding was provided by the United States Department of Veterans Affairs, the Department of Defense Prostate Cancer Research Program; the American Urological Association/ Foundation Astellas Rising Star in Urology Award, and the Robert C. Atkins Foundation.

Animals in the study were fed one of three diets: a very high fat/ no carbohydrate diet; a low-fat/ high carbohydrate diet; and a high fat/ moderate-carbohydrate diet, which is most similar to the "Western" diet most Americans eat, Freedland said. They were then injected with prostate tumors at the same time.

"The mice that were fed a no-carbohydrate diet experienced a 40 to 50 percent prolonged survival over the other mice," Freedland said.

Mice on the no-carbohydrate diet consumed more calories in order to keep body weights consistent with mice on the other study arms.

"We found that carbohydrate restriction without energy restriction – or weight loss – does indeed result in tumor growth delay," he said.

The researchers plan to begin recruiting patients at two sites – Duke and the University of California – Los Angeles – for a clinical trial to determine if restricting carbohydrate intake in patients with prostate cancer can similarly slow tumor growth. The trial should begin within a few weeks.

"It's very exciting – this is a potential new mechanism to fight prostate cancer growth and help patients live longer with their disease," Freedland said.

Microfossils challenge prevailing views of the effects of 'Snowball Earth' glaciations on life

(Santa Barbara, Calif.) — New fossil findings discovered by scientists at UC Santa Barbara challenge prevailing views about the effects of "Snowball Earth" glaciations on life, according to an article in the June issue of the journal Nature Geoscience.

By analyzing microfossils in rocks from the bottom of the Grand Canyon, the authors have challenged the view that has been generally assumed to be correct for the widespread die-off of early life on Earth.

"Snowball Earth" is the popular term for glaciations that occurred between approximately 726 and 635 million years ago and are hypothesized to have entombed the planet in ice, explained co-author Susannah Porter, assistant professor of earth science at UCSB. It has long been noted that these glaciations are associated with a big drop in the fossil diversity, suggesting a mass die-off at this time, perhaps due to the severity of the glaciations. However, the authors of the study found evidence suggesting that this drop in diversity occurred some 16 million or more years before the glaciations. And, they offer an alternative reason for the drop.

This is an exposure of the Chuar Group in Carbon Canyon, Grand Canyon. Carol Dehler

A location called the Chuar Group in the Grand Canyon serves as "one of the premier archives of mid-Neoproterozoic time," according to the article. This time period, before Snowball Earth, is preserved as a sort of "snapshot" in the canyon walls.

The scientists found that diverse assemblages of microscopic organic-walled fossils called acritarchs, which dominate the fossil record of this time, are present in lower rocks of the Chuar Group, but are absent from higher strata. In their place, there is evidence for the bacterial blooms that, the authors hypothesize, most likely appeared because of an increase in nutrients in the surface waters. This process is known as eutrophication, and occurs today in coastal areas and lakes that receive abundant runoff from fertilizers used in farming.

"One or a few species of phytoplankton monopolizes nutrients at the expense of others," said Porter, explaining the die-off of diverse acritarchs. "In addition, the algal blooms result in high levels of organic matter production, which we see evidence of in the high organic carbon content in upper Chuar Group rocks. In fact, the organic carbon content is so high in the upper Chuar Group, oil companies were interested in the Chuar Group as a possible source of oil and natural gas." As a result of high levels of organic matter, oxygen levels in the water can become depleted, resulting in widespread "dead zones." Porter and colleagues also found evidence for extreme anoxia in association with the bacterial blooms.

In an accompanying article describing the process of discovering the microfossils, Porter described a highlight of the trip, "…when we rode through the rapids and descended into 'Powell's bowels' — where the oldest rocks in the Grand Canyon frame the river passage. These rocks formed deep in the Earth approximately 1.8 billion years ago, and are very different in appearance from the overlying rocks."

The scientists braved extreme sun, rattlesnakes, scorpions, and dehydration to gather their data. They traveled by foot, helicopter, and river rafts, the last of which capsized on one occasion — although the samples remained intact.

Space storm caught slamming into Earth's atmosphere

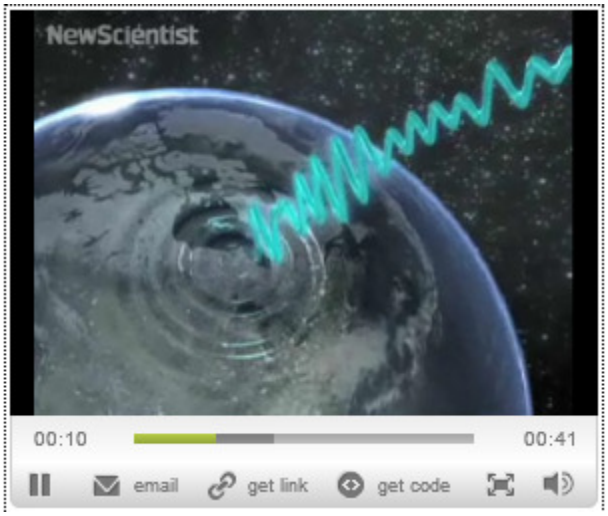
* 18:16 26 May 2009 **by David Shiga**, Toronto

A space storm has been observed exploding from a central point in Earth's upper atmosphere for the first time. The result could one day lead to better predictions of the storms, which can harm satellites and power grids on the ground.

The energy that powers space storms comes from clouds of plasma hurled at Earth by the sun. These clouds stretch our planet's magnetic field like a rubber band, storing energy in a long magnetic tail behind our planet.

The energy released when the field snaps back into place creates the ethereal glow of auroras (see a gallery of the light shows). It also floods the space around our planet with radiation that can incapacitate satellites and sicken astronauts, and can trigger electric currents on Earth capable of knocking out power grids.

Now, scientists have obtained the clearest view yet of the energy that was released in the magnetic tail arriving and initiating a disturbance in Earth's upper atmosphere, or ionosphere.



Video: ***Space storm sighting***

'Rock in a pond'

Jonathan Rae of the University of Alberta in Edmonton led a team that made the observations of the onset of a space storm in March 2007, using a network of cameras and magnetic instruments at ground stations scattered across Canada.

The observations show magnetic ripples in the ionosphere spreading at speeds exceeding 100,000 kilometres per hour from an initial point above Canada. A strong auroral display, characteristic of a space storm, followed less than three minutes later.

"The magnetic oscillations come down and hit the upper atmosphere in a particular location and then spread out from that location," says Rae. "It almost looks like a rock in a pond."

Power down

Scientists hope the new insight into how space storms begin and unfold will help pave the way for better predictions.

"If we can predict these events with some certainty, hopefully more than minutes, maybe hours before they occur, we collectively can take remedial action," says David Kendall of the Canadian Space Agency, which is funding the ground-based observation network. That would allow astronauts to take cover inside their spacecraft and satellites to power down to prevent damage, he says.

Rae reported the results on Monday at a geophysics conference in Toronto.

Journal reference: Journal of Geophysical Research (DOI: 10.1029/2008JA013559)

Diabetes drug shows promise against multiple sclerosis

A drug currently FDA-approved for use in diabetes shows some protective effects in the brains of patients with relapsing remitting multiple sclerosis, researchers at the University of Illinois at Chicago College of Medicine report in a study currently available online in the Journal of Neuroimmunology.

In a small, double-blinded clinical trial, patients with relapsing remitting multiple sclerosis were assigned to take pioglitazone (a drug commercially known as Actos used to treat type-2 diabetes) or a placebo. Patients continued their normal course of therapy during the trial.

Standard neurological tests were done initially, as were MRI scans to provide baseline values for lesions typically seen in MS patients. The patients were evaluated every two months, and blood samples were taken. Repeat MRI scans were done after five months and again after one year.

Patients taking pioglitazone showed significantly less loss of gray matter over the course of the one-year trial than patients taking placebo. Of the 21 patients who finished the study, patients taking pioglitazone had no adverse reactions and, further, found taking pioglitazone, which is administered in an oral tablet, easy.

"This is very encouraging," said Douglas Feinstein, research professor of anesthesiology at UIC. "Gray matter in the brain is the part that is rich in neurons. These preliminary results suggest that the drug has important effects on neuronal survival."

Feinstein's lab has been interested in the class of drugs called thiazolidinediones, or TZDs. Several TZDs have been approved for use in the treatment of type-2 diabetes because of the drugs' effect on the body's response to insulin.

The researchers focused on pioglitazone because of its known anti-inflammatory effects, Feinstein said. They used primary cultures of brain cells to show that pioglitazone reduced the production of toxic chemicals called cytokines and reactive oxygen species. These molecules are believed to be important in the development of symptoms in MS.

Feinstein's lab proceeded to test pioglitazone in an animal model of MS. They and others showed that pioglitazone and other TZDs "can significantly reduce the clinical signs in mice with an MS-type disease," said Feinstein.

"More importantly, when mice who are already ill are treated with pioglitazone, the clinical signs of the disease go away," he said. "We were able to induce almost complete remissions in a number of mice."

"We are now working to determine the mechanisms to explain the protective effect on neurons that we see in our studies," said Feinstein. "We hope to expand into a larger trial to confirm these preliminary results."

A hidden drip, drip, drip beneath Earth's surface

Geologists find 'blob' of material beneath the US West Great Basin

There are very few places in the world where dynamic activity taking place beneath Earth's surface goes undetected.

Volcanoes, earthquakes, and even the sudden uplifting or sinking of the ground are all visible results of restlessness far below, but according to research by Arizona State University (ASU) seismologists, dynamic activity deep beneath us isn't always expressed on the surface.

The Great Basin in the western United States is a desert region largely devoid of major surface changes. The area consists of small mountain ranges separated by valleys and includes most of Nevada, the western half of Utah and portions of other nearby states.

For tens of millions of years, the Great Basin has been undergoing extension--the stretching of Earth's crust.

While studying the extension of the region, geologist John West of ASU was surprised to find that something unusual existed beneath this area's surface.

West and colleagues found that portions of the lithosphere--the crust and uppermost mantle of the Earth--had sunk into the more fluid upper mantle beneath the Great Basin and formed a large cylindrical blob of cold material far below the surface of central Nevada. It was an extremely unexpected finding in a location that showed no corresponding changes in surface topography or volcanic activity, West says.

West compared his unusual results of the area with tomography models--CAT scans of the inside of Earth--done by geologist Jeff Roth, also of ASU. West and Roth are graduate students; working with their advisor, Matthew Fouch, the team concluded that they had found a lithospheric drip. Results of their research, funded by the National Science Foundation (NSF), were published in the May 24 issue of the journal Nature Geoscience.

"The results provide important insights into fine-scale mantle convection processes, and their possible connections with volcanism and mountain-building on Earth's surface," said Greg Anderson, program director in NSF's Division of Earth Sciences.

A lithospheric drip can be envisioned as honey dripping off a spoon, where an initial lithospheric blob is followed by a long tail of material.

When a small, high-density mass is embedded near the base of the crust and the area is warmed up, the high-density piece will be heavier than the area around it and it will start sinking. As it drops, material in the lithosphere starts flowing into the newly created conduit.

Seismic images of mantle structure beneath the region provided additional evidence, showing a large cylindrical mass 100 km wide and at least 500 km tall (about 60 by 300 miles).

"As a general rule, I have been anti-drip since my early days as a scientist," admits Fouch. "The idea of a lithospheric drip has been used many times over the years to explain things like volcanism, surface uplift, surface subsidence, but you could never really confirm it--and until now no one has caught a drip in the act, so to speak."

Originally, the team didn't think any visible signs appeared on the surface.

"We wondered how you could have something like a drip that is drawing material into its center when the surface of the whole area is stretching apart," says Fouch.

"But it turns out that there is an area right above the drip, in fact the only area in the Great Basin, that is currently undergoing contraction. John's finding of a drip is therefore informing geologists to develop a new paradigm of Great Basin evolution."

Scientists have known about the contraction for some time, but have been arguing about its cause.

As a drip forms, surrounding material is drawn in behind it; this means that the surface should be contracting toward the center of the basin. Since contraction is an expected consequence of a drip, a lithospheric drip could well be the answer to what is being observed in the Great Basin.

"Many in the scientific community thought it couldn't be a drip because there wasn't any elevation change or surface manifestation, and a drip has historically always been connected with major surface changes," says West. "But those features aren't required to have the drip. Under certain conditions, like in the Great Basin, drips can form with little or no corresponding changes in surface topography or volcanic activity."

All the numerical models computed by the team suggest that the drip isn't going to cause things to sink down or pop up quickly, or cause lots of earthquakes.

There would likely be little or no impact on the people living above the drip. The team believes that the drip is a transient process that started some 15-20 million years ago, and probably recently detached from the overlying plate.

"This finding would not have been possible without the incredible wealth of seismic data captured by EarthScope's Transportable Array (TA) as it moved across the western United States," says West.

"We had access to data from a few long-term stations in the region, but the excellent data and 75-km grid spacing of the TA is what made these results possible."

This is a great example "of science in action," says Fouch. "We went in not expecting to find this. Instead, we came up with a hypothesis that was not what anyone had proposed previously for the area, and then we tested the hypothesis with as many different types of data as we could find.

"In all cases so far it has held up. We're excited to see how this discovery plays a role in the development of new ideas about the geologic history of the western U.S."

Global Update

Parasites: Giving a Deworming Drug to Girls Could Cut H.I.V. Transmission in Africa

By DONALD G. McNEIL Jr.

Giving an inexpensive deworming drug to millions of girls in rural Africa could substantially reduce transmission of the virus that causes AIDS, researchers say.

The drug praziquantel, which costs only 32 cents per child, would prevent schistosomiasis, a worm disease that starts as a urinary tract infection but, untreated, can lead to female genital sores that make it easier for H.I.V. to enter. Once lesions appear, the drug can kill the worms but not cure the sores, so girls must be protected before they reach sexual maturity.

The New York Times

The study, by researchers from the Sabin Vaccine Institute, Imperial College London and Oslo University Hospital, appears in PLoS Neglected Tropical Diseases.

There are 207 million cases of schistosomiasis in the world, 90 percent of them in Africa. In Africa, humans typically get it from wading into snail-infested water to swim or wash clothes. The worms leave the snails and burrow into the skin; the first symptom is bloody urine.

The success of a pilot program in Burkina Faso suggested that all the 70 million toddlers and school-age children who are infected in Africa could be treated for $22 million; repeating that every two years for a decade would cost $112 million.

"For this relatively small investment, the reproductive health of young women would be improved," the authors wrote, "and there is a reasonable chance that H.I.V./AIDS transmission can be reduced."

Personal Health

A Brain Disorder Easily Missed

By JANE E. BRODY

Edward Ferguson, a civil engineer living in Vancouver, Wash., retired at age 65 from a job handling multimillion-dollar contracts. Five years later he could not balance a checkbook, walk without falling, drive a car, control his bladder or recognize his granddaughter.

Instead of the active retirement he had anticipated, Mr. Ferguson, now 74, thought he would spend the rest of his life in a wheelchair, incontinent and struggling with dementia. Ten doctors were unable to tell him what was wrong, but an Internet search by his daughter found a condition that seemed to match his symptoms: normal pressure hydrocephalus, or N.P.H.

The disorder involves a build-up of spinal fluid in the ventricles of the brain, causing pressure on nerves that control the legs, balance, bladder and cognitive function. "It's as if the brain has reverted to babyhood," Dr. Michael Kaplitt, a neurosurgeon at NewYork-Presbyterian Hospital/Weill Cornell Medical Center, said in an interview. "Like babies, people with N.P.H. walk slowly with feet wide apart, they are incontinent and have no memory."

Dr. Kaplitt calls it "a classic triad of symptoms" that should alert doctors to the possibility of N.P.H.

Yet the condition is frequently misdiagnosed as dementia, Alzheimer's disease, Parkinson's disease or a spinal problem. Or it is attributed to age — nearly all who are affected are over 55.

Living With Uncertainty

"I was the most frustrated person in the world because at no time did a doctor give us a real diagnosis," said Mr. Ferguson's wife, Elva. The suspicions of Mr. Ferguson's daughter eventually led to an accurate diagnosis through an M.R.I. and neurological tests. The Fergusons also found Dr. Jeffrey Chen, the director of neurotrauma for the Legacy Health System in Portland, Ore., who is skilled at treating this often-reversible condition.

Two days after surgery to install a programmable shunt that relieved the pressure on the frontal lobes of his brain, Mr. Ferguson walked across a room for the first time in a year. He was able to think and write clearly, and his incontinence improved.

The Fergusons are now looking forward to their 56th anniversary. Mr. Ferguson, who had contemplated suicide, considers himself to have a second chance at life. "At one point I saw no light at the end of the tunnel," he said, "and now it is just so beautiful there."

A Correctable Problem

No one knows how often N.P.H. occurs because it is so often missed or misdiagnosed. Estimates range from 50,000 to 375,000 people in the United States, with the higher figure more likely to be correct, said Dr. Mark Luciano, a neurosurgeon at the Cleveland Clinic.

"There are a lot of people out there with a correctable problem that is attributed to old age," Dr. Luciano said. "When the problem is fixed, it's like rescuing them from oblivion. A small percentage of people with dementia — maybe 10 or 15 percent — really have N.P.H."

The disorder was recognized and named in 1965. But most doctors who treat older people are unaware of it or fail to think of it when treating patients with classic, albeit confusing, symptoms.

In most cases, the cause of N.P.H. is unknown. Some patients had suffered a severe head injury, stroke, meningitis or a brain tumor, perhaps decades earlier, which may have caused scarring or inflammation that gradually interfered with drainage of spinal fluid.

Dr. Kaplitt explained that each day the brain normally produces "about two soda cans' worth of spinal fluid." This fluid protects the brain's soft tissue, which floats in the skull. Made deep in the brain, spinal fluid flows through a series of channels to the brain's four ventricles and finally exits to outside the brain and spinal cord.

Each day the same amount of spinal fluid that is produced must be reabsorbed into the bloodstream. But if something slows or blocks its path, it builds up in the ventricles, which expand and press on nerves in the brain.

Diagnosis and Treatment

Normal pressure hydrocephalus is best diagnosed by a team that includes a radiologist, neuropsychologist and neurologist or neurosurgeon experienced in distinguishing this condition.

The best clue often comes from a careful medical history, since N.P.H. typically starts with gait problems, Dr. Luciano and his colleague, Dr. Ronan Factora, a geriatrician at the Cleveland Clinic, reported last year in the journal Geriatrics.

Cognitive impairment typically does not precede gait problems, they said, but when it does, or when dementia has become severe, the response to treatment is lessened. Incontinence, which starts out as urinary urgency, can occur at any point in the disease, and is often worsened by problems with walking or dementia.

Although there is no one route to diagnosis, if N.P.H. is suspected, a CT scan or M.R.I. of the brain can reveal one or more enlarged ventricles, an essential feature of the condition. On an M.R.I., Dr. Kaplitt said, the spinal fluid often is cloudy or turbulent.

Treating N.P.H. involves inserting a shunt into the brain to drain off accumulating spinal fluid and divert it to the abdomen, where it can be reabsorbed into the bloodstream. The ideal shunt has a valve and can be reprogrammed to regulate the drainage. Repeat surgery is a possibility if the shunt drains off too much or too little spinal fluid. While the shunt is not a cure for N.P.H., in the 70 to 80 percent of patients who benefit from it, it may give them a decade or more of near-normal life, the experts said.

To locate support groups and centers that can diagnose and treat N.P.H., you might check the Web site established by Codman, the maker of a programmable shunt, www.lifenph.com.

Essay

Referral System Turns Patients Into Commodities

By SANDEEP JAUHAR, M.D.

I was chatting recently with a doctor friend who was depressed because he thought he had lost a referral source.

"This internist was sending me patients," he told me, as I recall. "Then last month he sent me only one patient. And this month only one patient."

I nodded hesitantly, unsure what he was driving at.

"So I understand something must have happened," he said.

"Like what?" I asked.

He threw up his hands, exasperated by my obliviousness. "He met someone else! He developed a relationship with another cardiologist."

I smiled at the overwrought response, with its connotations of a romantic breakup. But to my friend, this was no joke. Like most specialists, his livelihood depends on referrals. And like most, he will go to great lengths to preserve his

referral sources.

Physician-to-physician referrals are the currency of day-to-day transactions in medicine, but as with any currency, they can be manipulated.

Logic says that a referral should depend only on a patient's needs and the reputation and skill of the physician to which the patient is referred. But medicine is a business too, so that isn't how it always works in practice.

The talk springs up in every doctors' lounge: "Dr. X is opening shop — let's give him some business." When my wife told me she wanted to start an endocrinology practice, I reassured her that I would send patients to her, and that so would my brother, also a doctor, and his friends. As far as I can tell, there are no restrictions on such a practice.

Studies suggest that physicians receive up to 45 percent of new patients by referral, usually from other physicians. Referral rates to specialists in the United States are estimated to be at least twice as high as in Great Britain. The rates reflect several aspects of American medicine: increasing specialization, the lack of time for any doctor to give to complex cases, and fear of lawsuits over not consulting an expert. At the same time, referrals are a way for cash-strapped doctors to generate business.

When I was in training, simple referrals from internists, like patients with only mild hypertension, bothered me as a waste of time. Now that I am in practice, I welcome them. I haven't changed my mind that these referrals are probably unnecessary, and there is plenty of evidence that wasteful expert consultation is adding to health costs and creating redundant care. But as a full-fledged doctor, I appreciate the business. It is hard not to view a referral as an overture from another physician, and it is equally hard not to return the favor.

A sort of paradox is at work. Specialists are better paid than primary care physicians, but they are also less autonomous because, unlike primary care physicians, they depend on other doctors for referrals. There is pressure on specialists to keep referral sources happy, especially in doctor-saturated metropolitan areas like New York City.

There are limits, of course, on the autonomy of referring physicians, too. For instance, by federal law a doctor cannot refer patients to himself or to a business in which he has a significant financial stake, like a laboratory or imaging center, and he cannot be paid for a referral. The reasoning is that such behavior can interfere with clinical judgment, decrease quality and increase costs.

In 2006, Tenet Healthcare Corp., based in Dallas, agreed to pay $21 million to settle a whistleblower lawsuit asserting that a hospital it owned in San Diego had paid kickbacks to physicians for referrals. (Tenet did not admit wrongdoing.) That same year, a New Jersey teaching hospital was investigated for giving sham salaries to community doctors in a reported attempt to increase the number of referrals to its cardiac surgery program. Two cardiologists pleaded guilty to federal fraud charges.

But there are gray areas in practice. The Office of the Inspector General in the Department of Health and Human Services has investigated office space rentals, for example. Across the country, mobile medical imaging companies have made arrangements with internists to perform, in their offices, cardiac ultrasounds, which the companies send to cardiologists for interpretation. Insurance companies that cover the imaging pay the companies, and the companies pay rent to the internists. By law, these rent payments must reflect fair market value and be unrelated to the volume of patients referred by the internists for imaging. But according to doctors familiar with these agreements, that isn't always the case.

"Obviously you get more rent if you provide 50 patients than if you provide 5," an internist on Long Island, who did not want his name used, told me.

When I asked whether it wasn't just a form of a kickback, he shrugged.

"When the companies take more time, they have to pay more rent," he said. "You don't say it is per patient; you say per hour. But patients equal time."

Though he no longer participates in these contracts, he was open about the payments — about $100 per patient — and he saw nothing wrong with them. "As internists, we don't bill for procedures, so we have to figure out another way to make money," he said. "Every little bit helps."

Whether the rent payments amount to indirect kickbacks is an open question still being investigated by the inspector general. The real issue, I think, is not the rentals but a referral system that is too easily corrupted. There is so much pressure to generate referrals that lines become crossed.

Our health care system needs a different approach, one in which patients are not treated as commodities.

One possibility is what Gail Wilensky, a health policy expert, argued for this year in The New England Journal of Medicine: a single payment that would cover all physician services and hospital care for any one patient. A major driver of referral proliferation is that doctors are paid piecework. There is less of an incentive to increase volume if payments are bundled rather than discrete for every service.

A bundled-payments system is already in place for hospitals, dialysis centers and nursing homes. Extending such a strategy to individual doctors' payments seems to be the logical next step.

Sandeep Jauhar is a cardiologist on Long Island and the author of the recent memoir "Intern: A Doctor's Initiation."

Basics

Fungi, From Killer to Dinner Companion

By NATALIE ANGIER

According to Roman legend, there once was a cruel boy who tortured a fox by tying straw to its tail and then setting the straw ablaze. The god Robigus was so outraged that he punished humanity with wheat rust, a fungal nightmare that leaves crops looking as though they had been burned. For centuries afterward, the Romans sought to appease the deity through annual sacrifices of dogs and cows unlucky enough to have rust-colored fur.

Robigus, Lord of Fungus, is still furiously among us, but these days he's collecting his sacrificial spoils personally. In the eastern United States, thousands of cave-dwelling bats have died of an aggressive fungal disease called white-nose syndrome, and hundreds of thousands if not millions more are at risk of contracting the condition. Frogs and salamanders worldwide are dying in catastrophic numbers, very likely of a fungal disorder called chytridiomycosis, which clogs an amphibian's skin and deranges its blood chemistry. Forests along the western and southern coasts of North America are withering as a result of fungal blooms injected into the wood by pine-boring beetles.

Serge Bloch

We have already lost our majestic American chestnut trees to blight and our favorite shade trees to Dutch elm disease. Can't we just break out a few giant bombs of Ajax and wipe the world clean of its infernal fungus, its allergenic mold and sporulating mildew, its rot and blight, smut and rust, its jock itch and athlete's foot that can plague even the most devoted couch morel?

We can never rid the world of its fungus, of course, nor would we want to. Fungi represent a kingdom unto themselves, up there in taxonomic sovereignty with the kingdoms Animalia and Plantae, the bacteria and the protists. Some 100,000 species of fungi have been tallied, and scientists estimate that at least another 1.5 million remain to be discovered.

Fungi are everywhere, on every continent and in every sea, floating in the air, lacing through the soil, resting on your skin, colonizing mucosal cavities within, and festively decorating that long-neglected peach. And though some fungi are pathogenic and will kill the living tissue they have penetrated, the vast majority are benign, and many are essential to the life forms around them.

"They are the major decomposers," outdoing even bacteria, worms and maggots in their saprophagic industry, said David J. McLaughlin, a mycologist at the University of Minnesota. If you want true antisepsis, look to the fruits of Robigus.

Fungi also have a talent for symbiosis, for establishing cross-kingdom quid pro quos that keep the fungus fed and happy while lending its partner vast new powers. Maybe 90 percent of all land plants depend on the so-called mycorrhizal fungi that stipple their roots and feed modestly on their plant sugars to in turn supply them with nutrients from the soil like phosphorus and nitrogen. And botanists suspect that plants might never have made the leap onto land some 500 million years ago without their mycorrhizal assistants.

Fungus may well have given rise to human culture, or at least the comedy of human comity. For a loaf of bread to break with old friends and a jug of wine to help forge new ones, we can thank the fungus Saccharomyces, baker's and brewer's yeast.

More recently, Saccharomyces has served as an agreeable model organism in the laboratory, an excellent way to explore how genes behave and cells divide and a much cheaper date than a rodent. Fungal cells turn out to be surprisingly similar to animal cells, and researchers recently determined that the fungal and animal lineages didn't split from each other until millions of years after both had branched away from the plants.

The defining traits of a fungus are gustatory and architectural. Whereas animals ingest a meal first and then digest it internally, fungi do the reverse. After latching on to a suitable food source, they release enzymes to break down the substance into a soupy mash of sugars and amino acids, which they can then absorb through the membranes of their filamentous hyphae. Some fungi remain simple, even unicellular, but others can sprout elaborate fruiting bodies packed with billions of microscopic spores, billions of wistful homuncular fungi.

The most familiar fruiting bodies are the mushrooms, with their vivid pigments of inscrutable purpose and their still more inscrutable forms — here a swollen pink pincushion or a bird's nest filled with eggs, there a protruding black tongue or a batch of bright butter coral. Given sufficient food and room, the filaments of a founding fungus may grow over thousands of acres of soil and persist for centuries or millennia, all the while

spawning genetically identical mushrooms above ground, and biologists have argued that such hyphal masses qualify as some of the largest and most ancient organisms on Earth.
Most fungi are adapted to grow in cool or foresty temperatures, maybe 60, 70 degrees Fahrenheit, which is why the pathogens among them tend to prey on plants, or cold-blooded animals like insects, reptiles or amphibians.

Even then, most fungal diseases are not fatal, and the virulent strain that is thought to be involved in today's mass amphibian die-offs may have been introduced into natural populations by frogs used in medical research.

With their hot body temperatures, mammals and birds suffer from few fungal diseases save those confined to the coolish epidermis. Bats are mammals, but the species now afflicted by white-nose syndrome are cave-hibernating bats, and when the bats lapse into their hibernation torpor, said David S. Blehert, a microbiologist with the United States Geological Survey's National Wildlife Health Center in Madison, Wis., their core body temperature drops down to just a couple of degrees above cave conditions, as low as 44 degrees.

"This pathogen is treating the bats as if they were forgotten tubs of cottage cheese in the back of the refrigerator," Dr. Blehert said. Moreover, the fungus appears to be unusually virulent. "We're seeing in excess of 90 percent mortality at some sites," Dr. Blehert added.

Since the disease was first identified west of Albany in March 2007, it has spread to bats in nine states and is on the cusp of reaching bat populations that aggregate in groups 300,000 strong, "the largest colonies of hibernating mammals known on the planet," Dr. Blehert said. In an effort to block the pathogen's passage, wildlife authorities are closing off caves to human traffic, for now the only measure they can think of to keep the wrath of Robigus at bay.

Q & A

Barnyard Pestilence

By C. CLAIBORNE RAY

Q. Did all human infectious diseases originate in domesticated animals?
A. Of 25 infectious diseases that have historically caused high mortality in human beings, many probably or possibly reached humans from domesticated animals, according to a major review article published in Nature in 2007.

The main ones among so-called temperate diseases are diphtheria, influenza A, measles, mumps, pertussis, rotavirus, smallpox and tuberculosis. Three others probably came from apes (hepatitis B) or rodents (plague and typhus), the review says, and four other temperate diseases (rubella, syphilis, tetanus and typhoid) came from sources that are still unknown.

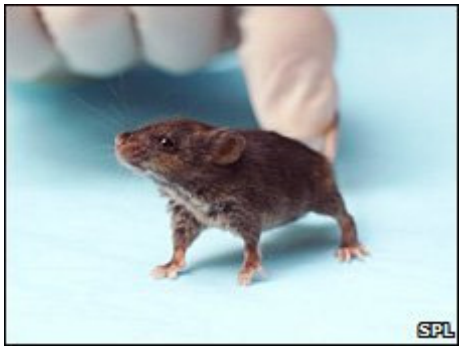
Among the important tropical diseases, the review says, domestic animal origins can be ruled out for 6 of the 10: AIDS, dengue fever, vivax malaria and yellow fever, all derived from wild primates; cholera, from aquatic algae and invertebrates; and falciparum malaria, from birds. The case is not clear for Chagas' disease, West and East African sleeping sickness and visceral leishmaniasis, because the ancestors of the agents that cause them infect both domestic and wild mammals.

The strong links to domestic animals for the temperate diseases is tied to the rise of agriculture, 11,000 years ago, which allowed human populations to survive and pass on the diseases and brought these populations into frequent contact with source animals. The main reason few tropical diseases arose from domestic animals is that such animals have historically been concentrated mainly in the temperate zones. The sole abundant domestic animal to have originated in the tropics is the chicken, from Southeast Asia.

Mouse genome laid bare to science

By Paul Rincon Science reporter, BBC News

Scientists have finished sequencing the mouse genome after a 10-year effort. The humble mouse is the experimental workhorse in laboratories worldwide, so this high-quality genome sequence will aid in the fight against human disease. The search for novel treatments could benefit from a greater understanding of the mouse genetic code, which is about 75% similar to our own. An international team of researchers have published details of the work in the open-access journal PLoS Biology.



It took scientists a decade to sequence the complete genome

The sequence comprises the full complement of genetic material in the nucleus of a cell. It is effectively the genetic "instruction booklet" for a living animal.

The mouse (Mus musculus) becomes only the second mammal after humans to have its complete genome laid bare.

But draft sequences have been published for the chimp, dog, rat, cat, macaque and even the duck-billed platypus

The mouse is the animal most often used to better understand human illnesses and how they develop.

Research carried out using mice has led to advances in the treatment of cancer, diabetes, heart disease and countless other conditions.

Good model

Co-author Professor Chris Ponting, from the University of Oxford, told BBC News the work confirmed that the mouse was an excellent experimental model for human disease. "Completion of the genome is extremely important in helping us to identify the genes that underpin biology that is the same across all mammals," he said.

But he said it was also important to separate the genes humans shared with mice from those which differed between them.

About 75% of mouse genes have a single equivalent in humans. But some 5,000 genes arose after the ancestors of mice and humans went their separate evolutionary ways.

"In retrospect, our previous picture of the mouse genome was incomplete," said Dr Leo Goodstadt from the University of Oxford.

"Only when all the missing pieces of the genomic puzzle had been filled in did we realise that we had been missing large numbers of genes found only in mice, and not in humans."

The mouse genome sequencing effort began in 1999, and a draft sequence was published in 2002.

The cost, borne by US and UK sequencing centres, is estimated to exceed $100m (£62m).

Some groups oppose animal experimentation, campaigning to ban or limit the animals used.

In the UK, growth in the use of genetically modified (GM) animals - mainly mice - is largely responsible for a steady rise in the numbers of animals used in experiments since 1997.

Professor Ponting, from the Medical Research Council's (MRC) Functional Genomics Unit at Oxford, said the complete genome could provide insights into the evolution of mammals.

Humans and mice share a remarkable level of similarity, despite having evolved independently for the last 90 million years.

Giant dinosaurs 'held heads high'

By Victoria Gill Science reporter, BBC News

Diplodocus's impressive neck sweeps along the main hall of London's Natural History museum, welcoming its visitors.

Now, findings suggest that 150 million years ago the giant may have held its head higher for much of the time.

By studying the skeletons of living vertebrates, Mike Taylor, from the University of Portsmouth, and his team, reshaped the dinosaur's resting pose.

But there is more than one way to assemble a dino-skeleton, and more than one theory on the sauropods' stance.

Dr Taylor said he is not suggesting that museums should re-pose their long-necked sauropod skeletons from the current horizontal position to a more upright posture.

"The diplodocus in the main hall vestibule of the Natural History Museum is in a perfectly good posture," he told BBC News. "It's one within a whole range of movement that would have been entirely possible."

But, after studying X-rays of members of 10 different vertebrate groups, Dr Taylor is convinced that when they were not reaching down for a drink, the sauropods stood with their heads held very high indeed.

With their necks aloft, like giraffes, the dinosaurs would have towered up to 15m above the ground.

Living model

Dr Taylor and his colleagues found that the necks of mammals and birds - the only modern groups that share the upright leg posture of dinosaurs - are "strongly inclined" vertically.

"Our approach was embarrassingly straightforward," said Dr Taylor. "We looked at real animals, and at the whole animal."

Bones can only give us so much information, he explained, and the soft tissue in the animal's huge neck could "enable greater flexibility than the bones alone suggest".

Some of the earliest reconstructions of sauropod skeletons - in the late 19th and early 20th Century - were posed with erect necks, so the idea is not new.

"It's largely in recent years that this view has changed," Dr Taylor said.

"But we can be confident that they held their heads upright."

Many scientists, however, still maintain a more horizontal view.

And a recent paper, published by Australian scientist Roger Seymour in the journal Biology Letters, went even further.

It suggested that the creatures would not actually be able to lift their heads up to eat from high trees, because this would raise their brains so far above their hearts that their blood pressure would have to be elevated to a dangerous - possibly lethal - level.

But Dr Taylor is not swayed by this argument.

"There are some [living animals] where the heart is able to exert much greater pressure than Seymour's equations predict [is possible]. We don't see why that couldn't also be true in sauropods."

Sauropod (Walking with Dinosaurs)

Heads up

Paul Barrett, a palaeontologist from London's Natural History Museum, thinks the sauropods were likely to have been able to lift their heads high, but he remains unconvinced that would have been their "resting posture".

"It would require lots of muscular activity, and put a lot of strain on their hearts," he said.

Dr Barrett explained that, since it is impossible to know how thick the pads of connective tissue between the dinosaurs' vertebrae were, it is difficult to estimate how much of a role this tissue, along with muscles and tendons, played in the animals' range of movement.

"Sauropods are bizarre," he told BBC News. "There is no living animal built in the same way."

So, although the study of living animals' skeletons is very valuable, he added, "finding a model to explain the biology of these creatures is not that easy".

Religions owe their success to suffering martyrs

* 27 May 2009 **by Bob Holmes**

WHAT is the difference between Jesus Christ and Superman? The content of religions and popular tales is often similar, but only religions have martyrs, according to an analysis of behavioural evolution published this week.

When religious leaders make costly sacrifices for their beliefs, the argument goes, these acts add credibility to their professions of faith and help their beliefs to spread. If, on the other hand, no one is willing to make a significant sacrifice for a belief then observers - even young children - quickly pick up on this and withhold their own commitment. "Nobody takes a day off to worship Superman or gives money to the Superman Foundation," points out Joseph Henrich, an evolutionary anthropologist at the University of British Columbia in Vancouver, Canada.

The more costly the behaviour, the more likely it is to be sincere: few would willingly give their life for an ideal they did not believe in, and devotees who take vows of poverty or chastity are clearly putting their money where their mouth is. Such credibility-enhancing displays are even more effective if performed by a high-status individual such as a priest or other leader, says Henrich.

Once people believe, they are more likely to perform similar displays themselves. Henrich created a mathematical model to test his ideas and showed that this self-reinforcing loop can stabilise a system of beliefs and actions, and help them persist through many generations (Evolution and Human Behavior, DOI: 10.1016/j.evolhumbehav.2009.03.005).

This dynamic helps explain why so many religions involve costly renunciations. For example, Henrich notes that the persecution of early Christians by Roman authorities may have spread Christian beliefs by allowing believers to be martyred for their faith - the ultimate credibility-enhancing display.

The principle applies to other social movements too. Studies of 19th-century utopian communes such as Hutterites and Shakers show that those making the strictest demands on their followers were most likely to persist, says Henrich. "You can see the changes in action. The number of those costly commitment rituals increases over time."

Henrich's analysis fills an important hole in our understanding of the rise of religions, says Richard Sosis, an anthropologist at the University of Connecticut in Storrs.

The hypothesis still needs to be tested, for example with lab experiments on belief transmission, and historical studies of religions. But if Henrich is right, churches that liberalise their behavioural codes may be sabotaging themselves by reducing their followers' commitment. This may explain why strict evangelical Christian churches are expanding in the US at the expense of mainstream denominations. "To be a member you've got to walk the walk and talk the talk," says Henrich. "And this transmits deeper faith to the children."

What goes down, must come up: Earth's leaky mantle

Geoscientists offer new model for degassing of Earth's mantle

HOUSTON -- A new analysis of the processes that constantly stir the Earth's deep mantle is helping to explain how the mantle holds onto a portion of ancient noble gases that were trapped during the Earth's formation.

The research, which appears this week in the journal Nature, takes aim at a question that has vexed geoscientists for years: how to reconcile leading theories about the convection of Earth's mantle with observations of ancient noble gases in volcanic rocks. Researchers at Rice University and Harvard University developed a new model to explain how noble gases -- elements like helium, neon and argon -- are lost from the Earth's interior during mantle convection.

"Most existing models find that convection should have left the mantle extensively depleted in ancient noble gases, unless part or all of the lower mantle has been somehow isolated," said study co-author Helge Gonnermann, assistant professor of Earth science at Rice. "We set out to see if there was a mechanism that could both preserve ancient noble gases in the lower mantle and still be consistent with the existing framework for whole mantle convection."

On human timescales, the Earth's surface seems to change very little. But geoscientists know the planet's topmost layer, or lithosphere, is actually a series of interlocking tectonic plates that are in constant motion. When plates collide, mountain ranges form, and when they pull apart, as happens deep beneath the oceans, new crust forms by partial melting of the uppermost mantle. Plates also slide one beneath another in a process known as subduction, and seismologists discovered about 15 years ago that some subducted plates plunge deep into the Earth. In some cases, they even sink across the mantle transition zone, a layer about 660 kilometers deep that divides the Earth's upper and lower mantle.

"This was a real problem because the prevailing view in geoscience was that only the upper mantle was involved in this plate tectonic recycling process," Gonnermann said. "One reason people believed this was because there appear to be relatively high concentrations of ancient noble gases in ocean island basalts, volcanic rocks found at volcanic island chains, such as Hawaii."

One of these ancient noble gases is helium-3, an isotope of helium that isn't created by any process inside the Earth. Consequently, scientists know that virtually all the helium-3 found on Earth is left over from the planet's formation. Helium-3 tends to get released from the mantle when it rises to form new crust. As the mantle cycles, from mantle to ocean crust and back to mantle again, geochemists expect to see less and less helium-3. While this is what's observed in most basalt rocks formed from lavas erupting at mid-ocean ridges, there are exceptions, particularly in basalt rocks from Hawaii and other volcanic ocean island chains.

Ocean island chains are thought to form when mantle plumes rise from the lowermost mantle to the Earth's surface, where the mantle undergoes partial melting to produce basalt magma.

"The presence of ancient noble gases in these basalts implies that they have remained locked inside the lower mantle since the Earth formed about 4.5 billion years ago," Gonnermann said. "In contrast, most of these ancient noble gases appear to have leaked out of the upper mantle, because the plate tectonic recycling process allows noble gases to escape with the basalt magma as it continuously forms new ocean crust at mid-ocean ridges."

In the new study, Gonnermann and longtime collaborator Sujoy Mukhopadhyay, a Harvard geochemist, developed a model that could reconcile convection involving the lower mantle with the helium-3 measurements found in ocean island basalts.

The model suggests that both the upper and lower mantle are involved in convection, but it affects them in different ways. Whereas the upper mantle has been extensively degassed through repeated tectonic cycling, the lower mantle has been recycling approximately once during the past 4.5 billion years.

Continuous mixing of subducted plates into the lower mantle has been diluting the concentrations of ancient noble gases there. Instead of extracting ancient noble gases at their original concentrations, progressively smaller amounts are extracted at any given rate of tectonic cycling. Consequently, about 40 percent of the ancient helium-3 can still be present in the lower mantle, even though it may have undergone one complete tectonic cycling over the past 4.5 billion years.

"Contrary to the conventional view that tectonic cycling of the lower mantle should result in extensive mixing between the lower and upper mantle, thereby erasing any differences in helium-3, we find that much of the tectonic cycling of the lower mantle essentially bypasses the upper mantle," Mukhopadhyay said. "What goes down must come up: Slabs that subduct and mix into the lower mantle are balanced by mantle plumes, rich in helium-3, which rise from the lower mantle to the Earth's surface without mixing significantly as they traverse the upper mantle." *The research is supported by the National Science Foundation and the University of Hawaii.*

Rising sea levels: Survival tips from 5000 BC

* 26 May 2009 **by Catherine Brahic**

WITH rising seas lapping at coastal cities and threatening to engulf entire islands in the not-too-distant future, it's easy to assume our only option will be to abandon them and head for the hills. There may be another way, however. Archaeological sites in the Caribbean, dating back to 5000 BC, show that some ancient civilisations had it just as bad as anything we are expecting. Yet not only did they survive a changing coastline and more storm surges and hurricanes: they stayed put and successfully adapted to the changing world. Now archaeologists are working out how they managed it and finding ways that we might learn from their example.

The sea-level rise that our ancestors dealt with had nothing to do with human-induced climate change, of course: it was a hangover from the last ice age. As the massive ice sheet that lay on North America melted, the continent was buoyed upwards. As a result, the northern Caribbean, on the other end of the same tectonic plate, sank, making seas in the region rise up to 5 metres over 5000 years.

Although the cause of this rise was very different to what we face today, the effects were probably the same. Rising waters not only nibble away at coastlines, they also mean that hurricanes and storm surges reach further inland. Higher seas also mean that groundwater becomes contaminated with salt, and as the water table rises the waterlogged land becomes more likely to flood.

Despite these changes, excavations of ancient houses in what is now the province of Ciego de Avila in northern Cuba suggest that the region was inhabited between 5000 BC and just 300 years ago. One of the best-preserved ancient sites is the village of Los Buchillones (see image), now 150 metres out to sea, which was inhabited from AD 1260 until the mid-1600s by people known as the Taino. For Jago Cooper, an archaeologist at the University of Leicester, UK, who studies the site and others across the Caribbean, the village provides a rare chance to study the pinnacle of Taino knowledge (see image). "The people at Los Buchillones represent a way of living that capitalises on hundreds or even thousands of years of experience of living in the area," he says.

So how did they survive as the waters rose? The first clue comes in the proverbial wisdom that every real estate agent knows: location, location, location. Palaeoclimatologist Matthew Peros of the University of Ottawa in Canada and his colleagues have taken sediment cores between the modern shore and the remains of the village, and these show that houses in Los Buchillones were built on stilts over a lagoon (see image). The land barrier that lay between the lagoon and the ocean would have provided the village with some protection from storm surges. Other settlements in the area were in similarly protected pockets, or built on the leeward side of hills. Building in sheltered spots may seem an obvious precaution, but Cooper argues it's a crucial bit of know-how that the region has since lost. Modern towns and cities, he says, tend to be in more vulnerable, exposed places.

Perhaps surprisingly, building over water may also have made the homes less at risk of flooding. While living in the hills or on higher ground inland may seem a safer bet as the coast becomes less predictable, flood water rushing down hillsides during storms can destroy even the sturdiest house. Building over the lagoon meant that flood water, whether rushing in from the sea or down from the land, could pass underneath the house, minimising damage. This approach seemed to work: radiocarbon dating of Taino posts has shown that they were in place for hundreds of years. What's more, the bark is still on the posts, which tells Cooper that they had never been knocked over and reset. "Unless you're an archaeologist, you can't remove them from the mud without the bark coming off," he says. Older coastal sites elsewhere in the Caribbean have evidence of similar posts, suggesting that the locals may have developed stilted architecture over the centuries to deal with the fickle elements.

While the stilts were deliberately sturdy (see image), the rest of the house was quite the opposite. In 1998, a team led by David Pendergast of the Royal Ontario Museum in Toronto, Canada, unearthed the remains of an entire Taino house, with beams, rafters, roof timber and the palm leaves that made up the house's thatch all collapsed on top of each other.

Living in flimsy, thatched, wooden houses may seem a bad choice, given the extreme weather the Taino were exposed to, but it could actually have been a sensible strategy. Before the arrival of Europeans, villages were often sited close to caves. Because the same caves are used as storm shelters today, archaeologists speculate that the ancient people abandoned their homes for the caves when conditions got too dangerous to stay put. When the storm had passed, they could go home and rebuild, replacing lost thatch and beams within a couple of days, says Cooper. By contrast, modern houses in Cuba are made of concrete or brick, making them expensive and laborious to rebuild after a hurricane.

Clearly, convincing coastal populations to abandon their homes and possessions when a storm appears is unlikely to be popular today. Even so, there are lessons to learn from this style of building. Houses built on sturdy stilts could allow people to remain on the coast in spite of rising sea levels, provided that safe havens built further inland could house the entire population in a storm. This approach has begun to be used in the

Maldives after the 2004 tsunami made 20 islands in the archipelago uninhabitable (New Scientist, 9 May, p 37)Movie Camera. Using local materials to build houses would also make them cheaper and easier to rebuild.

Homes, of course, are only one part of what it takes to maintain a civilisation. People need food too. Cooper and his colleagues have found evidence that, along with growing crops, and collecting shellfish and other marine food, the Taino gradually diversified their diet, fishing in new areas and trading food with inland villages. Widening their food options in this way may have acted as insurance when times got tough.

Other civilisations in the region took a different approach. In Belize, rising sea levels meant that some regions were completely transformed. Pollen and ash remains show that 2000 years ago the Mayans were growing maize with slash-and-burn agriculture in some areas that over the course of later centuries became permanently flooded wetlands. Despite this, the people stuck around and, amazingly, continued to grow their crops. They did this by digging huge networks of drainage channels and raising their fields so that roots sat above intruding seawater. Some researchers speculate that they made the best of a bad situation by catching fish, and hunting turtles and waterfowl from the canals.

There are useful lessons here, says Tim Beach of Georgetown University in Washington DC, who has studied the Mayan channels. "There is little doubt we will have to adapt to sea-level rise, and the Maya did it with wood and stone tools," he says. "These are low-cost approaches that developing countries may want to use, where they cannot afford dams and dykes to keep out the sea."

There is little doubt we will have to adapt to sea-level rise, and the Maya did it with wood and stone tools

Of course, we now have several advantages over these ancient communities. In place of stone tools we have industrial machinery. In place of the spirits the ancient Taino used to help forecast storms we have live satellite forecasts. But for all our modern technology, as the sea threatens to reclaim the coasts once again, we may have much to learn from the ancient people who took it all in their stride.

Catherine Brahic is New Scientist's environment reporter

Geographic isolation drives the evolution of a hot springs microbe

CHAMPAIGN, Ill. — Sulfolobus islandicus, a microbe that can live in boiling acid, is offering up its secrets to researchers hardy enough to capture it from the volcanic hot springs where it thrives. In a new study, researchers report that populations of S. islandicus are more diverse than previously thought, and that their diversity is driven largely by geographic isolation.

The findings open a new window on microbial evolution, demonstrating for the first time that geography can trump other factors that influence the makeup of genes an organism hosts.

S. islandicus belongs to the archaea, a group of single-celled organisms that live in a variety of habitats including some of the most forbidding environments on the planet. Once lumped together with bacteria, archaea are now classified as a separate domain of life.

"Archaea are really different from bacteria – as different from bacteria as we are," said University of Illinois microbiology professor Rachel Whitaker, who led the study.

Whitaker has spent almost a decade studying the genetic characteristics of S. islandicus. The new study, in the Proceedings of the National Academy of Sciences, compares three populations of S. islandicus, from hot springs in Yellowstone National Park, Lassen National Park in California and the Mutnovsky Volcano on the Kamchatka Peninsula, in eastern Russia.

The extreme physical needs of S. islandicus make it an ideal organism for studying the impact of geographic isolation. It can live only at temperatures that approach the boiling point of water and in an environment that has the pH of battery acid. It breathes oxygen, eats volcanic gases and expels sulfuric acid. It is unlikely that it can survive even a short distance from the hot springs where it is found.

By comparing the genetic characteristics of individuals from each of the three locations, Whitaker and her colleagues were able to see how each of the S. islandicus populations had evolved since they were isolated from one another more than 900,000 years ago.

The complete genetic package, or genome, of S. islandicus contains a set of core genes that are shared among all members of this group, with some minor differences in the sequence of nucleotides that spell out individual genes. But it also contains a variable genome, with groups of genes that differ – sometimes dramatically – from one subset, or strain, to another.

Whitaker's team found that the variable genome in individual strains of S. islandicus is evolving at a rapid rate, with high levels of variation even between two or three individuals in the same location.

"Some people think that these variable genes are the way that microbes are adapting to new environments," Whitaker said. "You land in a new place, you need a new function in that new place, you pick up that set of genes from whoever's there or we don't know who from, and now you can survive there. We have shown that does not occur."

"This tells you that there's a lot more diversity than we thought," Whitaker said. "Each hot spring region has its own genome and its own genome components and is evolving in its own unique way. And if each place is evolving in its own unique way, then each one is different and there's this amazing diversity. I mean, beetles are nothing compared to the diversity of microbes."

Archaea, like bacteria, can transfer genes to one another, but they also obtain new genes from free-floating genetic elements, called plasmids, or from viruses that infect the cells and insert their own genes into the archaeal DNA. What did vary in the genomes of S. islandicus could be traced back to plasmids and viruses, Whitaker said. There were also a lot of lost genes, with much variation in the genes lost between the strains.

"Most of the genes that are coming and going, at least on Sulfolobus, seem to be on viruses and plasmids," Whitaker said. The researchers found that about one-third of the variable genes were specific to a geographic location. The viruses and plasmids that had lent their genes to Sulfolobus in one site were different from those found in another. Also, much of the variation was found in genes devoted to the microbe's immune system, indicating that S. islandicus is evolving largely in response to the assault of local pathogens such as viruses.

These findings challenge the idea that microbes draw whatever they may need from a near-universal pool of available genetic material, Whitaker said. It appears instead that S. islandicus, at least, acquires new genes from a very limited genetic reservoir stored in viruses and other genetic elements that are constrained to each geographic location on Earth.

Virtual fossils reveal how ancient creatures lived

* 27 May 2009 **by Jo Marchant**

BEHIND the war of words over the significance of Ida, the 47-million-year-old primate fossil unveiled last week, a quiet revolution in palaeontolgy is unfolding. Thanks to a souped-up version of a technique better known for its use in medical diagnostics, we are gaining unprecedented insights into the way prehistoric creatures lived, breathed and grew.

The technique is X-ray computed tomography (CT). Though X-rays have been used to look into fossils since this type of radiation was discovered in 1895, the flat images it produced changed little over the following century. As recently as 2004, a review in The British Journal of Radiology (vol 77, p 420) saw little merit in X-ray images of fossils beyond acting as a guide to palaeontologists chipping away the rock encasing them.

X-ray computed tomography techniques have allowed researchers to discover many new species, including this cockroach that was imaged while still encased in amber **(Image: European Synchrotron Radiation Facility (ESRFD))**

CT changes all that. It takes X-rays of an object from many directions, then crunches the resulting data to create a 3D image. Researchers can rotate this "virtual fossil" to inspect it from any angle, zoom in to view details, or fly straight through it to admire what's hidden inside. "It's revolutionising the way we see fossils," says Jørn Hurum of the Natural History Museum in Oslo, Norway, one of the team who studied Ida.

This requires much more energetic X-rays than normal radiography (see "Building a fossil, pixel by pixel"), and it is only recently that CT scanners capable of both penetrating dense fossils and imaging them at high resolution have become available. "A few years ago, if someone showed a 3D CT model at a conference, you'd get gasps from the audience," says Paul Barrett, a palaeontologist at the Natural History Museum (NHM) in London. "Now it's one of the first things that people think of."

The technology has vastly increased the range of samples that can be studied and the information gleaned from them. Many fossils are just too intricate or delicate to be separated physically from the surrounding rock. Even Ida's beautifully prepared skeleton could not reveal crucial information about her growth and development. For this, the researchers needed to study individual teeth, which would have required destroying the skull (see picture on right).

Many fossils are too intricate or delicate to be separated physically from the surrounding rock

Instead, the team used CT to generate virtual reconstructions of the teeth. Their next step will be to do the same for Ida's foot and ankle bones, especially the talus bone. This will be key to relating Ida to other species, because in many primate specimens the talus is the only bone to survive.

In other situations, CT may be the only way to tell that a fossil is there at all. Paul Tafforeau, a palaeontologist at the European Synchrotron Radiation Facility (ESRF) in Grenoble, France, has used high-energy X-rays produced by the synchrotron to peer inside hundreds of pieces of opaque amber from a site in south-west France. "We found 356 inclusions in just four days," he says.

The 100-million-year-old creatures he found range from snails to damselflies, and Tafforeau's 3D images reveal unprecedented detail, down to submicrometre resolution. Many are new species, including two cockroaches (see main picture) and a wasp (Geodiversitas, vol 31, p 7, p 73 and p 137).
The fossils are invisible to anyone without a particle accelerator. So Tafforeau has used the scans to make magnified plastic models of the reconstructed creatures, and last week made them available on an online database.

Perhaps the most revolutionary application of CT is the insight it can give into fossils' internal structures. "For the first time, we can see inside things without breaking them," says Hurum. And that allows palaeontologists to move beyond surface anatomy to probe how ancient creatures ticked. "You can start to look at questions relating to the biology of extinct species," says Barrett. Over the last three years or so, CT has been used to reveal structures as diverse as the cleavage patterns inside billion-year-old worm embryos (Nature, vol 442, p 680), the optic lobes of a fossilised fish brain (Proceedings of the National Academy of Sciences, DOI: 10.1073/pnas.0807047106) and the spacing of vertebrae inside a 4-tonne mummified dinosaur.

Using a CT scanner recently bought by the NHM, Barrett and his colleagues have imaged the delicate inner ears of modern birds and reptiles and have matched the structures this reveals to the creatures' hearing ability. From similar scans on an Archaeopteryx fossil, they conclude that the prehistoric creature had similar hearing to the modern-day emu, at the lower end of the sensitivity range of living birds (Proceedings of the Royal Society B, vol 276, p 1355).

Barrett also reports this month that the hollowed bones and air sacs found in modern birds were present in the earliest pterosaurs, suggesting that this characteristic respiratory system - crucial for birds' ability to fly - evolved much earlier than thought (Biology Letters, DOI: 10.1098/rsbl.2009.0139).

Meanwhile Tafforeau is working with researchers from the Max Planck Institute for Evolutionary Anthropology in Leipzig, Germany, to learn more than ever before from fossilised teeth. This is an important area, since 95 per cent of the vertebrate fossil record consists of teeth alone.

Animal teeth lay down a new layer of dentine every day. "They're recording events such as illness, stress and weaning," says Tafforeau, but in the past the only way to study these tiny growth lines had been to cut teeth open. This was not an option for important specimens, and fewer than 30 teeth were sacrificed in three decades. The advent of CT has allowed more than 150 to be studied in the past two years.
Growth lines in teeth reflect events during the creature's life, such as illness and stress

By relating the actual age of early hominids (from counting the growth lines) to their developmental age (from the growth stage of the teeth), the researchers can compare how fast different species mature. Modern chimps grow up twice as fast as we do, so one key question is to pin down when our longer childhood - thought to be necessary for the development of the human brain - evolved. Tafforeau and colleagues recently showed that Neanderthals grow up only slightly faster than humans and are now studying other hominins.

Right now, the main factor holding back research is the limited access to scanners. There are only a few synchrotron sources in the world capable of doing this work, and the best lab-based scanners cost hundreds of thousands of dollars. This roadblock will disappear as more institutes make the investment, allowing CT to become a routine part of what palaeontologists do, Hurum predicts.

So will there be any need in future for the traditional hammer and chisel? "Real specimens are preferable for many kinds of investigation," says Derek Briggs, director of the Yale Peabody Museum of Natural History in New Haven, Connecticut.

But Richie Abel, who runs the NHM's scanner, has no such qualms. "I think CT will replace the traditional approach. Why spend two years in a room chipping stone, when you could be spending those two years studying the fossil?"

Building a fossil, pixel by pixel

Scanning with computed tomography (CT) is like playing an ultra-complicated game of 3D sudoku.

By firing X-rays through an object from hundreds of different angles the scanner generates data on the total density of the material along each path. From this, software can calculate the density of each point inside the object, building a 3D image of its internal structure.

This requires a much more powerful X-ray beam than conventional radiography, because it must penetrate all the way through an object, even at its widest point. The strongest beams available are those emitted when electrons are accelerated around a synchrotron particle accelerator and focused using magnets. What's more, these all have the same wavelength, which means the CT can be combined with other techniques, such as phase-contrast imaging, to enhance the result.

Because synchrotron beams are tightly focused, they cannot be used to image large objects. This is where lab-based scanners come into their own. The X-rays from these machines splay out, and in one case have successfully imaged a 4-tonne mummified dinosaur.

The software is improving too, thanks in part to ever-faster computer processors, says Andrew Ramsey of Metris, which makes CT scanners. Graphics cards for computer games have also allowed images to be generated more rapidly. Five years ago, he says, it would have taken six weeks to reconstruct a cube measuring 2000 pixels on each edge. "Now I can do that in 40 minutes."

When is it Safe To Hire Someone With a Criminal Record?

New Carnegie Mellon Study Provides Empirical Basis For Employers To Use in Assessment of Prior Criminal Records

PITTSBURGH—Carnegie Mellon University researchers have created a model for providing empirical evidence on when an ex-convict has been "clean" long enough to be considered "redeemed" for employment purposes.

The new study, which appears in the current issue of Criminology, estimates that after five years of staying clean an individual with a criminal record is of no greater risk of committing another crime than other individuals of the same age. The research comes at a time when President Barack Obama's crime agenda includes breaking down employment barriers for people who have a prior criminal record, but who have stayed clean since their earlier offense.

"In the past, employers had no way of knowing when it might be safe to look past a criminal record," said Alfred Blumstein, co-author of the study and the J. Erik Jonsson University Professor of Urban Systems and Operations Research at Carnegie Mellon's H. John Heinz III College. "Hiring an ex-offender was a totally arbitrary decision. We believe our model can change that and help provide employers with data in making such decisions. Or it can be used by state criminal-record repositories in deciding when a prior arrest is too 'stale' to warrant distributing." Blumstein's co-author is Kiminori Nakamura, a Ph.D. student at the Heinz College.

The issue of employing ex-offenders has become more of a problem, as a vast majority of larger U.S. employers now perform criminal background checks, Blumstein said. He noted that advances in information technology allow criminal records to be kept longer and to be distributed easily, and employers are concerned about liability risk if the former offender commits a new crime. Blumstein said this makes it difficult for a large number of people who have committed crimes when they were much younger, but have stayed clean since then.

The study, funded by The National Institute of Justice, used criminal-history records of more than 88,000 first-time offenders in New York in 1980. Most committed new crimes within the first few years after their initial arrest, but only a small minority had a new arrest after staying clean for at least five years. After determining whether the offenders had remained clean during the ensuing 25 years, the data on the 1980 offenders was compared against two comparison groups. The study determined that after about five years those in the offender group were at or below the risk of arrest as people in the general population who were the same age. A more demanding comparison is with people of the same age who had never been arrested. Those with a prior record had to stay clean longer, but their risk could be close enough even to that low-risk group.

Future studies will address other states and sampling years to assess the consistency of results. This effort is intended to develop standards for employers and record repositories to help reduce the handicaps imposed on those who had committed a crime when they were younger.

Dementia drugs may put some patients at risk, Queen's study shows

Side effects associated with several commonly-prescribed dementia drugs may be putting elderly Canadians at risk, says Queen's University Geriatrics professor Sudeep Gill.

Cholinesterase inhibitors (Aricept, Exelon and Reminyl) are often prescribed for people with Alzheimer's disease and related dementias because they increase the level of a chemical in the brain that seems to help memory. Although such drugs are known to provoke slower heart rates and fainting episodes, the magnitude of these risks has not been clear until now.

"This is very troubling, because the drugs are marketed as helping to preserve memory and improve function," says Dr. Gill, who is an Ontario Ministry of Health and Long-term Care Career Scientist, working at Providence Care's St. Mary's of the Lake Hospital in Kingston. "But for a subset of people, the effect appears to be the exact opposite."

In a large study using province-wide data, Dr. Gill and his colleagues discovered that people who used cholinesterase inhibitors were hospitalized for fainting almost twice as often as people with dementia who did not receive these drugs. Experiencing a slowed heart-rate was 69 per cent more common amongst cholinesterase inhibitor users. In addition, people taking the dementia drugs had a 49 per cent increased chance of having permanent pacemakers implanted and an 18 per cent increased risk of hip fractures.

Unfortunately, Dr. Gill continues, this class of drugs is one of the few effective dementia treatments available today. Acknowledging that these drugs do have an important role in the management of dementia, he suggests that people who are already at a higher risk (for example, those who have had previous episodes of fainting or slowed heart rate) may want to ask their doctors to reassess the value of taking the drugs.

Slowing of the heart rate from cholinesterase inhibitors, if significant, may cause a person to faint and suffer fall-related injuries such as a broken hip - often debilitating and sometimes fatal for seniors. However, many physicians aren't aware of the connection between these problems and the dementia drugs, Dr. Gill notes.

If the association with dementia drugs is not identified, people who faint may be prescribed a permanent pacemaker: an invasive procedure that can involve serious complications for seniors. Both the injuries incurred from falling and the risks from pacemaker implants are "downstream consequences" of not recognizing this drug-induced phenomenon.

"This study does not suggest that dementia patients shouldn't take these drugs," says Dr. Gill. "What's critical is that patients, caregivers and physicians be aware of the potential side effects, and weigh these risks carefully against the potential for beneficial effects."

The findings are published in the journal, Archives of Internal Medicine. Scientists from the Institute for Clinical Evaluative Sciences, the University of Toronto and Harvard University are also on the research team.

The study uses data housed at the Institute for Clinical Evaluative Sciences (ICES). Ontario's first satellite unit of ICES was established at Queen's in 2007 to provide university researchers with electronic access to Ontario health datasets and population registries by secured and encrypted lines. Areas of focus at Queen's include cancer, pharmacological studies and dementia.

How oxidative stress may help prolong life

Oxidative stress has been linked to aging, cancer and other diseases in humans. Paradoxically, researchers have suggested that small exposure to oxidative conditions may actually offer protection from acute doses. Now, scientists at the University of California, San Diego, have discovered the gene responsible for this effect. Their study, published in PLoS Genetics on May 29, explains the underlying mechanism of the process that prevents cellular damage by reactive oxygen species (ROS).

"We may drink pomegranate juice to protect our bodies from so-called 'free radicals' or look at restricting calorie intake to extend our lifespan," said Trey Ideker, PhD, chief of the Division of Genetics in the Department of Medicine at UC San Diego's School of Medicine and professor of bioengineering at the Jacobs School of Engineering. "But our study suggests why humans may actually be able to prolong the aging process by regularly exposing our bodies to minimal amounts of oxidants."

Reactive oxygen species (ROS), ions that form as a natural byproduct of the metabolism of oxygen, play important roles in cell signaling. These very small molecules include oxygen ions, free radicals and peroxides. However, during times of environmental stress (for example, ultraviolet radiation or heat or chemical exposure), ROS levels can increase dramatically. This can result in significant damage to cellular damage to DNA, RNA and proteins – cumulating in an effect called oxidative stress.

One major contributor to oxidative stress is hydrogen peroxide, converted from a type of free radical that leaks from the mitochondria as it produces energy. While the cell has ways to help minimize the damaging effects of hydrogen peroxide by converting it to oxygen and water, this conversion isn't 100 percent successful.

Ideker and first author Ryan Kelley used the rich functional genomics toolbox of yeast to identify pathways involved in the cell's adaption to hydrogen peroxide. Adaption (or hormesis) is an effect where a toxic substance acts like a stimulant in small doses, but is an inhibitor in large doses.

To shed light on the molecular mechanisms of adaptation, Ideker and Kelley designed a way to identify genes involved in adaptation to hydrogen peroxide. They elicited adaptation by pre-treating cells with a mild dose of hydrogen peroxide, followed by a high dose. They observed that the cells undergoing this adaptation protocol exhibited a smaller reduction in viability than cells exposed to only an acute treatment protocol (in which about half of the cells died.)

To figure out which genes might control this adaptation mechanism, Kelley and Ideker ran a series of experiments in which cells were forced to adapt while each gene in the genome was removed, one by one – covering a total of nearly 5,000 genes. By systematically removing genes, they identified a novel factor called Mga2 – and discovered that this transcription factor is essential for adaptation.

"This was a surprise, because Mga2 is found at the control point of a completely different pathway than those which respond to acute exposure of oxidative agents," said Ideker. "This second pathway is only active at lower doses of oxidation."

This finding may explain recent studies suggesting that eating less may, in fact, raise ROS levels – and, in doing so, provide protection from acute doses of oxidants. This is counter to the hypothesis that caloric

restriction extends lifespan in some species because it reduces ROS produced as a by-product of the energy regenerated by mitochondria.

"It may be that adaption to oxidative stress is the main factor responsible for the lifespan-expanding effects of caloric restriction," said Ideker. "Our next step is to figure out how Mga2 works to create a separate pathway – to discover the upstream mechanism that senses low doses of oxidation and triggers a protective mechanism downstream." Further efforts to understand this process may have broad implications on models of aging and disease.

This work was supported by a grant from the National Institute of Environmental Health Sciences. Ideker is a David and Lucille Packard Fellow.

A Human Language Gene Changes the Sound of Mouse Squeaks

By NICHOLAS WADE

People have a deep desire to communicate with animals, as is evident from the way they converse with their dogs, enjoy myths about talking animals or devote lifetimes to teaching chimpanzees how to speak. A delicate, if tiny, step has now been taken toward the real thing: the creation of a mouse with a human gene for language.

The gene, FOXP2, was identified in 1998 as the cause of a subtle speech defect in a large London family, half of whose members have difficulties with articulation and grammar. All those affected inherited a disrupted version of the gene from one parent. FOXP2 quickly attracted the attention of evolutionary biologists because other animals also possess the gene, and the human version differs significantly in its DNA sequence from those of mice and chimpanzees, just as might be expected for a gene sculpted by natural selection to play an important role in language.

Researchers at the Max Planck Institute for Evolutionary Anthropology in Leipzig, Germany, have now genetically engineered a strain of mice whose FOXP2 gene has been swapped out for the human version. Svante Paabo, in whose laboratory the mouse was engineered, promised several years ago that when the project was completed, “We will speak to the mouse.” He did not promise that the mouse would say anything in reply, doubtless because a great many genes must have undergone evolutionary change to endow people with the faculty of language, and the new mouse was gaining only one of them. So it is perhaps surprising that possession of the human version of FOXP2 does in fact change the sounds that mice use to communicate with other mice, as well as other aspects of brain function.

That is the result reported in the current issue of the journal Cell by Wolfgang Enard, also of the Leipzig institute, and a large team of German researchers who studied 300 features of the humanized mice. FOXP2, a gene whose protein product switches on other genes, is important during the embryo’s development and plays an active part in constructing many tissues, including the lungs, stomach and brain. The gene is so vital that mice in which both copies of the gene are disrupted die after a few weeks.

Despite the mammalian body’s dependence on having its two FOXP2 genes work just right, Dr. Enard’s team found that the human version of FOXP2 seemed to substitute perfectly for the mouse version in all the mouse’s tissues except for the brain.

In a region of the brain called the basal ganglia, known in people to be involved in language, the humanized mice grew nerve cells that had a more complex structure. Baby mice utter ultrasonic whistles when removed from their mothers. The humanized baby mice, when isolated, made whistles that had a slightly lower pitch, among other differences, Dr. Enard says. Dr. Enard argues that putting significant human genes into mice is the only feasible way of exploring the essential differences between people and chimps, our closest living relatives.

There are about 20 million DNA differences between the genomes of humans and chimps, but most make no physical difference. To understand which DNA changes are important, the genes must be put into another species. There is no good way of genetically engineering chimps, even it were ethically acceptable, so the mouse is the test of choice, in Dr. Enard’s view.

Dr. Joseph Buxbaum, an expert on the molecular basis of psychiatric disease at Mount Sinai Medical Center, said Dr. Enard’s team had taken a good first step toward understanding the role of FOXP2 in the development of the brain. “The most surprising finding, and cause for great optimism, is that the gene does seem to have a great effect on pathways of neural development in mice,” he said.

Dr. Gary Marcus, who studies language acquisition at New York University, said the study showed lots of small effects from the human FOXP2, which fit with the view that FOXP2 plays a vital role in language, probably with many other genes that remain to be discovered. “People shouldn’t think of this as the one language gene but as part of a broader cascade of genes,” he said. “It would have been truly spectacular if they had wound up with a talking mouse.”

Anthropologist advances 'kelp highway' theory for Coast settlement

Migrating peoples were sophisticated in sea harvesting, Jon Erlandson says

Larry Pynn Vancouver Sun

The Pacific Coast of the Americas was settled starting about 15,000 years ago during the last glacial retreat by seafaring peoples following a "kelp highway" rich in marine resources, a noted professor of anthropology theorized Wednesday.

Jon Erlandson, director of the Museum of Natural and Cultural History at the University of Oregon, suggested that especially productive "sweet spots," such as the estuaries of B.C.'s Fraser and Stikine rivers, served as corridors by which people settled the Interior of the province.

Erlandson said in an interview these migrating peoples were already sophisticated in harvesting from the sea and would have worked their way down the coast in search of new sites.

"I think as much as anything it was an exploratory urge," he said at an international conference on the history of marine mammals at the University of B.C. "Populations were gradually growing and people kept moving. What's around the next bend? If there were no people there, it must have been a really powerful draw to keep exploring."

The kelp highway theory runs up against the long-held belief that the first humans entered the Americas on a land bridge that spanned the Bering Strait.

Erlandson said the kelp highway represented a diverse ecosystem and would have extended from what is today Japan past Russia's Kamchatka Peninsula and Alaska's Aleutian Islands all the way down the west coast of North America to Mexico's Baja peninsula and then continuing again in the waters off Peru, Ecuador, and Chile in South America. "These kelp forests would have provided a migration corridor near shore with no major barriers," he said. "It would have been a very similar ecological zone to follow and a rich one."

It's hard to know what kind of vessels carried these early seafarers, although dugouts (perhaps carved from driftwood) and skin boats are possible, he said.

The world's first evidence of human harvesting of marine life is found at Olduvai Gorge in Tanzania dated to about 2.3 million years ago. Simple shoreline ponds were likely employed to catch fish.

The first evidence of sophisticated fishing technology dates back 90,000 years to the Democratic Republic of the Congo, formerly Zaire, where harpoons were crafted from stone points with bone barbs to catch Nile perch.

Evidence of seaweed recovered from hearths at the Monte Verde II archeological site in southern Chile has been dated to about 14,000 years ago.

The first seafarers would have over-exploited resources initially amidst a windfall of marine life, but over time would have learned to live sustainably off the ocean, Erlandson said.

"There is a general human tendency, when you come into great abundance, to waste it. In B.C, in California and other parts of the world there is evidence early they did impact resources. "But I think they learned lessons from it, just as we're trying to learn lessons from the overfishing of recent decades."

Of aboriginal involvement in the elimination of sea otters from B.C.'s West Coast during the European fur trade starting in the late 1700s, he said: "That was part of a globalized economy, a cash economy that was fundamentally different."

Erlandson is part of research on California's Channel Islands that has found evidence of human occupation -- the Chumash people -- spanning 13,000 years, evidence that they must have found a way to live sustainably from the ocean around them. "When Europeans got there, within 150 years all sorts of animals were devastated. When you compare the two records, they are dramatically different." he said.

Ancient volcanic eruptions caused global mass extinction

A previously unknown giant volcanic eruption that led to global mass extinction 260million years ago has been uncovered by scientists at the University of Leeds.

The eruption in the Emeishan province of south-west China unleashed around half a million cubic kilometres of lava, covering an area 5 times the size of Wales, and wiping out marine life around the world.

Unusually, scientists were able to pinpoint the exact timing of the eruption and directly link it to a mass extinction event in the study published today in Science. This is because the eruptions occurred in a shallow sea – meaning that the lava appears today as a distinctive layer of igneous rock sandwiched between layers of sedimentary rock containing easily datable fossilised marine life.

The layer of fossilised rock directly after the eruption shows mass extinction of different life forms, clearly linking the onset of the eruptions with a major environmental catastrophe.

The global effect of the eruption is also due to the proximity of the volcano to a shallow sea. The collision of fast flowing lava with shallow sea water caused a violent explosion at the start of the eruptions – throwing huge quantities of sulphur dioxide into the stratosphere.

"When fast flowing, low viscosity magma meets shallow sea it's like throwing water into a chip pan – there's spectacular explosion producing gigantic clouds of steam," explains Professor Paul Wignall, a palaeontologist at the University of Leeds, and the lead author of the paper.

The injection of sulphur dioxide into the atmosphere would have lead to massive cloud formation spreading around the world - cooling the planet and ultimately resulting in a torrent of acid rain. Scientists estimate from the fossil record that the environmental disaster happened at the start of the eruption.

"The abrupt extinction of marine life we can clearly see in the fossil record firmly links giant volcanic eruptions with global environmental catastrophe, a correlation that has often been controversial," adds Professor Wignall.

Previous studies have linked increased carbon dioxide produced by volcanic eruptions with mass extinctions. However, because of the very long term warming effect that occurs with increased atmospheric carbon dioxide (as we see with current climate change) the causal link between global environmental changes and volcanic eruptions has been hard to confirm.

This work was done in collaboration with the Chinese University of Geosciences in Wuhan and funded by a grant from the Natural Environment Research Council, UK.

Cottonseed-Based Drug Shows Promise Treating Severe Brain Cancer, Say UAB Researchers

BIRMNGHAM, Ala. - An experimental drug derived from cottonseeds shows promise in treating the recurrence of glioblastoma multiforme, widely considered the most lethal brain cancer, said researchers at the University of Alabama at Birmingham (UAB).

The new results are from a Phase II clinical trial of AT-101, a pill manufactured from a potent compound in cottonseeds that overcomes the abnormal growth patterns of tumor cells. This cottonseed-based agent must be properly dosed and monitored by physicians.

In clinical tests, AT-101 halted the cancer's progression in many of the 56 patients, said John Fiveash, M.D., an associate professor in the UAB Department of Radiation Oncology and the lead researcher on the new study. Despite undergoing other treatments, including surgery, chemotherapy and radiation, the trial patients' brain cancer had begun to grow again prior to starting AT-101 treatments. The trial-monitored patients took only AT-101 daily for three out of four weeks. Glioblastomas are more common in adults and are considered fast-growing brain tumors that are very difficult to treat, Fiveash said.

After getting this drug some of these patients went many months without any new growth in their tumors," Fiveash said. "We are able to do that with a well-tolerated oral medication, and that is a major benefit." His initial results will be presented May 30 during the poster discussion of central nervous system tumors at the American Society for Clinical Oncology annual meeting in Orlando, Fla.

Fiveash said the drug would likely work best in combination with radiation and chemotherapy to boost the cancer-fighting properties of those treatments. Also, investigators are trying to learn which patients are most likely to benefit from AT-101.

The AT-101 trial is a partnership that includes Fiveash, the UAB Comprehensive Cancer Center, Massachusetts General Hospital in Boston, Johns Hopkins University in Baltimore, The Cleveland Clinic in Ohio, Henry Ford Hospital in Detroit, Emory University in Atlanta, Moffit Cancer Center in Tampa, the University of Pennsylvania in Philadelphia, Wake Forest University in Winston-Salem, N.C., and the National Cancer Institute's Cancer Therapeutics Evaluation Program.

AT 101 is manufactured by Ascenta Therapeutics Inc. based in Malvern, Penn. Multiple preclinical and clinical trials with AT-101 are ongoing in several tumor types, including prostate, lung, B-cell malignancies and other forms of cancer.

Nontoxic hull coating resists barnacles, may save ship owners millions

North Carolina State University engineers have created a non-toxic "wrinkled" coating for use on ship hulls that resisted buildup of troublesome barnacles during 18 months of seawater tests, a finding that could ultimately save boat owners millions of dollars in cleaning and fuel costs.

The research conducted by Dr. Kirill Efimenko, research assistant professor in the Department of Chemical and Biomolecular Engineering, and Dr. Jan Genzer, professor in the same department, shows for the first time that surface coatings containing nests of different-sized "wrinkles" are effective in preventing barnacles from firmly latching on to the coatings.

"The results are very promising," Efimenko said. "We are dealing with a very complex phenomenon. Living organisms are very adaptable to the environment, so we need to find their weakness. And this hierarchical wrinkled topography seems to do the trick."

Researchers created the coatings by stretching a rubber sheet, applying an ultra-violet ozone treatment to it, and then relieving the tension, causing five generations of "wrinkles" to form concurrently. The coatings were

further covered with an ultra-thin layer of semifluorinated material. During ocean tests performed in Wilmington, N.C., the wrinkled materials remained free of barnacles after 18 months of seawater exposure, while flat coatings with the same chemical composition showed barnacle buildup after just one month in seawater.

Engineers and scientists have strived for decades to uncover ways to keep barnacles off ship hulls. Barnacle colonization on a ship bottom increases the ship's "drag" in the water, forcing the engine to burn more fuel to maintain the same speed. After six months in the water, a ship's fuel consumption increases substantially, Efimenko said. That costs ship owners — including the military — plenty of extra cash.

"It's like running your air conditioner with the windows open," Genzer said.

Barnacle buildup also forces owners to remove ships from the water and place them on dry docks for cleaning. This expensive procedure costs ships valuable time at sea when they could be making money.

For many years, ship owners fought barnacles by coating their hulls with toxic substances that resisted barnacle buildup. But those substances killed fish and other marine life in harbors, causing governments around the world to ban ships from using them.

That led to increased interest in endowing the ship coatings with wrinkled topographies. The coatings share traits with surfaces found in nature, where rough surfaces such as shark skin generally stay free of debris buildup. In contrast, other marine species, such as whales, have smooth skin but often carry barnacles as unwanted hitchhikers.

The NC State team collaborated on the research with Drs. John Finlay, Maureen E. Callow and James A. Callow from the University of Birmingham in the U.K. The work was funded by the U.S. Office of Naval Research.

The group's findings are published in the May 27 issue of the journal ACS Applied Materials and Interfaces. The work is also highlighted in the May 8 edition of Science.

Roommate Assignments Key In Increasing Interracial Friendships In College

COLUMBUS, Ohio – White students generally increased their number of interracial friendships during their first year of college, while black students showed a slight decrease, according to a study at one highly selective private university.

Results showed that students were particularly likely to develop more interracial friendships if they were paired with a residence-hall roommate of a different race.

But white students who joined fraternities or sororities didn't increase their number of friends of other races during their first college year.

Overall, the results support the validity of the saying that "birds of a feather flock together," said Claudia Buchmann, co-author of the study and associate professor of sociology at Ohio State University.

"White and black students tend to have the majority of friends of the same race," she said.

But factors such as extracurricular activities and, especially, living arrangements, can have a significant impact on the number of interracial friendships that students develop, at least at colleges such as the one studied.

"The close ties that college students form when they live together in residence halls seem to break down the racial barriers better than any other experience in college," Buchmann said.

"Just having diversity in classrooms is not enough to encourage interracial friendships. Residence halls are a key."

Buchmann conducted the study with Elizabeth Stearns of the University of North Carolina at Charlotte and Kara Bonneau of the North Carolina Education Research Data Center. Their results appear in the current issue of the journal Sociology of Education.

Buchmann emphasized that the study was done at one university, and is only representative of students who attend similar, highly selective private universities in the United States. But the study is particularly valuable because of its unique data set which allowed the researchers to see how individual students' friendship networks changed in the transition from high school to college.

"If you're in a single room, you're likely to interact with others in your residence hall, and that means you'll be exposed to students of other races," Buchmann said. "But if you have a same-race roommate, you may not have a reason to expand your network."

The sample included 800 students who were surveyed in the summer before they enrolled in college, and again during the second semester of their first year at the university. Among other questions, students were asked to provide information on up to eight of their friends, including their race.

Results showed that prior to entering college, white students reported far fewer interracial friendships than did any other group. They also lived in neighborhoods and attended high schools with the highest concentration of whites.

During the first year of college, white students' proportion of different-race friends increased from about 11 percent to 16 percent. Black students' proportion of different-race friends declined from about 40 percent to 31 percent.

Why do the proportion of interracial friendships decline for black students? Buchmann believes that college is often the first time that many black students have a relatively large population of other black students with whom to interact. They may choose to "cocoon" with other black students as they acclimate themselves to a predominantly white campus.

Latino, Asian and other-race students had a significantly higher proportion of interracial friendships than did whites before college, and the pattern continued in the first year of college.

During that first year, 80 percent of Latinos' friends were of a different race, while the proportion was 42 percent for Asians and 92 percent for other races.

The results showed the key role that roommate selection and residence halls in general played in fostering interracial friendships in college, according to Buchmann.

Students with a roommate of a different race had significantly higher proportions of interracial friendships than did those with a same-race roommate.

Even students with no roommate in the residence halls had more interracial friends than those with a roommate of the same race.

"If you're in a single room, you're likely to interact with others in your residence hall, and that means you'll be exposed to students of other races," Buchmann said. "But if you have a same-race roommate, you may not have a reason to expand your network."

While living arrangements had a significant effect on friendship networks, classrooms did not. Students who had classes with a greater racial mix did not report higher levels of interracial friendships than those whose classes did not have as much diversity. That's probably because students don't spend nearly as much time in class as they do in their residence halls, she said.

Findings showed that students who joined groups that were highly segregated also had fewer interracial friendships than those who didn't join those kinds of groups. That was true of students who joined cultural or ethnic clubs, and white students who joined fraternities or sororities.

"Many of the fraternities and sororities are predominantly white, so those who join don't get the chance to meet a diverse group of students," she said.

The fact that students will often choose to join groups, like fraternities and sororities, that are not very diverse shows the importance of colleges trying other ways of getting races to mix – such as roommate assignments, Buchmann said.

"Colleges need to find ways to create opportunities for students to expand their horizons and encourage them to break out of the familiar and comfortable," she said. "One way they can do that is by having random roommate assignments that will ensure that some students will have a different-race roommate."

Adult Bone Marrow Stem Cells Injected into Skeletal Muscle Can Repair Heart Tissue

BUFFALO, N.Y. -- University at Buffalo researchers have demonstrated for the first time that injecting adult bone marrow stem cells into skeletal muscle can repair cardiac tissue, reversing heart failure.

Using an animal model, the researchers showed that this non-invasive procedure increased myocytes, or heart cells, by two-fold and reduced cardiac tissue injury by 60 percent.

The therapy also improved function of the left ventricle, the primary pumping chamber of the heart, by 40 percent and reduced fibrosis, the hardening of the heart lining that impairs its ability to contract, by up to 50 percent.

"This work demonstrates a novel non-invasive mesenchymal stem cell (MSC) therapeutic regimen for heart failure based on an intramuscular delivery route," said Techung Lee, Ph.D., UB associate professor of biochemistry and senior author on the paper.

Mesenchymal stem cells are found in the bone marrow and can differentiate into a variety of cell types.

"Injecting MSCs or factors released by MSCs improved ventricular function, promoted myocardial regeneration, lessened apoptosis (cell death) and fibrotic remodeling, recruited bone marrow progenitor cells and induced myocardial expression of multiple growth factor genes," Lee said.

"These findings highlight the critical 'cross-talks' between the injected MSCs and host tissues, culminating in effective cardiac repair for the failing heart."

The paper reporting this development appears online in the Articles-in-Press section of the American Journal of Physiology -- Heart Circulation Physiology at http://ajpheart.physiology.org/cgi/reprint/00186.2009v1.

The heart disease death rate has dropped significantly in the last three decades due to better treatments, resulting in large numbers of people living with heart failure. This advance has lead to another health hurdle:

The only therapy available to reverse the decline in cardiac function is heart transplantation, and donor hearts are very scarce.

Clinical trials of myocardial stem cell therapy traditionally have relied on surgery -- infusing the stem cells directly into the heart or injecting them into the myocardium, the heart muscle -- invasive methods that can result in harmful scar tissue, arrhythmia, calcification or small vessel blockages.

"In our research with a swine model of heart failure," said Lee, "we've found that only 1-to-2 percent of MSCs infused into the myocardium grafted into the heart, and there was no evidence that they differentiated into heart muscle cells. In addition, diseased tissue is not a healthy environment for cell growth.

"For these reasons, and because patients with heart failure are not good surgical risks, it made sense to explore a non-invasive cell delivery approach," said Lee. "An important feature of MSCs is their ability to produce a plethora of tissue healing effects, known as "tropic factors," which can be harnessed for stem cell therapy for heart failure.

Lee noted that the multiple trophic factors produced by MSCs have been shown in the literature to be capable of reducing tissue injury, inhibiting fibrosis, promoting angiogenesis, stimulating recruitment and proliferation of tissue stem cells, and reducing inflammatory oxidative stress, a common cause of cardiovascular disease and heart failure.

"Since skeletal muscle is the most abundant tissue in the body and can withstand repeated injection of large number of stem cells, we thought it would be a good method to deliver MSCs," Lee said. "We hypothesized that MSCs, via secretion of these functionally synergistic trophic factors, would be able to rescue the failing heart even when delivered away from the myocardium.

"This study proves our hypothesis," said Lee. "We've demonstrated that injecting MSCs, or trophic factors released by MSCs, into skeletal muscle improved ventricular function, promoted regeneration of heart tissue, decreased cell death and improved other factors that cause heart failure.

"This non-invasive stem cell administration regimen, if validated clinically, is expected to facilitate future stem cell therapy for heart failure."

Lee said the next step is to use genetic and pharmacological engineering to make the stem cells more active, so good therapeutic effects can be achieved with fewer cells.

"That is our goal. It would reduce the cost of stem cell therapy and make it more affordable for patients in the future."

Arsalan Shabbir and David Zisa, graduate students in UB's M.D./Ph.D. Medical Science Training Program, and Gen Suzuki, Ph.D., research scientist in the UB Center for Research in Cardiovascular Medicine, Department of Medicine, also contributed to the research.
The work was supported by grants from the National Institutes of Health and New York State Stem Cell Science (NYSTEM).
The University at Buffalo is a premier research-intensive public university, a flagship institution in the State University of New York system and its largest and most comprehensive campus. UB's more than 28,000 students pursue their academic interests through more than 300 undergraduate, graduate and professional degree programs. Founded in 1846, the University at Buffalo is a member of the Association of American Universities.

Spanish prostitutes least likely to use condoms

The Centre for Epidemiological Studies into Sexually-Transmitted Diseases and AIDS in Catalonia (CEEISCAT) started a pioneering study in Spain in 2005 to look into the prevalence of sexually-transmitted diseases (STDs) among female sex workers (SWs). The objective was to monitor the rates of infection with both HIV and other diseases over time, as well as the prevalence of risky behaviour.

"The phenomenon of prostitution has changed over recent years in Spain, going from prostitution as an activity carried out by Spanish women, often injecting drug users, to a situation where it is carried out by women from other countries, which has led to behavioural and social changes", Cinta Folch, lead author of the study and a researcher at CEEISCAT, tells SINC.

Only 10.8% of the 400 women interviewed were native Spaniards, and these tended to be older women who were injecting drug users. The rest came from Latin America (30.7%), eastern Europe (32.5%) and Africa (26%). The researchers found that 95.5% of these sex workers use condoms during vaginal sex with clients, but that they do not ordinarily use them with their regular partners (only 12.4%).

"A significant finding is that the Spanish women are the least likely to use a condom with their clients. The reason could be the age of these working women. Their clients may be more stable and they may trust them more. In addition, the IV drug users among the SWs are the Spanish women (9.3%), and this fact could lead them to have unprotected sex", stresses the CEEISCAT expert.

The conclusions of this study, published recently in the journal Sexually Transmitted Diseases, show the rate of HIV infection to be 1.8%, that of Chlamydia trachomatis 5.5% and Neisseria gonorrhoeae 0.5%. The only differences were observed in the HIV infection rates, which were significantly higher among the Spanish SWs,

at 9.3%. In addition, 49.7% of the women interviewed reported incidences when condoms had split over the past six months.

Even so, the researchers remain cautious about the figures obtained. STD infection rates appear to be lower in Catalonia than in the rest of Europe, but it is hard to generalise. "Our studies are quantitative and have their limitations, so we cannot extrapolate from them, although one can observe trends", points out Folch. Once the 2009 figures are available it will be possible to compare the data.

Guaranteeing public healthcare

The research shows that SWs working in Catalonia have highly defined social and cultural traits, according to where they come from. "We must pay special attention to the section of Spanish SWs who, although they are in the minority, have the highest rates of HIV infection and drug use, as well as taking the lowest level of precautions during commercial sex", explain the researchers.

According to the study, a key issue in the prevention and control of HIV/STDs is to provide access to health centres, as well as diagnosing and treating STDs as a means of helping to prevent the spread of HIV. "This means understanding the prevalence of these infections and the behaviours related to them, in order to be able to design suitable prevention strategies", concludes Folch.

Folch C, Sanclemente C, Esteve A, Martró E, Molinos S, Casabona J y grupo de trabajo HIVITS-TS. Diferencias en las características sociales, conductas de riesgo y prevalencia de VIH/infecciones de transmisión sexual entre trabajadoras del sexo españolas e inmigrantes en Cataluña. Med Clin (Barc). 2009 Mar 21;132(10):385-388.

Other publications of interest:

Folch C, Esteve A, Sanclemente C, Martró E, Lugo R, Molinos S, Gonzalez V, Auxina V, Casabona J. Prevalence of HIV, Chlamydia trachomatis and Neisseria gonorrhoeae, and risk factors for Sexually Transmitted Infections among immigrant female sex workers in Catalonia, Spain. Sex Transm Dis. 2008 Feb;35(2):178-183.

How many scientists fabricate and falsify research?

Press release from PLoS ONE

It's a long-standing and crucial question that, as yet, remains unanswered: just how common is scientific misconduct? In the online, open-access journal PLoS ONE, Daniele Fanelli of the University of Edinburgh reports the first meta-analysis of surveys questioning scientists about their misbehaviours. The results suggest that altering or making up data is more frequent than previously estimated and might be particularly high in medical research.

Recent scandals like Hwang Woo-Suk's fake stem-cell lines or Jon Sudbø's made-up cancer trials have dramatically demonstrated that fraudulent research is very easy to publish, even in the most prestigious journals. The media and many scientists tend to explain away these cases as pathological deviations of a few "bad apples." Common sense and increasing evidence, however, suggest that these could be just the tip of the iceberg, because fraud and other more subtle forms of misconduct might be relatively frequent. The actual numbers, however, are a matter of great controversy.

Estimates based on indirect data (for example, official retractions of scientific papers or random data audits) have produced largely discrepant results. Therefore, many researchers have asked scientists directly, with surveys conducted in different countries and disciplines. However, they have used different methods and asked different questions, so their results also appeared inconclusive.

To make these surveys comparable, the meta-analysis focused on behaviours that actually distort scientific knowledge (excluding data on plagiarism and other kinds of malpractice) and extracted the frequency of scientists who recalled having committed a particular behaviour at least once, or who knew a colleague who did.

On average, across the surveys, around 2% of scientists admitted they had "fabricated" (made up), "falsified" or "altered" data to "improve the outcome" at least once, and up to 34% admitted to other questionable research practices including "failing to present data that contradict one's own previous research" and "dropping observations or data points from analyses based on a gut feeling that they were inaccurate."

In surveys that asked about the behaviour of colleagues, 14% knew someone who had fabricated, falsified or altered data, and up to 72% knew someone who had committed other questionable research practices.

In both kinds of surveys, misconduct was reported most frequently by medical and pharmacological researchers. This suggests that either the latter are more open and honest in their answers, or that frauds and bias are more frequent in their fields. The latter interpretation would support growing fears that industrial sponsorship is severely distorting scientific evidence to promote commercial treatments and drugs.

As in all surveys asking sensitive questions, it is likely that some respondents did not reply honestly, especially when asked about their own behaviour. Therefore, a frequency of 2% is probably a conservative estimate, while it remains unclear how the figure of 14% should be interpreted.

***Citation**: Fanelli D (2009) How Many Scientists Fabricate and Falsify Research? A Systematic Review and Meta-Analysis of Survey Data. PLoS ONE 4(5): e5738. doi:10.1371/journal.pone.0005738 http://dx.plos.org/10.1371/journal.pone.0005738*

Nasa Satellite Detects Red Glow To Map Global Ocean Plant Health

Researchers have conducted the first global analysis of the health and productivity of ocean plants, as revealed by a unique signal detected by a NASA satellite. Ocean scientists can now remotely measure the amount of fluorescent red light emitted by ocean phytoplankton and assess how efficiently the microscopic plants are turning sunlight and nutrients into food through photosynthesis. They can also study how changes in the global environment alter these processes, which are at the center of the ocean food web.

Single-celled phytoplankton fuel nearly all ocean ecosystems, serving as the most basic food source for marine animals from zooplankton to fish to shellfish. In fact, phytoplankton account for half of all photosynthetic activity on Earth. The health of these marine plants affects commercial fisheries, the amount of carbon dioxide the ocean can absorb, and how the ocean responds to climate change.

"This is the first direct measurement of the health of the phytoplankton in the ocean," said Michael Behrenfeld, a biologist who specializes in marine plants at the Oregon State University in Corvallis, Ore. "We have an important new tool for observing changes in phytoplankton every week, all over the planet." The findings were published this month in the journal Biogeosciences and presented at a news briefing on May 28.

Over the past two decades, scientists have employed various satellite sensors to measure the amount and distribution of the green pigment chlorophyll, an indicator of the amount of plant life in the ocean. But with the Moderate Resolution Imaging Spectroradiometer (MODIS) on NASA's Aqua satellite, scientists have now observed "red-light fluorescence" over the open ocean.

"Chlorophyll gives us a picture of how much phytoplankton is present," said Scott Doney, a marine chemist from the Woods Hole Oceanographic Institution and a co-author of the paper. "Fluorescence provides insight into how well they are functioning in the ecosystem."

All plants absorb energy from the sun, typically more than they can consume through photosynthesis. The extra energy is mostly released as heat, but a small fraction is re-emitted as fluorescent light in red wavelengths. MODIS is the first instrument to observe this signal on a global scale.

"The amount of fluorescent light emitted is not constant; it changes with the health of the plant life in the ocean," said Behrenfeld. "The challenge with global MODIS fluorescence data is to uncover the important biological information that is hidden in it."

Red-light fluorescence reveals insights about the physiology of marine plants and the efficiency of photosynthesis, as different parts of the plant's energy-harnessing machinery are activated based on the amount of light and nutrients available. For instance, the amount of fluorescence increases when phytoplankton are under stress from a lack of iron, a critical nutrient in seawater. When the water is iron-poor, phytoplankton emit more solar energy as fluorescence than when iron is sufficient.

The fluorescence data from MODIS gives scientists a tool that enables research to reveal where waters are iron-enriched or iron-limited, and to observe how changes in iron influence plankton. The iron needed for plant growth reaches the sea surface on winds blowing dust from deserts and other arid areas, and from upwelling currents near river plumes and islands.

The new analysis of MODIS data has allowed the research team to detect new regions of the ocean affected by iron deposition and depletion. The Indian Ocean was a particular surprise, as large portions of the ocean were seen to "light up" seasonally with changes in monsoon winds. In the summer, fall, and winter – particularly summer – significant southwesterly winds stir up ocean currents and bring more nutrients up from the depths for the phytoplankton. At the same time, the amount of iron-rich dust delivered by winds is reduced.

"On time-scales of weeks to months, we can use this data to track plankton responses to iron inputs from dust storms and the transport of iron-rich water from islands and continents," said Doney. "Over years to decades, we can also detect long-term trends in climate change and other human perturbations to the ocean."

Climate change could mean stronger winds pick up more dust and blow it to sea, or less intense winds leaving waters dust-free. Some regions will become drier and others wetter, changing the regions where dusty soils accumulate and get swept up into the air. Phytoplankton will reflect and react to these global changes.

"NASA satellites are powerful tools," said Behrenfeld. "Huge portions of the ocean remain largely unsampled, so the satellite view is critical to seeing the big picture that complements the process-oriented understanding we get from work on ships and in laboratories."

The research was funded by NASA and involved collaborators from the University of Maine, the University of California-Santa Barbara, the University of Southern Mississippi, NASA's Goddard Space Flight Center, the Woods Hole Oceanographic Institution, Cornell University, and the University of California-Irvine.

http://www.nasa.gov/topics/earth/features/modis_fluorescence.html

New swine flu cases point to invisible pandemic

* 13:17 29 May 2009 **by Debora MacKenzie**

Hospitals in Greece have identified H1N1 swine flu in two students who had no contact with known cases of the virus and had not been in countries with widespread infection. The infections were discovered even though the students should not have been tested for swine flu under European rules. The Greek authorities say this shows the rules must change.

Indeed, an investigation by New Scientist earlier this month showed that the EU rules would exclude exactly such cases and could make H1N1 appear much less widespread in Europe than it is.

Takis Panagiotopoulos of the Hellenic Centre for Disease Control and Prevention in Athens and colleagues reported on 28 May in Eurosurveillance, a weekly bulletin published by the European Centre for Disease Prevention and Control (ECDC) in Stockholm, Sweden, that two Greek men returning home from Scotland had tested positive this week for H1N1 swine flu.

Chance test

The two go to university in Edinburgh and had attended term-end parties at the end of last week. Both developed coughs and fevers at the weekend before flying back to Greece, where one went to hospital in Athens on Tuesday.

"The examining physician decided to take a pharyngeal swab, which was tested at the National Influenza Reference Laboratory for Southern Greece, although the patient did not meet the European Union and national criteria for the new influenza A (H1N1) testing," the team reports. The swab was tested with a kit for H1N1 distributed by the US Centers for Disease Control and Prevention (CDC), and was positive for swine flu. The student in Athens warned the second student, who was now in Thesaloniki. He also tested positive. Both cases were mild. Contacts of the two in Greece and Scotland and on the flights are being traced.

'Missing cases'

The Greek cases are "community acquired", meaning they have no contacts with known cases or countries with swine flu. The ECDC guidelines adopted by most EU countries, including Greece, recommend testing for H1N1 only when people have such contacts, excluding community acquired cases.

"It is of concern that with the present EU [testing criteria] we are by definition going to miss cases infected locally in the event of established community transmission," the Greek team warns. "It is probably necessary to modify the present EU definition … to also include clusters of patients with influenza-like illness, irrespective of travel history," they say, especially as the tourist season is getting under way.

Officially, swine flu has increased very slowly in Britain, even though the virus appears to be as contagious as ordinary flu. John Oxford of the University of London says the UK may have tens of thousands of mild, untested cases. The US CDC says there could be 100,000 cases in the US, even though only a few thousand, mostly severe, cases have been tested. Finding community acquired cases outside the Americas is a requirement for declaring H1N1 swine flu an official pandemic, which the WHO has not yet done.

Marijuana rivals mainstream drugs for HIV/AIDS symptoms

Los Angeles, London, New Delhi, Singapore and Washington DC (May 29, 2009) – Those in the United States living with HIV/AIDS are more likely to use marijuana than those in Kenya, South Africa or Puerto Rica to alleviate their symptoms, according to a new study published in Clinical Nursing Research, published by SAGE. Those who did use marijuana rate it as effective as prescribed or over the counter (OTC) medicines for the majority of common symptoms, once again raising the issue that therapeutic marijuana use merits further study and consideration among policy makers.

A significant percentage of those with HIV/AIDS use marijuana as a symptom management approach for anxiety, depression, fatigue, diarrhoea, nausea, and peripheral neuropathy. Members of the University of California, San Francisco (UCSF) International HIV/AIDS Nursing Research Network examined symptom management and quality of life experiences among those with HIV/AIDS in the US, Africa, and Puerto Rico, to gain a fuller picture of marijuana's effectiveness and use in this population.

With data from a longitudinal, multi-country, multi-site, randomised control clinical trial, the researchers used four different evaluation tools to survey demographics, self-care management strategies for six common symptoms experienced by those living with HIV/AIDS, quality of life instrument and reasons for non-adherence to medications.

Either marijuana use for symptom management is vastly higher in the US, or participants elsewhere chose not to disclose that they use it: nine tenths of study participants who said they used marijuana live in the US. No African participants said they used it, and the remaining ten percent were from Puerto Rico.

The researchers found no differences between marijuana users and nonusers in age, race, and education level, income adequacy, having an AIDS diagnosis, taking ARV medications, or years on ARV medications. But the

two groups did differ in that marijuana users had been HIV positive longer, and were more likely to have other medical conditions. Transgender participants were also more likely to use marijuana.

Participants using marijuana as a management strategy were spread fairly consistent across all six symptoms, ranging from a low of 20% for fatigue to a high of 27% for nausea. Prescribed medications were used by 45% of those with fatigue, ranging down to almost 18% of those with neuropathy.

The findings contained nuances when comparing marijuana to other medications. Those who used marijuana rated their anxiety significantly lower than those who did not, and women who used marijuana had more intense nausea symptoms. For those who use both marijuana and medications for symptom management, antidepressants were considered more effective than marijuana for anxiety and depression, but marijuana was rated more highly than anti-anxiety medications. Immodium was better for diarrhoea than marijuana, as were prescribed medications for fatigue. However, marijuana was perceived to be more effective than either prescribed or OTC medications for nausea and neuropathy. However, the differenced in perceived efficacy in all these results were slight.

As found in previous studies, those who used marijuana were less likely to comply with their regime of ARV medications. But perhaps counter-intuitively of the many reasons given for skipping pills, 'forgetfulness' was no different in this group than among those who did not use marijuana. Marijuana use is known to contribute to patients' lack of compliance with ARV drugs, however those who use marijuana to target a particular symptom are actually more likely to stick closely to their ARV regimen too. The researchers point out that of those who used marijuana for their symptoms, it is not known whether they also used the drug for recreation. Patterns of how marijuana use interferes with patients' adherence to medication regimens, along with other drugs, warrant further study.

The 775 participants were recruited from Kenya, South Africa, two sites in Puerto Rico, and ten sites in the United States. They had on average been diagnosed for a decade - the majority (70%) were taking anti-retroviral (ARV) medications and more than half had other medical conditions alongside HIV/AIDS. It is hard to pinpoint the marijuana use targeted to alleviate symptoms of those other illnesses as distinct from those relating solely to HIV/AIDS.

Data suggest that marijuana is a trigger among those susceptible to psychosis, and is also associated with the risk of suicidal thoughts. However it is not linked to an increased risk of lung cancer (over and above risks associated with smoking it along with tobacco).

The question of the use of marijuana for symptom management when legal drugs are available remains a practice and policy issue.

"Given that marijuana may have other pleasant side effects and may be less costly than prescribed or OTC drugs, is there a reason to make it available?" asks study leader Inge Corless. "These are the political ramifications of our findings. Our data indicate that the use of marijuana merits further inquiry."

Marijuana Effectiveness as an HIV Self-Care Strategy by Inge B. Corless, Teri Lindgren, William Holzemer, Linda Robinson, Shahnaz Moezzi, Kenn Kirksey, Christopher Coleman, Yun-Fang Tsai, Lucille Sanzero Eller, Mary Jane Hamilton, Elizabeth F. Sefcik, Gladys E. Canaval, Marta Rivero Mendez, Jeanne K. Kemppainen, Eli H. Bunch, Patrice K. Nicholas, Kathleen M. Nokes, Pamela Dole and Nancy Reynolds is published in the May 2009 issue of Clinical Nursing Research (Volume 18, No. 2). The article will be free to access online for a limited period from http://cnr.sagepub.com/cgi/reprint/18/2/172

Pressure to Look Attractive Linked to Fear of Rejection in Men and Women

More evidence that pressure to be "attractive" provokes negative outcomes

BUFFALO, N.Y. – People who feel pressure to look attractive are more fearful of being rejected because of their appearance than are their peers, according to a new study by researchers at the University at Buffalo and the University of Kent.

The study of appearance-based rejection sensitivity among college students was conducted by Lora Park, Ph.D., assistant professor of psychology and graduate student Ann Marie DiRaddo, of the University at Buffalo, and Rachel Calogero, Ph.D., a lecturer in psychology at the University of Kent.

It was published in the spring edition of Psychology of Women Quarterly (Vo. 33, Issue 1), a publication of the American Psychological Association.

The researchers found that overall women showed greater sensitivity to appearance rejection than did men. This was particularly true of women who felt they needed to look attractive in order to be accepted by their peers. The study also found that men and women who had internalized media ideals of attractiveness had higher levels of appearance-based rejection sensitivity than did their peers.

No relationship was found between parents' perceptions of attractiveness and study participants' increased sensitivity to appearance-based rejection. Thus, peer and media influences, rather than parental influence, play a key role in appearance-based rejection sensitivity.

"There is a lot of research to suggest that physically attractive people are less stigmatized by others in this society, and have significant advantages in many areas of life than those who are viewed as physically unattractive," Park says.

"Our study suggests that when people feel pressure to look attractive, whether from their friends or the media, they may be putting themselves at risk for experiencing negative outcomes that may limit their development and enjoyment of life in many ways."

Indeed, previous research by Park found that appearance-based rejection sensitivity is related to negative mental and physical health outcomes, such as feeling unattractive, feeling badly about oneself when comparing one's appearance with others, feeling lonely and rejected when thinking about disliked aspects of one's appearance, and showing increased risk for eating disorders.

The study sample consisted of 220 (106 women, 114 men) U.S. college students ranging from 18 to 33 years of age. Participants responded to a series of questionnaires, including scales that assessed the perceived influence of peers and parents on sensitivity to appearance-based rejection, and the Sociocultural Attitudes Toward Appearance Scale-3, which assesses dimensions of media influence related to body image and appearance.

These results were found even after controlling for people's self-esteem, self-perceived attractiveness and sensitivity to rejection in general.

Although the current study focused on a predominantly young, white college-age sample, Park says future research should investigate appearance-based rejection sensitivity across diverse age and ethnic groups, in order to better understand its prevalence and to examine how it might be reduced.

Regular Light Bulbs Made Super-Efficient with Ultra-Fast Laser

Laser Process Doubles Brightness for the Same Amount of Energy

An ultra-powerful laser can turn regular incandescent light bulbs into power-sippers, say optics researchers at the University of Rochester. The process could make a light as bright as a 100-watt bulb consume less electricity than a 60-watt bulb while remaining far cheaper and radiating a more pleasant light than a fluorescent bulb can.

The laser process creates a unique array of nano- and micro-scale structures on the surface of a regular tungsten filament - the tiny wire inside a light bulb - and theses structures make the tungsten become far more effective at radiating light.

The findings will be published in an upcoming issue of the journal Physical Review Letters.

"We've been experimenting with the way ultra-fast lasers change metals, and we wondered what would happen if we trained the laser on a filament," says Chunlei Guo, associate professor of optics at the University of Rochester. "We fired the laser beam right through the glass of the bulb and altered a small area on the filament. When we lit the bulb, we could actually see this one patch was clearly brighter than the rest of the filament, but there was no change in the bulb's energy usage."

The key to creating the super-filament is an ultra-brief, ultra-intense beam of light called a femtosecond laser pulse. The laser burst lasts only a few quadrillionths of a second. To get a grasp of that kind of speed, consider that a femtosecond is to a second what a second is to about 32 million years. During its brief burst, Guo's laser unleashes as much power as the entire grid of North America onto a spot the size of a needle point. That intense blast forces the surface of the metal to form nanostructures and microstructures that dramatically alter how efficiently can radiate from the filament.

In 2006, Guo and his assistant, Anatoliy Vorobeyv, used a similar laser process to turn any metal pitch black. The surface structures created on the metal were incredibly effective at capturing incoming radiation, such as light.

"There is a very interesting 'take more, give more' law in nature governing the amount of light going in and coming out of a material," says Guo. Since the black metal was extremely good at absorbing light, he and Vorobyev set out to study the reverse process - that the blackened filament would radiate light more effectively as well. "We knew it should work in theory," says Guo, "but we were still surprised when we turned up the power on this bulb and saw just how much brighter the processed spot was."

In addition to increasing the brightness of a bulb, Guo's process can be used to tune the color of the light as well. In 2008, his team used a similar process to change the color of nearly any metal to blue, golden, and gray, in addition to the black he'd already accomplished. Guo and Vorobeyv used that knowledge of how to control the size and shape of the nanostructures - and thus what colors of light those structures absorb and radiate—to change the amount of each wavelength of light the tungsten filament radiates. Though Guo cannot yet make a simple bulb shine pure blue, for instance, he can change the overall radiated spectrum so that the tungsten, which normally radiates a yellowish light, could radiate a more purely white light.

Guo's team has even been able to make a filament radiate partially polarized light, which until now has been impossible to do without special filters that reduce the bulb's efficiency. By creating nanostructures in tight, parallel rows, some light that emits from the filament becomes polarized.

The team is now working to discover what other aspects of a common light bulb they might be able to control. Fortunately, despite the incredible intensity involved, the femtosecond laser can be powered by a simple wall outlet, meaning that when the process is refined, implementing it to augment regular light bulbs should be relatively simple.

Guo is also announcing this month in Applied Physics Letters a technique using a similar femtosecond laser process to make a piece of metal automatically move liquid around its surface, even lifting a liquid up against gravity. *This research was supported by the U.S. Air Force Office of Scientific Research.*

Recognizing signs and symptoms of acute HF

ESC press release -- Heart Failure Congress 2009

Although heart failure is a chronic condition, acute exacerbations are frequent and occur with serious complications; patients with heart failure and their families can help improve prognosis in acute events if they are taught to recognise the tell-tale signs of worsening condition and seek immediate medical help. "Any delayed recognition of these signs is associated with an increased rate of hospitalisation and complications, including mortality," says Professor Ferenc Follath from the University Hospital of Zurich, Switzerland.

Speaking at Heart Failure Congress 2009, Professor Follath explained that around two-thirds of these acute events occur in patients with known heart failure, and around one-third as a first event in those with undiagnosed heart failure.1,2 Recognition of the signs and symptoms of a worsening condition, therefore, will help minimise any delay in treatment and reduce complication rates.

Citing existing data, Professor Follath said that heart failure patients and their families should be on the alert for any evidence of the symptoms presented by patients admitted to hospital for emergency treatment. These symptoms include:

* shortness of breath (dyspnea), found to be evident in 92% of acute heart failure patients
* peripheral oedema (in 35%)
* cough (in 33%)
* breathing difficulty when lying flat (orthopnea, in 30%)
* chest pain (in 29%)
* nocturnal dyspnea (in 28%)
* fatigue (in 17%)
* palpitations (in 7%)

Shortness of breath, said Professor Follath, is by far the most common presenting symptom, and families should recognise that it can be described in various ways – from "suffocation" to "tight chest" to "heavy breathing". At the same time, he warned that many elderly patients with heart failure may have co-existing conditions with non-cardiac symptoms, and these may be misleading. Careful instruction, therefore, in a simple understandable way is essential to ensure early warning and speedy treatment.

An American study reported in 2008 found that patients hospitalised with acute heart failure had experienced considerable delays in seeking medical care (with an average delay time of 13.3 hours).3 Male sex, multiple presenting symptoms, absence of a history of heart failure, and seeking medical care between midnight and 6 a.m. were associated with prolonged prehospital delay.

"This is why it is so important to instruct patients and their families how to recognise the symptoms of acute heart failure," said Professor Follath, "to seek medical help without loosing critical time of hours or even days before appropriate treatment can be started."

According to Professor John McMurray, President of the Heart Failure Association of the ESC, cases admitted to hospital for acute heart failure had until recently a very poor prognosis, but the better identification of symptoms - and thus their more appropriate treatment - have brought about a 40-50% reduction in mortality rates in a short time.

NOTES :

1. Heart Failure Congress 2009 is organised by the European Society of Cardiology and Heart Failure Association of the ESC, and takes place from 30 May to 2 June at the Palais Acropolis, Nice, France.

2. Follath F. Apprendre aux patients a reconnaître les signes d'alerte. 31 May 2009, 08.30-10.00 Heart Failure Congress 2009.

3. Goldberg RJ, Goldberg JH, Pruell S, et al. Delays in seeking medical care in hospitalized patients with decompensated heart failure. Am J Med 2008; 121: 212-218.

** Information on the scientific programme is available at http://spo.escardio.org/Welcome.aspx?eevtid=31*

** More information on Heart Failure Congress 2009 and on the press releases is available from the ESC press office at press@escardio.org OR on site at +33 (0)6 22 41 84 92.*