

<http://www.bbc.co.uk/news/health-25231910>

Belting out a tune 'helps those struggling to breathe'

Around the world an estimated 64 million people are struggling to breathe on a daily basis. But could a simple sing-song bring the relief they are looking for?

By Anna Lacey BBC Health Check

"If I want to walk any distance then I find a landmark about 15 paces away, make for that and stop to get my breath," says Jane Petto, who lives near Tunbridge Wells in Kent. "And if I see stairs - just looking at them tires me out. They take forever."

Jane is one of millions of people worldwide who suffer from Chronic Obstructive Pulmonary Disease, or COPD. It is a lifelong condition caused by damage to the air sacs and passages that make up the lungs - and can make breathing a constant battle. The World Health Organization expects COPD to be the third leading cause of death by 2030.

But despite having a profound impact on her daily life, there is one activity that gives Jane some respite - singing. "When you've got COPD, breathing is on your mind all the time. But strangely I don't notice it when I'm singing. I can hold a note for ages," she says.

Surprising as it may sound, it has long been suspected that singing can help people with breathing difficulties. But now a new long-term study on COPD and singing from Canterbury Christ Church University in Kent has shown that the benefits are real.

Dr Ian Morrison, a senior research fellow and one of the project's authors, said: "Lung function improved dramatically, particularly after about five months, once people had got used to what they were doing and changed their breathing habits." "To get such an improvement really was quite remarkable."

Take a deep breath

Joining a choir is by no means a conventional solution for such a serious illness. But the research team felt they had good reason to investigate its effects.

Dr Morrison says that people with breathing problems tend to develop a lot of anxiety about the very process of inhaling. "The tendency is to do 'gasp' breathing so they're taking short little breaths. "This actually fills up the lungs without clearing them, making it even more difficult to breathe."

Due to their obstructed airways, many people with COPD already find emptying their lungs a challenge.

Gasping makes the problem worse and can, in the most serious cases, lead to a build-up of carbon dioxide in the blood, which can result in respiratory failure. In contrast, the techniques used in singing encourage people to breathe in a much deeper, more controlled manner. "The whole musculature around the lungs, throat and the upper chest improve with time," says Dr Morrison. "They use what they have much better and you really see a difference in the skill of actually breathing."

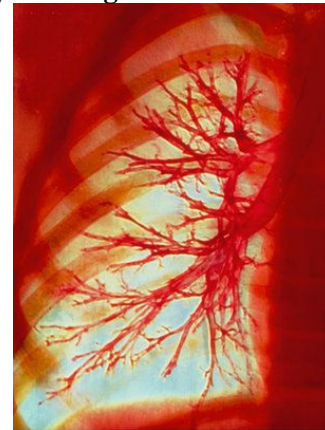
To test its effects, Morrison and his colleagues asked over 100 COPD patients - ranging from mild to severely affected - to attend weekly singing sessions over a 12-month period.

They measured their lung capacity with a device known as a spirometer - which looks a bit like a giant breathalyser - and asked participants to fill in a questionnaire to find out on a qualitative level how they were feeling.

One of the tests involved measuring how much air a person could force out in a rapid puff. "On average the people in our study had 50% of expected lung function," said Prof Stephen Clift, the study's lead author. "That means about 1.5 litres of air in a one second puff. For healthy lungs, we would expect something more like 3 litres."

Without treatment, people with COPD can expect to see the size of their puff decrease by around 40ml a year.

Fill your lungs: the art of breathing



- *Trained singers can hold notes for longer than the average person because they know how to optimise their lung capacity.*
- *Vocal coach Claire Alsop suggests visualising your lungs expanding by holding your arms in front of you like a ballerina, and moving them outwards as you breathe in.*
- *Keep the shoulders down and knees "bouncy", not locked, feet slightly apart at a "ten to two" position (like the hands on a clock).*
- *Breathe out with a "tffff" sound - feel your diaphragm pushing the air out.*
- *Extraordinary feats of lung control include A-ha's Morten Harket, whose 20.2 second sung note on 'Summer Moved On' is believed to be the longest in pop history. This beats Bill Withers' note on 'Lovely Day' by just over 2 seconds.*

The very best the team had hoped for was that after singing regularly for one year, the size of that puff would stay the same. "Instead we got an increase of 30ml," says Prof Clift. "Although the changes are small, the progressive nature of COPD means that any loss of function year-on-year is going to be more significant for them. "In our study, we not only appeared to halt the decline but people showed a small improvement." Dr Morrison added: "There's also the social and psychological side, because any long term condition is isolating. "So if people can get out and do things and get peer support, then their wellbeing improves as well."

'Singing on prescription'

In terms of treating COPD, the study's results are enticing. Of the deaths predicted by the WHO, most will occur in low- and middle-income countries. The beauty of singing is that whether you're Tom Jones or tone deaf, anyone can strike up a tune anywhere they please - for free.

Cooking in indoor stoves and working in dusty places can lead to COPD, but by far the biggest risk factor is cigarette smoking. It accounts for 80% of COPD cases worldwide, and quitting smoking is the best advice, according to Dr Penny Woods, chief executive of the British Lung Foundation.

"COPD is a chronic disease and it cannot be cured - the damage is irreversible. "However, someone already diagnosed with COPD could greatly decrease the progression of the disease if they give up smoking, helping them maintain a better quality of life for longer."

The study's authors certainly do not claim that singing can cure COPD or be an alternative to interventions such as giving up smoking. But Dr Morrison thinks that it could be a useful tool in helping people to manage the condition and live with it day to day. "Deep down, what we're looking for is singing on prescription for various long-term conditions," he says. "However this was only a feasibility study so it wasn't randomised and there wasn't a control. But we can now set up a controlled trial where some people sing, some people don't and that would be even more powerful way of showing these good results."

But volunteers like Jane are already convinced that singing has made a difference. She said: "I was diagnosed with COPD 17 years ago and then 13 years ago I was diagnosed with lung cancer as well so I had my right lung out. "Surviving as I have with everything that's gone against me, I put it down to singing. "I've been involved with singing all my life and there's so much going on with the words and the harmony that you're not thinking about breathing at all. But yet the breathing is working."

<http://nyti.ms/1ecY1IL>

Ancient Martian Lake May Have Supported Life

About 3.5 billion years ago - around the time life is thought to have first arisen on Earth - Mars had a large freshwater lake that might well have been hospitable to life, scientists reported Monday.

By KENNETH CHANG

The lake lay in the same crater where NASA's Mars rover Curiosity landed last year and has been exploring ever since. It lasted for hundreds or thousands of years, and possibly much longer. Whether any life ever appeared on Mars is not yet known, and Curiosity was not designed to answer that question. But the data coming back from the planet indicate that the possibility of life, at least in the ancient past, is at least plausible. John P. Grotzinger, a professor of geology at the California Institute of Technology who is the project scientist for the Curiosity mission, said that if certain microbes like those on present-day Earth had plopped into that ancient Martian lake, they would most likely have found a pleasant place to call home.

"The environment would have existed long enough that they could have been sustained, prospered, grown, multiplied," he said. "All the essential ingredients for life were present.

"Potentially the aqueous stream, lake, groundwater system could have existed for millions to tens of millions of years," he added. "You could easily get a lake with the area of the Finger Lakes in upstate New York."

The interpretation comes from detailed analysis of two mudstones drilled by Curiosity earlier this year. The structure, chemistry and mineralogy of the sedimentary rocks were not alien. "The whole thing just seems extremely Earthlike," Dr. Grotzinger said. The scientists presented their latest findings at a meeting of the American Geophysical Union in San Francisco and in a set of six articles published in the journal Science.

The surface of Mars today is frigid and arid, bombarded by sterilizing radiation, but after it formed and cooled with the rest of the solar system about 4.5 billion years ago, it was initially a warmer and wetter place during its first billion years. Over the past decade, scientists have identified several sites on Mars that they think were once habitable.

In 2004, after NASA's rover Opportunity discovered evidence that the Martian places it was traversing had once been soaking wet, Steven W. Squyres, the mission's principal investigator, declared, "This is the kind of place that would have been suitable for life."

But that location would have been an extremely challenging environment for life to take hold - very salty and highly acidic. Later, the scientists said the soils had been soaked not so much by water as by sulfuric acid.

NASA chose the 96-mile-wide Gale Crater as Curiosity's landing site because readings from orbit identified the presence of clay minerals, which form in waters with a neutral pH. Curiosity's instruments indeed detected clays in the two mudstones, named John Klein and Cumberland.

The clays appear to have formed at the lake bottom, not swept down from the walls of Gale Crater, strengthening the case that the lake water was not acidic.

Curiosity also measured carbon, hydrogen, oxygen, sulfur, nitrogen and phosphorus, elements that are critical for life on Earth, as well as iron and sulfur minerals that could have served as food for microbes.

"If there were microbial organisms around, I think they would have liked that environment," said David T. Vaniman, a researcher at the Planetary Science Institute in Tucson and the lead author of a Science paper examining the mineralogy. On Earth, a class of such microbes known as chemolithoautotrophs live in caves, hydrothermal vents and the deep underground.

An impact, probably by an asteroid, excavated Gale Crater 3.6 billion to 3.8 billion years ago, and the John Klein and Cumberland mudstones formed out of sediments that subsequently accumulated in the crater. That is roughly the same age as rocks on Earth with the earliest signs of life.

"You can actually begin to line up in time what the Earth was doing and what Mars was doing," Dr. Grotzinger said. "It's kind of cool."

The Gale Crater lake was also of the same era as the sulfuric-acid-soaked rocks that Opportunity found. That suggests that as Mars dried out, conditions in different regions varied widely. "Things have just gotten more complex than we thought," Dr. Grotzinger said.

Curiously, even though the rocks formed in a lake, soluble elements like sodium and calcium had not been washed away. That suggests that the climate even then was cold and arid, just not as cold and arid as it is today - perhaps an ice-covered lake.

"What does it mean about the climate?" Dr. Vaniman said. "It's something we're all thinking about."

What has not been found yet is solid evidence for the carbon molecules known as organics that could serve as the building blocks of life. Such molecules are not always preserved in stone and are destroyed by radiation. By measuring the abundance of certain elements, a technique that has long been used to date Earth rocks, Kenneth A. Farley, a professor of geochemistry at Caltech, was able to estimate that the sediments eroded from rocks 4.2 billion years old, give or take 350 million years, and that the rocks had been exposed at the surface for about 80 million years.

Previously, planetary scientists estimated ages by counting craters - the older a surface, the greater the number of craters. Dr. Farley's numbers fit with expectations for the Gale Crater rocks - "it's a nice demonstration this method could work," Dr. Farley said - and the dating technique could help locate rocks that have been exposed to radiation recently, raising the odds of finding organics, if they are present.

"That's a big step forward for the exploration of life on Mars," Dr. Grotzinger said. "We're now exploring for that subset of environments can preserve organic carbon."

http://www.eurekalert.org/pub_releases/2013-12/msu-hr1120913.php

Hard rock life

Scientists are digging deep into the Earth's surface collecting census data on the microbial denizens of the hardened rocks.

What they're finding is that, even miles deep and halfway across the globe, many of these communities are somehow quite similar.

The results, which were presented at the American Geophysical Union conference Dec. 8, suggest that these communities may be connected, said Matthew Schrenk, Michigan State University geomicrobiologist.

"Two years ago we had a scant idea about what microbes are present in subsurface rocks or what they eat," he said. "We're now getting this emerging picture not only of what sort of organisms are found in these systems but some consistency between sites globally - we're seeing the same types of organisms everywhere we look." Schrenk leads a team funded by the Alfred P. Sloan Foundation's Deep Carbon Observatory studying samples from deep underground in California, Finland and from mine shafts in South Africa. The scientists also collect microbes from the deepest hydrothermal vents in the Caribbean Ocean.

"It's easy to understand how birds or fish might be similar oceans apart," Schrenk said. "But it challenges the imagination to think of nearly identical microbes 16,000 kilometers apart from each other in the cracks of hard rock at extreme depths, pressures and temperatures."

Cataloging and exploring this region, a relatively unknown biome, could lead to breakthroughs in offsetting climate change, the discovery of new enzymes and processes that may be useful for biofuel and biotechnology research, he added.

For example, Schrenk's future efforts will focus on unlocking answers to what carbon sources the microbes use, how they cope in such extreme conditions as well as how their enzymes evolved to function so deep underground.

"Integrating this region into existing models of global biogeochemistry and gaining better understanding into how deep rock-hosted organisms contribute or mitigate greenhouse gases could help us unlock puzzles surrounding modern-day Earth, ancient Earth and even other planets," Schrenk said.

Collecting and comparing microbiological and geochemical data across continents is made possible through the DCO. The DCO has allowed scientists from across disciplines to better understand and describe these phenomena, he added.

Additional researchers included Julie Huber of Marine Biological Lab, T.C. Onstott of Princeton University, Merja Itavaara of VTT Finland and Ramunas Stepanauskas of Bigelow Laboratories.

http://www.eurekalert.org/pub_releases/2013-12/uob-hc120913.php

How 'good cholesterol' stops inflammation

Researchers at the University Hospital and the University of Bonn have discovered a central molecular switch

High-density lipoprotein (HDL), known colloquially as "good cholesterol", protects against dangerous deposits in the arteries. An important function of HDL is its anti-inflammatory properties. An international research team at the Institute of Innate Immunity at the University Hospital of Bonn and the LIMES Institute at the University of Bonn has identified a central switch by which HDL controls the inflammatory response. The results are presented in the current issue of "Nature Immunology".

High cholesterol levels are seen as a cause of dangerous deposits in the bloodstream, which lead to hardening of the arteries (atherosclerosis). As a consequence, thrombosis, strokes, and heart attacks can develop, which are among the leading causes of death in Western society. Low-density lipoprotein (LDL) is commonly referred to as the "bad cholesterol", because it promotes atherosclerosis. In contrast, the "good cholesterol", high-density lipoprotein (HDL), helps transport excess cholesterol out of the bloodstream and can counteract an inflammatory reaction in damaged vessel walls.

"It has long been known that HDL has a protective function in cardiovascular diseases that are based on atherosclerosis", reports Prof. Eicke Latz, Director of the Institute of Innate Immunity at the University of Bonn and who is further affiliated with the German Center for Neurodegenerative Diseases (DZNE) and the University of Massachusetts Medical School in the USA. "The molecular causes to which this protective effect of HDL can be attributed were unclear until now". For instance, studies had shown that therapies that simply increase HDL levels in the blood of patients are not sufficient to reduce the incidence of atherosclerosis. HDL has anti-inflammatory effects on immune cells – however the mechanisms have remained unclear until now. The research group has now investigated how HDL acts upon inflammatory processes.

Bioinformatics approach revealed a candidate gene

Principle investigators Dr. Dominic De Nardo and Larisa I. Labzin are both Australians currently training in the lab of Prof. Eicke Latz. In collaboration with other working groups of the University of Bonn, an international research team from Japan, Australia, China, the USA, and Germany has identified how HDL acts to prevent chronic inflammation. In a very extensive study over a period of about three years, the group performed experiments in human and mouse cells, to determine which genes are regulated by high HDL levels. "At first, we were really just feeling around in the dark", reports Prof. Latz. Close cooperation with the working group of Prof. Joachim L. Schultze of the Life and Medical Sciences (LIMES) Institute of the University of Bonn finally got the scientists on the right track. "With the aid of genomic and bioinformatics approaches, we were able to filter out a candidate gene from the wealth of regulated genes", adds Prof. Schultze.

This gene is found in phagocytes, which act in the body like police on the beat and, as part of the innate immune defense system, arrest intruders. These patrolmen are supported by a kind of "criminal file", the so-called Toll-like receptors (TLR). With their help, the phagocytes can distinguish between "good" and "bad". If it is a dangerous intruder, the TLR can also trigger the release of inflammatory substances via biochemical signaling pathways. The transcriptional regulator, ATF3, plays a key role in this process. "It reduces the transcription of the inflammatory genes and prevents further stimulation of inflammatory processes via the Toll-like receptors", explains Dr. Dominic De Nardo.

Sustained inflammatory reactions can lead to organ failure

The immune system uses inflammatory processes to keep pathogens in check, to detect damaged tissue, and then repair it. In sustained inflammatory reactions, however, there are dangerous consequences –including blood poisoning or organ failure. "The transcriptional regulator ATF3 acts to reduce these inflammatory reactions by suppressing the activation of inflammatory genes following excessive stimulation of

immunoreceptors", reports Dr. De Nardo. In the end, high-density lipoprotein (HDL) is responsible for down regulating the inflammatory reactions, via the activation of ATF3. "To put it simply, high HDL levels in blood are an important protective factor against sustained inflammation", summarizes Prof. Latz.

"Our studies also indicate that the amount of HDL in blood alone is not decisive for the protective function of HDL, but that the anti-inflammatory function is probably more important. These results also suggest a molecular approach for treating inflammation in other widespread diseases, such as diabetes", sums up Prof. Latz .

Publication: High-density lipoprotein mediates anti-inflammatory reprogramming of macrophages via the transcriptional regulator ATF3, Nature Immunology, DOI: 10.1038/ni.2784

http://www.eurekalert.org/pub_releases/2013-12/yumc-pee120913.php

Penicillin equally effective as 'big gun' antibiotics for treating less severe childhood pneumonia

Children hospitalized for pneumonia have similar outcomes, regardless treatment with "big gun" antibiotics or ampicillin or penicillin

Children hospitalized for pneumonia have similar outcomes, including length of stay and costs, regardless of whether they are treated with "big gun" antibiotics such as ceftriaxone or cefotaxime or more narrowly focused antibiotics such as ampicillin or penicillin, according to a Vanderbilt study published in Pediatrics.

Study authors said the findings are important because pneumonia is one of the most common reasons for hospitalization among U.S. children and because broad-spectrum antibiotics are frequently overprescribed, leading to antibiotic resistance.

"Sometimes there is a perception, not restricted to pneumonia, that the use of a broad spectrum antibiotic, a big gun, is going to be the best treatment for all patients. This perception can complicate the selection of antibiotics especially when there is limited information to support the decision," said senior author Carlos G. Grijalva, M.D., MPH, assistant professor of Health Policy. "To help inform those decisions, this study compared two pneumonia treatment regimens, a big gun (broad spectrum antibiotics) vs. a small gun (narrow spectrum antibiotics), and found there were no significant differences in clinical outcomes or associated costs."

In Summer 2011, the Pediatric Infectious Diseases Society and Infectious Diseases Society of America (PIDS/IDSA) released joint community-acquired pneumonia guidelines that recommend narrow-spectrum antibiotic therapy for most children hospitalized with pneumonia but, until now, few studies had compared the effectiveness of this strategy relative to use of broad spectrum antibiotics.

Using data from 43 children's hospitals in the U.S., the authors compared outcomes among children 6 months to 18 years of age hospitalized for pneumonia between 2005 and 2011, receiving either ampicillin or penicillin (narrow spectrum) or a third generation cephalosporin (ceftriaxone or cefotaxime,[broad spectrum]). According to the PIDS/IDSA guidelines, both treatment strategies are effective for disease caused by Streptococcus pneumoniae, the most common bacterial cause of pneumonia.

Lead author Derek J. Williams, M.D. MPH, assistant professor of Pediatrics, said doctors worry about increases in unnecessary use of broad spectrum antibiotics because they drive increases in disease caused by antibiotic-resistant bacteria.

"We have seen increases in use of broad spectrum antibiotics and concurrent increases in disease caused by resistant bacteria. For this study, we hypothesized that narrow and broad-spectrum antibiotics would have similar effectiveness in the treatment of childhood pneumonia. Our findings support the preferential use of narrow spectrum antibiotics as first-line therapies for most children hospitalized with pneumonia," Williams said.

"Although interventions such as the introduction of the pneumococcal conjugate vaccines into the U.S. childhood vaccination schedule in 2000 have led to reductions in pneumococcal disease in general and reductions in disease caused by vaccine strains resistant to antibiotics, additional actions are necessary to inform antibiotic selection and to continue reducing antibiotic resistance."

In the study, nearly 90 percent of children received broad-spectrum therapy, compared with only 10 percent receiving narrow-spectrum therapy.

"The 2011 PIDS/IDSA guidelines recommending ampicillin or penicillin represents a major shift toward more narrowly focused treatment, and this is one of the first studies that directly compared these agents against the more commonly used broader spectrum therapies," Williams said. "Although ampicillin or penicillin therapy was as effective as the third generation cephalosporins, use of the narrower spectrum drugs was very uncommon prior to release of the guidelines. In the near future, it would be interesting to evaluate whether the release of the consensus guidelines and related efforts facilitate widespread adoption of the new treatment recommendations."

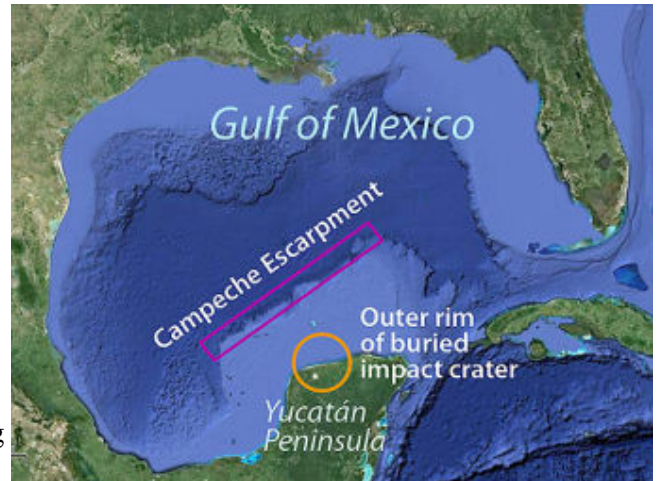
Mapping the demise of the dinosaurs

This map shows the Gulf of Mexico and the locations of the Campeche Escarpment and the buried impact crater that caused a global extinction event about 65 million years ago.

SAN FRANCISCO, CA - About 65 million years ago, an asteroid or comet crashed into a shallow sea near what is now the Yucatán Peninsula of Mexico. The resulting firestorm and global dust cloud caused the extinction of many land plants and large animals, including most of the dinosaurs. At this week's meeting of the American Geophysical Union (AGU) in San Francisco, MBARI researchers will present evidence that remnants from this devastating impact are exposed along the Campeche Escarpment - an immense underwater cliff in the southern Gulf of Mexico.

The ancient meteorite impact created a huge crater, over 160 kilometers across. Unfortunately for geologists, this crater is almost invisible today, buried under hundreds of meters of debris and almost a kilometer of marine sediments. Although fallout from the impact has been found in rocks around the world, surprisingly little research has been done on the rocks close to the impact site, in part because they are so deeply buried. All existing samples of impact deposits close to the crater have come from deep boreholes drilled on the Yucatán Peninsula.

In March 2013, an international team of researchers led by Charlie Paull of the Monterey Bay Aquarium Research Institute (MBARI) created the first detailed map of the Campeche Escarpment. The team used multi-beam sonars on the research vessel Falkor, operated by the Schmidt Ocean Institute. The resulting maps have recently been incorporated in Google Maps and Google Earth for viewing by researchers and the general public.



This map shows the Gulf of Mexico and the locations of the Campeche Escarpment and the buried impact crater that caused a global extinction event about 65 million years ago. Base image-Google Earth

Paull has long suspected that rocks associated with the impact might be exposed along the Campeche Escarpment, a 600-kilometer-long underwater cliff just northwest of the Yucatán Peninsula. Nearly 4,000 meters tall, the Campeche Escarpment is one of the steepest and tallest underwater features on Earth. It is comparable to one wall of the Grand Canyon - except that it lies thousands of meters beneath the sea. As in the walls of the Grand Canyon, sedimentary rock layers exposed on the face of the Campeche Escarpment provide a sequential record of the events that have occurred over millions of years. Based on the new maps, Paull believes that rocks formed before, during, and after the impact are all exposed along different parts of this underwater cliff.

Just as a geologist can walk the Grand Canyon, mapping layers of rock and collecting rock samples, Paull hopes to one day perform geologic "fieldwork" and collect samples along the Campeche Escarpment. Only a couple of decades ago, the idea of performing large-scale geological surveys thousands of meters below the ocean surface would have seemed a distant fantasy. Over the last eight years, however, such mapping has become almost routine for MBARI geologists using underwater robots.

The newly created maps of the Campeche Escarpment could open a new chapter in research about one of the largest extinction events in Earth's history. Already researchers from MBARI and other institutions are using these maps to plan additional studies in this little-known area. Detailed analysis of the bathymetric data and eventual fieldwork on the escarpment will reveal fascinating new clues about what happened during the massive impact event that ended the age of the dinosaurs - clues that have been hidden beneath the waves for 65 million years.

In addition to the Schmidt Ocean Institute, Paull's collaborators in this research included Jaime Urrutia-Fucugauchi from the Universidad Nacional Autónoma de México and Mario Rebolledo-Vieyra of the Centro de Investigación Científica de Yucatán. Paull also worked closely with MBARI researchers, including geophysicist and software engineer Dave Caress, an expert on processing of multibeam sonar data, and geologist Roberto Gwiazda, who served as project manager and will be describing this research at the AGU meeting.

<http://phys.org/news/2013-12-perfluorotributylamine-long-lived-greenhouse-gas.html>

Perfluorotributylamine: New long-lived greenhouse gas discovered

Scientists from U of T's Department of Chemistry have discovered a novel chemical lurking in the atmosphere that appears to be a long-lived greenhouse gas (LLGHG).

The chemical – perfluorotributylamine (PFTBA) – is the most radiatively efficient chemical found to date, breaking all other chemical records for its potential to impact climate.

Radiative efficiency describes how effectively a molecule can affect climate. This value is then multiplied by its atmospheric concentration to determine the total climate impact.

PFTBA has been in use since the mid-20th century for various applications in electrical equipment and is currently used in thermally and chemically stable liquids marketed for use in electronic testing and as heat transfer agents. It does not occur naturally, that is, it is produced by humans. There are no known processes that would destroy or remove PFTBA in the lower atmosphere so it has a very long lifetime, possibly hundreds of years, and is destroyed in the upper atmosphere.

"Global warming potential is a metric used to compare the cumulative effects of different greenhouse gases on climate over a specified time period," said Cora Young who was part of the U of T team, along with Angela Hong and their supervisor, Scott Mabury. Time is incorporated in the global warming potential metric as different compounds stay in the atmosphere for different lengths of time, which determines how long-lasting the climate impacts are.

Carbon dioxide (CO₂) is used as the baseline for comparison since it is the most important greenhouse gas responsible for human-induced climate change. "PFTBA is extremely long-lived in the atmosphere and it has a very high radiative efficiency; the result of this is a very high global warming potential. Calculated over a 100-year timeframe, a single molecule of PFTBA has the equivalent climate impact as 7100 molecules of CO₂," said Hong.

<http://www.medscape.com/viewarticle/817490?src=rss>

Hepatitis C Virus Remains Infective for 6 Weeks on Fomites

Drops of hepatitis C virus (HCV) dry and remain infective for 6 weeks at room temperature, according to a new study. Therefore, fomites may be a source of nosocomial HCV infections.

Lara C. Pullen, PhD

The persistence of the virus on fomites may also underlie the continued high incidence of HCV infection among people who inject drugs.

Elijah Painstil, MD, from the Department of Pediatrics the Department of Pharmacology, Yale School of Medicine, New Haven, Connecticut, and colleagues published their microculture assay results online November 23 in the Journal of Infectious Diseases. They designed their study to mimic the natural events that might lead to the transmission of HCV, using a genetically modified HCV laboratory clone that was derived from a genotype 2a virus.

Drops of plasma spiked with the 2a HCV reporter virus were placed into a 24-well plate and stored uncovered for up to 6 weeks. The drops ranged from 20 to 33 μ L (mean volume, 29 μ L). The investigators performed the experiment 3 times.

"In our simulation of real world risks of HCV transmission in settings conducive to exposure to HCV-contaminated fomites, we observed that [cell culture derived HCV (HCVcc)] could maintain infectivity for up to 6 weeks at 4° and 22°C. This finding supports our hypothesis that the increasing incidence of nosocomial HCV infections may be due to accidental contact with HCV-contaminated fomites and other hospital equipment even after prolonged periods after their deposition. Moreover, we found that HCVcc infectivity was influenced by HCVcc viral titer and the temperature and humidity of the storage environment," the authors write.

They add that all of the HCVcc-contaminated drops dried within 4 hours at room temperature and became easy to overlook. Dried drops are thus a challenge for infection control and are possibly a source of accidental exposure to HCV.

"[G]iven the infection control implications of our findings, we decided to investigate if commonly used antiseptics are effective against HCV. We demonstrated that bleach, cavicide, and ethanol are effective at their recommended concentrations," the authors elaborate.

Commercial antiseptics did vary in their anti-HCV activity. Bleach (diluted 1:10) was more effective than cavicide (diluted 1:10), which was more effective than ethanol (70%).

This study was made possible by grant from National Institutes of Health/National Institute on Drug Abuse. The authors have disclosed no relevant financial relationships.

J Infect Dis. Published online November 23, 2013. [Full text](#)

<http://bit.ly/1j6mzyZ>

Mars Radiation Risk 'Manageable' for Human Missions

A manned mission to Mars would be risky, but the radiation hazards are less acute than originally believed, according to measurements by NASA's Mars rover Curiosity.

Dec 9, 2013 04:43 PM ET // by Mike Wall, Space.com

The risk of radiation exposure is not a show-stopper for a long-term manned mission to Mars, new results from NASA's Curiosity rover suggest. A mission consisting of a 180-day cruise to Mars, a 500-day stay on the Red Planet and a 180-day return flight to Earth would expose astronauts to a cumulative radiation dose of about 1.01 sieverts, measurements by Curiosity's Radiation Assessment Detector (RAD) instrument indicate.

To put that in perspective: The European Space Agency generally limits its astronauts to a total career radiation dose of 1 sievert, which is associated with a 5-percent increase in lifetime fatal cancer risk.

"It's certainly a manageable number," said RAD principal investigator Don Hassler of the Southwest Research Institute in Boulder, Colo., lead author of a study that reports the results today (Dec. 9) in the journal *Science*.

A 1-sievert dose from radiation on Mars would violate NASA's current standards, which cap astronauts' excess-cancer risk at 3 percent. But those guidelines were drawn up with missions to low-Earth orbit in mind, and adjustments to accommodate trips farther afield may be in the offing, Hassler said. "NASA is working with the National Academies' Institute of Medicine to evaluate what appropriate limits would be for a deep-space mission, such as a mission to Mars," Hassler told SPACE.com. "So that's an exciting activity."

The new results represent the most complete picture yet of the radiation environment en route to Mars and on the Red Planet's surface. They incorporate data that RAD gathered during Curiosity's eight-month cruise through space and the rover's first 300 days on Mars, where it touched down in August 2012.

The RAD measurements cover two different types of energetic-particle radiation - galactic cosmic rays (GCRs), which are accelerated to incredible speeds by far-off supernova explosions, and solar energetic particles (SEPs), which are blasted into space by storms on our own sun. RAD's data show that astronauts exploring the Martian surface would accumulate about 0.64 millisieverts of radiation per day. The dose rate is nearly three times greater during the journey to Mars, at 1.84 millisieverts per day.

But Mars' radiation environment is dynamic, so Curiosity's measurements thus far should not be viewed as the final word, Hassler stressed. For example, RAD's data have been gathered near the peak of the sun's 11-year activity cycle, a time when the GCR flux is relatively low (because solar plasma tends to scatter galactic cosmic rays). Curiosity's radiation measurements should help NASA plan out a manned mission to Mars, which the space agency hopes to pull off by the mid-2030s, Hassler said. And they should also inform the search for signs of past or present life on the Red Planet - another top NASA priority.

For example, the new RAD results suggest that microbial life is unlikely to exist right at the Martian surface, Hassler said. But future missions may not have to drill too deeply underground to find pockets of Mars life, if it ever existed. "These measurements do tell us that we think it could be viable to find signs of possible extant or past life as shallow as 1 meter deep," Hassler said.

The new study is one of six papers published in *Science* today that report new results from Curiosity. Most of the other studies present evidence that the rover has found an ancient freshwater lake that could have supported microbial life for tens of thousands, and perhaps millions, of years.

<http://bit.ly/1bFfu1K>

Alien life could have basked in big bang's afterglow

Ancient alien life might have been incubating on strange exoplanets just 15 million years after the birth of the universe.

21:58 09 December 2013 by Jacob Aron

Although nothing more complex than microbes could have existed back then, the possibility may poke holes in the notion that the universe is fine-tuned for human existence.

Astronomers hunting for signs of alien life today look for exoplanets within the habitable zone of stars - the region around a star that is warm enough for liquid water to exist on a planet's surface. In the deep freeze of space, worlds that are too far from their host stars should be inhospitable to life as we know it.

But space wasn't always so frigid, argues Abraham Loeb of Harvard University. The very early universe was filled with superheated gas, or plasma, that gradually cooled and condensed to form stars and galaxies. We see the first light emitted by this plasma as the cosmic microwave background (CMB).

Today, the CMB's temperature is just a few degrees above absolute zero. But Loeb calculates that about 15 million years after the big bang, the radiation would have been warm enough to make the whole universe one large habitable zone. This life-friendly epoch would have lasted a few million years, enough time for microbes to emerge but not complex life, says Loeb.

Stable home

A thornier issue is whether any planets could have formed so early in the universe's history, along with the complex molecules necessary for life. When the hot plasma cooled, it initially produced only hydrogen and helium atoms. Heavier stuff had to be cooked up inside the nuclear forges of the first stars then expelled when those stars exploded.

Standard cosmology says that in most parts of the universe, the amounts of heavy elements needed to make planets didn't occur until hundreds of millions of years after the big bang. But our current understanding of the early distribution of matter is incomplete, says Loeb. If some regions were much denser than average, it is possible stars and planets formed there earlier – perhaps in time for the CMB to be the right temperature.

"These planets are very rare objects that are extremely unlikely, but because the universe is so large, you could still have them," he says.

Such physical conditions might have been right for life, but any microbes would also need enough time to evolve, argues Jack O'Malley-James at the University of St Andrews, UK. Our mid-sized sun is already almost 5 billion years old and is expected to live for another 5 billion. By contrast, the earliest stars would have been much more massive with shorter lifespans, maybe only a few million years or so. "These systems would have to be very calm and stable from a very early stage to give life a good chance of gaining a foothold," says O'Malley-James.

Great values

As wacky as the idea of such ancient life seems, Loeb thinks it is worth exploring if it puts a dent in the anthropic principle. This hotly debated idea in cosmology says that the fundamental constants in the universe are tuned in just the right way for us to be around to observe them.

For instance, a parameter called the cosmological constant accounts for the accelerated expansion of the universe due to dark energy. But theories predict that the value for this constant is more likely to be enormously larger than the one we have measured. If that were the case, the outwards push of dark energy should outmatch the pull of gravity, and structures like planets and galaxies should not have been able to form in the first place.

The anthropic principle solves this conundrum by assuming that the different possible values for the cosmological constant can appear across multiple universes. The value can also change with time in a given universe as it is tied to the density of matter, which changes as the universe expands. We happen to live in the universe that is suited to our existence at a time when the value of the constant is just right for human life to emerge and observe it. Many cosmologists don't like this line of reasoning, though, as they believe it is too simplistic.

"The anthropic argument gives us an excuse for not seeking a more fundamental understanding," says Loeb. That makes the notion of "big bang life" appealing. The denser regions of matter needed for it to arise would have also required a cosmological constant a million times larger than ours. That would mean life existed in our universe even at a time when the value of the cosmological constant would not have favoured humans, making our existence less special.

It is possible that life evolved during Loeb's habitable epoch, agrees Alexander Vilenkin at Tufts University in Medford, Massachusetts. However, he reckons the odds of it happening are very low, and that most life in our universe should instead be suited to today's conditions, so from a statistical view the anthropic principle lives on. "If we are typical observers, we should expect to live in a region with a small cosmological constant," Vilenkin adds.

Journal reference: arxiv.org/abs/1312.0613

<http://www.sciencedaily.com/releases/2013/12/131209181101.htm>

New Drug Approach Could Lead to Cures for Wide Range of Diseases

A team led by a longtime Oregon Health & Science University researcher has demonstrated in mice what could be a revolutionary new technique to cure a wide range of human diseases -- from cystic fibrosis to cataracts to Alzheimer's disease -- that are caused by "misfolded" protein molecules.

Misfolded protein molecules, caused by gene mutation, are capable of maintaining their function but are misrouted within the cell and can't work normally, thus causing disease. The OHSU team discovered a way to use small molecules that enter cells, fix the misfolded proteins and allow the proteins to move to the correct place and function normally again.

The researchers were led by P. Michael Conn, Ph.D., who was a senior scientist in reproductive sciences and neuroscience at OHSU's Oregon National Primate Research Center and professor of physiology and pharmacology, cell biology and development and obstetrics and gynecology at OHSU for the past 19 years. This month, Conn joined Texas Tech University Health Sciences Center as senior vice president for research and associate provost.

The team's work will be published this week in the early online edition of the Proceedings of the National Academy of Sciences. The work was the culmination of 13 years of work on the process by Conn and Jo Ann Janovick, former senior research associate at the ONPRC who is now also at TTUHSC. Richard R. Behringer, Ph.D., from the University of Texas MD Anderson Cancer Center, M. David Stewart, Ph.D., from the University of Houston, and Douglas Stocco, Ph.D., and Pulak Manna, Ph.D., from the department of biochemistry/microbiology at TTUHSC, also contributed to the work.

Conn and his team perfected the process in mice, curing them of a form of disease that causes males to be unable to father offspring. The identical disease occurs in humans and Conn believes the same concept can work to cure human disease as well.

"The opportunity here is going to be enormous," said Conn, "because so many human diseases are caused by misfolded proteins. The ability of these drugs -- called 'pharmacoperones' -- to rescue misfolded proteins and return them to normalcy could someday be an underlying cure to a number of diseases. Drugs that act by regulating the trafficking of molecules within cells are a whole new way of thinking about treating disease." Proteins must fold into three-dimensional shapes in precise ways to do their work within human cells. Before recent discoveries about misfolded proteins, scientists believed that proteins that were inactive were intrinsically non-functional. But work by Conn and others revealed that, when the proteins are misfolded, the cell's "quality control system" misroutes them within the cell and they cease to function only because of that misrouting. Pharmacoperones can fix misfolded proteins and thus make them functional again. Scientists had in recent years observed this process in cells under a microscope. The work of Conn's team is the first time the process has worked in a living laboratory animal.

"These findings show how valuable laboratory animals are in identifying new treatments for human disease," said Conn. "We expect that these studies will change the way drug companies look for drugs, since current screening procedures would have missed many useful pharmacoperone drugs."

A wide range of diseases are caused by an accumulation of misfolded proteins. Among the diseases are neurodegenerative diseases like Alzheimer's disease, Parkinson's disease and Huntington's disease. Other diseases include certain types of diabetes, inherited cataracts and cystic fibrosis.

Conn said the next steps will be clinical trials to see whether the same technique can work in humans.

The research was funded by the National Institutes of Health (grants OD012220 and DK85040), the Ben F. Love Endowment, the American Heart Association, the Texas Heart Institute and the Robert A. Welch Foundation.

Jo Ann Janovick, M. David Stewart, Darla Jacob, L. D. Martin, Jian Min Deng, C. Allison Stewart, Ying Wang, Anda Cornea, Lakshmi Chavali, Suhujey Lopez, Shoukhrat Mitalipov, Eunju Kang, Hyo-Sang Lee, Pulak R. Manna, Douglas M. Stocco, Richard R. Behringer, and P. Michael Conn. Restoration of testis function in hypogonadotropic hypogonadal mice harboring a misfolded GnRHR mutant by pharmacoperone drug therapy. PNAS, December 9, 2013 DOI: 10.1073/pnas.1315194110

http://www.eurekalert.org/pub_releases/2013-12/wt-atl120613.php

Antibiotic-resistant typhoid likely to spread despite drug control program

Restricting the use of antibiotics is unlikely to stop the spread of drug resistance in typhoid fever, according to a study funded by the Wellcome Trust and published in the journal eLife.

The findings reveal that antibiotic-resistant strains of Salmonella Typhi bacteria can out-compete drug sensitive strains when grown in the laboratory, even in the absence of antibiotics.

Typhoid fever is transmitted by consuming food or drink that is contaminated with Salmonella Typhi bacteria and the disease is linked to poor sanitation and limited access to clean drinking water. The disease can be treated but there is widespread drug resistance to common antibiotics and resistance to the recommended, more specialised antibiotic therapy for typhoid fever is increasing.

Researchers at the Oxford University Clinical Research Unit, Wellcome Trust Vietnam Research Programme, created twelve laboratory strains of Salmonella Typhi bacteria with one or more genetic mutations that confer resistance to the recommended antibiotic therapy for typhoid fever, fluoroquinolone. Typically, when bacteria develop antibiotic resistance it comes at a cost and when the drug is absent, they are usually weaker and less able to compete for food and resources than strains that are not resistant.

Dr Maciej Boni, a Sir Henry Dale Fellow funded jointly by the Wellcome Trust and Royal Society at the Oxford University Clinical Research Unit in Vietnam, who co-led the study, said: "When we grew different strains of Salmonella Typhi in the lab, we found that half of the antibiotic resistant strains had a growth advantage over their parent strain, even in the absence of antibiotic, enabling them to predominate in the population."

Dr Stephen Baker, also a Sir Henry Dale Fellow in the Oxford University Clinical Research Unit, said:

"Currently, the control of typhoid across Asia and Africa relies on treatment with fluoroquinolones but resistance is rising. Withdrawing or restricting the use of this class of antibiotics is one approach to try and

combat the spread of resistance. However, the results of this study suggest that we need to think beyond this, as antibiotic resistance will likely continue to rise even if these strategies are implemented."

Dr Jimmy Whitworth, Head of International Activities at the Wellcome Trust, said: "These important findings from researchers in Vietnam are very worrying. If confirmed, one of our main strategies for controlling drug-resistance in typhoid will be ineffective. We will need to concentrate on developing more effective and affordable vaccines, and improving water supplies and sanitation, a Herculean task for low and middle income countries."

There are an estimated 21 million cases of typhoid fever around the world each year. If left untreated, it's estimated that up to one in five with the disease will die and of those who survive, some will have permanent physical or mental disabilities. According to a World Health Organization report, 90% of the world's typhoid deaths occur in Asia and the disease persists mainly in children under five years.

Typhoid infects the gut and bloodstream, causing fever that can reach temperatures of 39°-40° C and constipation or diarrhoea. The disease can be associated with other characteristics including, rose-coloured spots on the chest, confusion and perforation of the gut.

<http://bit.ly/1k16s3I>

Relapse of 'cured' men shows HIV is far from beaten

HIV has re-emerged in two men who in July appeared to have been freed of the virus and were able to come off their antiretroviral medication.

12:01 10 December 2013 by Andy Coghlan

Known as the Boston patients after the city where they were treated, the men were two of a number of people reported as being virtually cured of HIV this year. The levels of the virus in their blood became almost undetectable for an extended period of time after a bone marrow transplant. Others include a baby in Mississippi and a group of 14 people in France known as the Visconti cohort, who were functionally cured of HIV, meaning that although their bodies still had traces of the virus, it was no longer active.

The disappointing news, reported at a meeting of HIV researchers in Miami, Florida, last week, highlights how far we still have to go before we actually cure the disease, despite the progress that has been made recently.

"Eliminating every last piece of virus is proving to be very, very difficult," says Sharon Lewin of Monash University in Melbourne, Australia.

New immune system

In 2008 and 2010, the two Boston patients were each given a bone marrow transplant to treat their blood cancer, effectively giving them a new immune system from a non-infected donor. Both continued to take their antiretroviral therapy after the transplant to prevent any residual virus hiding in their bodies from infecting their new blood cells.

Eight months after the operation, the virus was undetectable in their blood. Earlier this year, when they had been apparently virus-free for several years, both men opted to halt their antiretroviral therapy.

For several months, the approach seemed to have worked but last week, Timothy Henrich of Brigham and Women's Hospital in Boston, who treated the men, reported that the virus had crept back into their bloodstreams. Both have resumed antiretroviral therapy after stopping it for 12 and 32 weeks, respectively.

The therapy suppresses HIV levels in the body by disrupting viral replication in blood cells, usually CD4 cells, the white blood cells most vulnerable to infection. But it cannot reach and destroy the virus in cells where the virus is dormant and not replicating. These HIV reservoirs mean that if the treatment is discontinued when there is still a small amount of virus left in the body, it can emerge from its hiding place to re-establish infection. This is what is thought to have happened with the Boston patients.

"The results prove we still need to improve considerably our knowledge about HIV reservoirs and where the virus hides," says Asier Sáez-Cirión of the Pasteur Institute in Paris, a researcher following the Visconti cohort.

"We see that a very weak HIV reservoir does not suffice to achieve an HIV cure or long-term remission of infection."

Flush it out

One method of getting around this is to find a way to flush the hidden virus into the bloodstream so it can be purged with antiretroviral drugs.

Several drugs are being developed that do just that. So far, panobinostat looks the most promising – it is an experimental cancer drug developed by Novartis. At the meeting, Thomas Rasmussen of Aarhus University Hospital in Skejby, Denmark, presented preliminary results in 15 people taking the drug. After they received the drug for eight weeks, levels of HIV rose in their bloodstreams, suggesting that the drug may be flushing out hidden HIV. "It means we've stimulated the cells to start producing the virus," says Rasmussen.

Following the disappointment with the Boston patients, Rasmussen says the results need to be interpreted with extreme caution. "We could be flushing out the virus, but even if we are highly successful, there's likely to be more intervention needed to achieve a cure," he says.

One problem is that even if the virus is flushed out of the cells, those cells remain alive and may still contain active, potentially infectious virus. "Antiretroviral therapy will be able to block new infections, but will not deal with the cells producing the virus," says Sáez-Ciri3n. "Nor will the immune system from most patients be efficient enough to get rid of those cells."

A solution may be to boost the person's immune system to kill the virus-containing cells, although even this may not be enough. "We need to truly understand where the virus hides and whether it is repressed through similar mechanisms all over the body," says Sáez-Ciri3n. "It would thus be extremely useful to know where the viruses detected in the two Boston patients were coming from."

<http://www.sciencedaily.com/releases/2013/12/131210072030.htm>

Music Brings Memories Back to the Injured Brain

In the first study of its kind, two researchers have used popular music to help severely brain-injured patients recall personal memories.

Amee Baird and S3verine Samson outline the results and conclusions of their pioneering research in the recent issue of the journal *Neuropsychological Rehabilitation*.

Although their study covered a small number of cases, it's the very first to examine 'music-evoked autobiographical memories' (MEAMs) in patients with acquired brain injuries (ABIs), rather than those who are healthy or suffer from Alzheimer's Disease.

In their study, Baird and Samson played extracts from 'Billboard Hot 100' number-one songs in random order to five patients. The songs, taken from the whole of the patient's lifespan from age five, were also played to five control subjects with no brain injury. All were asked to record how familiar they were with a given song, whether they liked it, and what memories it invoked.

Doctors Baird and Samson found that the frequency of recorded MEAMs was similar for patients (38%-71%) and controls (48%-71%). Only one of the four ABI patients recorded no MEAMs. In fact, the highest number of MEAMs in the whole group was recorded by one of the ABI patients. In all those studied, the majority of MEAMs were of a person, people or a life period and were typically positive. Songs that evoked a memory were noted as more familiar and more liked than those that did not.

As a potential tool for helping patients regain their memories, Baird and Samson conclude that: "Music was more efficient at evoking autobiographical memories than verbal prompts of the Autobiographical Memory Interview (AMI) across each life period, with a higher percentage of MEAMs for each life period compared with AMI scores."

"The findings suggest that music is an effective stimulus for eliciting autobiographical memories and may be beneficial in the rehabilitation of autobiographical amnesia, but only in patients without a fundamental deficit in autobiographical recall memory and intact pitch perception."

The authors hope that their ground-breaking work will encourage others to carry out further studies on MEAMs in larger ABI populations. They also call for further studies of both healthy people and those with other neurological conditions to learn more about the clear relationship between memory, music and emotion; they hope that one day we might truly "understand the mechanisms underlying the unique memory enhancing effect of music."

<http://bit.ly/1jAvIxz>

There's a 1,200-year-old Phone in the Smithsonian Collections

One of the earliest examples of ingenuity in the Western Hemisphere is composed of gourds and twine

By Neil Baldwin

As a nomadic cultural historian, my subjects have led me in wildly different directions. I spent every Friday for five years in a dim, dusty reading room in West Orange, New Jersey, formerly a laboratory on the second floor of Thomas Edison's headquarters, deciphering the blunt-penciled scrawls of the celebrated inventor. Two years after my biography of Edison appeared, I found myself laboring up vertiginous stairs at daybreak in Mexico, photographing the faded ochre outlines of winged snakes etched into stone temples at the vast ruins of Teotihuac3n. The daunting treks led to a book on Mesoamerican myth, *Legends of the Plumed Serpent*.

Those two disparate worlds somehow collided unexpectedly on a recent afternoon in the hushed, temperature-controlled precincts of the National Museum of the American Indian storage facility in Suitland, Maryland. There, staffers pushing a rolling cart ushered one of the museum's greatest treasures into the high-ceilinged room. Nestled in an acid-free corrugated cardboard container was the earliest known example of telephone

technology in the Western Hemisphere, evoking a lost civilization - and the anonymous ancient techie who dreamed it up.

The gourd-and-twine device, created 1,200 to 1,400 years ago, remains tantalizingly functional - and too fragile to test out. "This is unique," NMAI curator Ramiro Matos, an anthropologist and archaeologist who specializes in the study of the central Andes, tells me. "Only one was ever discovered. It comes from the consciousness of an indigenous society with no written language."

We'll never know the trial and error that went into its creation. The marvel of acoustic engineering - cunningly constructed of two resin-coated gourd receivers, each three-and-one-half inches long; stretched-hide membranes stitched around the bases of the receivers; and cotton-twine cord extending 75 feet when pulled taut - arose out of the Chimu empire at its height.



From the Smithsonian National Museum of the American Indian (Travis Rathbone)

The dazzlingly innovative culture was centered in the Río Moche Valley in northern Peru, wedged between the Pacific Ocean and the western Andes. "The Chimu were a skillful, inventive people," Matos tells me as we don sterile gloves and peer into the hollowed interiors of the gourds. The Chimu, Matos explains, were the first true engineering society in the New World, known as much for their artisanry and metalwork as for the hydraulic canal-irrigation system they introduced, transforming desert into agricultural lands.

The artifact's recent past is equally mysterious. Somehow - no one knows under what circumstances - it came into the hands of a Prussian aristocrat, Baron Walram V. Von Schoeler. A shadowy Indiana Jones-type adventurer, Von Schoeler began excavating in Peru during the 1930s. He developed the "digging bug," as he told the New York Times in 1937, at the age of 6, when he stumbled across evidence of a prehistoric village on the grounds of his father's castle in Germany. Von Schoeler himself may have unearthed the gourd telephone. By the 1940s, he had settled in New York City and amassed extensive holdings of South American ethnographic objects, eventually dispersing his collections to museums around the United States.

The sophisticated culture was eclipsed when the Inca emperor Tupac Yupanqui conquered the Chimu king Minchancaman around 1470. During its heyday, the urban center of Chan Chan was the largest adobe metropolis in pre-Columbian America. The central nucleus covered 2.3 square miles.

Today, the angular contours of ten immense compounds, once surrounded by thick, 30-foot-high walls, are visible. The compounds, or *ciudadelas*, erected successively by ten Chimu kings, were subdivided into labyrinths of corridors, kitchens, courtyard gardens, wells, burial sites, supply rooms and residential and administrative chambers, or *audiencias*.

Like the Inca, Matos says, the Chimu were organized as "a top-down society; this instrument would have been made only for, and used by, a member of the elite, perhaps a priest."

Walls within walls and secluded apartments in the *ciudadelas* preserved stratification between the ruling elite and the middle and working classes. The NMAI telephone, Matos says, was "a tool designed for an executive level of communication" - perhaps for a courtier-like assistant required to speak into a gourd mouthpiece from an anteroom, forbidden face-to-face contact with a superior conscious of status and of security concerns.

Contemplating the brainstorm that led to the Chimu telephone - a eureka moment undocumented for posterity - summons up its 21st-century equivalent. On January 9, 2007, Steve Jobs strode onto a stage at the Moscone Center in San Francisco and announced, "This is the day I have been looking forward to for two and a half years." As he swiped the touchscreen of the iPhone, it was clear that the paradigm in communications technology had shifted. The unsung Edison of the Chimu must have experienced an equivalent, incandescent exhilaration when his (or her) device first transmitted sound from chamber to chamber.

<http://bit.ly/1c3paWD>

Damp spots found in supposedly dry Martian tropics

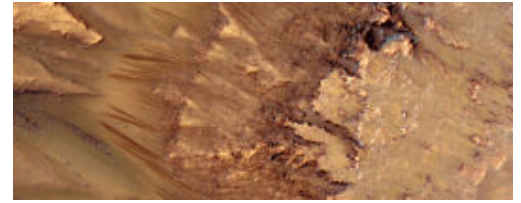
Dark streaks on sun-warmed slopes hint at unexpected dampness in the Martian tropics.

18:04 10 December 2013 by Jeff Hecht

If confirmed, the discovery would mean that water on Mars is more widespread than imagined - possibly adding a wrinkle to efforts to protect Mars from contamination with earthly life forms. Previous images taken from orbit showed similar streaks that appear to be moving down slopes in the planet's southern mid-latitudes. These dark spots appeared in sunny areas in late spring and summer then faded away, leading scientists to conclude that briny ice under the surface was melting, and that liquid water was seeping up and evaporating.

The latest pictures have doubled the number of southern sites with streaks and added some closer to the equator, most in the deep canyons of Valles Marineris. These dark spots also appear on sunny slopes and then vanish.

"As something that wets and dries again, water is a very attractive explanation," says Alfred McEwen at the University of Arizona in Tucson.



This colour-enhanced image shows the apparently damp streaks on the left-hand side NASA/JPL/University of Arizona

Damp surprise

Water ice wasn't expected to exist in the Martian tropics, where temperatures get high enough that even buried ice should have been vaporised. Small amounts of water might be condensing from the atmosphere rather than seeping up from ice deposits. Either way, McEwen is convinced that liquid water is somehow involved. "No one has come up with a good alternative model," he says.

The fresh evidence for seasonal streaks bolsters the case for briny liquids at work on Mars, says James Head at Brown University in Providence, Rhode Island, who was not involved in the study. Water at the equator would be very surprising, he adds, but it is possible some ice may remain under protective soil cover.

And that may force a rethink of future exploration plans, says McEwen. While spacecraft headed to Mars are carefully sterilised before launch, there is a risk that hardy hitchhiking microbes could make it all the way to the planet's surface. A 2008 report had concluded that tropical Mars is too dry for terrestrial life to survive there, making it a relatively safe landing zone. Evidence of recurring damp spots in the Martian tropics could change that assessment, says McEwen. *Journal reference: Nature Geoscience, DOI: 10.1038/NGEO2014*

<http://www.bbc.co.uk/news/science-environment-25312674>

Yellowstone supervolcano 'even more colossal'

The supervolcano that lies beneath Yellowstone National Park in the US is far larger than was previously thought, scientists report.

Rebecca Morelle By Rebecca Morelle Science reporter, BBC World Service
A study shows that the magma chamber is about 2.5 times bigger than earlier estimates suggested. A team found the cavern stretches for more than 90km (55 miles) and contains 200-600 cubic km of molten rock. The findings are being presented at the American Geophysical Union Fall Meeting in San Francisco.

Prof Bob Smith, from the University of Utah, said: "We've been working there for a long time, and we've always thought it would be bigger... but this finding is astounding."



It is unclear when the Yellowstone supervolcano will erupt again

If the Yellowstone supervolcano were to blow today, the consequences would be catastrophic.

The last major eruption, which occurred 640,000 years ago, sent ash across the whole of North America, affecting the planet's climate. Now researchers believe they have a better idea of what lies beneath the ground. The team used a network of seismometers that were situated around the park to map the magma chamber. Dr Jamie Farrell, from the University of Utah, explained: "We record earthquakes in and around Yellowstone, and we measure the seismic waves as they travel through the ground. "The waves travel slower through hot and partially molten material... with this, we can measure what's beneath."

The team found that the magma chamber was colossal. Reaching depths of between 2km and 15km (1 to 9 miles), the cavern was about 90km (55 miles) long and 30km (20 miles) wide. It pushed further into the north east of the park than other studies had previously shown, holding a mixture of solid and molten rock.

"To our knowledge there has been nothing mapped of that size before," added Dr Farrell.

The researchers are using the findings to better assess the threat that the volatile giant poses. "Yes, it is a much larger system... but I don't think it makes the Yellowstone hazard greater," explained Prof Bob Smith.

"But what it does tell us is more about the area to the north east of the caldera."

He added that researchers were unsure when the supervolcano would blow again.

Some believe a massive eruption is overdue, estimating that Yellowstone's volcano goes off every 700,000 years or so. But Prof Smith said more data was needed, because there had only been three major eruptions so far. These happened 2.1 million years ago, 1.3 million years ago and 640,000 years ago.

"You can only use the time between eruptions (to work out the frequency), so in a sense you only have two numbers to get to that 700,000 year figure," he explained. "How many people would buy something on the stock market on two days of stock data."

In another study presented at the AGU Fall Meeting, researchers have been looking at other, more ancient volcanic eruptions that happened along the same stretch of continental plate that Yellowstone's supervolcano sits on.

Dr Marc Reichow, from the University of Leicester, said: "We looked at a time window of between 12.5 to 8 million years ago. We wanted to know how to identify these eruptions and find out how frequently they happened." The team found there were fewer volcanic events during this period than had been estimated, but these eruptions were far larger than was previously thought.

Dr Reichow added: "If you look at older volcanoes, it helps to understand what Yellowstone is likely to do."

<http://www.bbc.co.uk/news/science-environment-25201572>

Dinosaur asteroid 'sent life to Mars'

The asteroid that wiped out the dinosaurs may have catapulted life to Mars and the moons of Jupiter, US researchers say.

By James Morgan Science reporter, BBC News

They calculated how many Earth rocks big enough to shelter life were ejected by asteroids in the last 3.5bn years. The Chicxulub impact was strong enough to fire chunks of debris all the way to Europa, they write in *Astrobiology*.

Thousands of potentially life-bearing rocks also made it to Mars, which may once have been habitable, they add.

"We find that rock capable of carrying life has likely transferred from both Earth and Mars to all of the terrestrial planets in the solar system and Jupiter," says lead author Rachel Worth, of Penn State University.

"Any missions to search for life on Titan or the moons of Jupiter will have to consider whether biological material is of independent origin, or another branch in Earth's family tree."

Panspermia - the idea that organisms can "hitchhike" around the solar system on comets and debris from meteor strikes - has long fascinated astronomers. But thanks to advances in computing, they are now able to simulate these journeys - and follow potential stowaways as they hitch around the Solar System.

In this new study, researchers first estimated the number of rocks bigger than 3m ejected from Earth by major impacts. Three metres is the minimum they think necessary to shield microbes from the Sun's radiation over a journey lasting up to 10 million years. They then mapped the likely fate of these voyagers. Many simply hung around in Earth orbit, or were slowly drawn back down. Others were pulled into the Sun, or sling-shotted out of the Solar System entirely. Yet a small but significant number made it all the way to alien worlds which might welcome life. "Enough that it matters," Ms Worth told BBC News.

About six rocks even made it as far as Europa, a satellite of Jupiter with a liquid ocean covered in an icy crust.

"Even using conservative, realistic estimates... it's still possible that organisms could be swimming around out there in the oceans of Europa," she said. Travel to Mars was much more common. About 360,000 large rocks took a ride to the Red Planet, courtesy of historical asteroid impacts.

Big bang theory

Perhaps the most famous of these impacts was at Chicxulub in Mexico about 66 million years ago - when an object the size of a small city collided with Earth.

The impact has been blamed for the mass extinction of the dinosaurs, triggering volcanic eruptions and wildfires which choked the planet with smoke and dust. It also launched about 70 billion kg of rock into space - 20,000kg of which could have reached Europa. And the chances that a rock big enough to harbour life arrived are "better than 50/50", researchers estimate. But could living organisms actually survive these epic trips?

"I'd be surprised if life hasn't gotten to Mars," Ms Worth told BBC News. "It's beyond the scope of our study. But it seems reasonable that at some point some Earth organisms have made it over there."

It has been shown that tiny creatures can withstand the harsh environment of space. And bacterial spores can be revived after hundreds of millions of years in a dormant state. But even if a hardy microbe did stow away for all those millennia, it might simply burn up on arrival, or land in inhospitable terrain.

The most habitable places in range of Earth are Europa, Mars and Titan - but while all three have likely held water, it may not have been on offer to visitors. Europa's oceans are capped by a crust of ice that may be impenetrably thick.

"But it appears regions of the ice sheet sometimes break into large chunks separated by liquid water, which later refreezes," Ms Worth said. "Any meteorites lying on top of the ice sheet in a region when this occurs would

A Hitchhikers Guide

Earth rocks big enough* to support life made it to:

Venus 26,000,000 rocks

Mercury 730,000

Mars 360,000

Jupiter 83,000

Saturn 14,000

Io 10

Europa 6

Titan 4

Callisto 1

***3m diameter or larger.**

Source: Worth et al, *Astrobiology*

stand a chance of falling through. "Additionally, the moons are thought to have been significantly warmer in the not-too-distant past."

Moon fossils

On Mars, there is little evidence of flowing water during the last 3.5bn years - the likeliest window for Earth life to arrive. But what if the reverse trip took place?

The early Martian atmosphere appears to have been warm and wet - prime conditions for the development of life. And if Martian microbes ever did exist, transfer to Earth is "highly probable" due to the heavy traffic of meteorites between our planets, Ms Worth told BBC News. "Billions have fallen on Earth from Mars since the dawn of our planetary system. It is even possible that life on Earth originated on Mars."

While her team are not the first to calculate that panspermia is possible, their 10-million-year simulation is the most extended yet, said astrobiologist Prof Jay Melosh, of Purdue University.

"The study strongly reinforces the conclusion that, once large impacts eject material from the surface of a planet such as the Earth or Mars, the ejected debris easily finds its way from one planet to another," he told BBC News. "The Chicxulub impact itself might not have been a good candidate because it occurred in the ocean (50 to 500m deep water) and, while it might have ejected a few sea-surface creatures, like ammonites, into space, it would not likely have ejected solid rocks.

"I sometimes joke that we might find ammonite shells on the Moon from that event. "But other large impacts on the Earth may indeed have ejected rocks into interplanetary space."

Another independent expert on panspermia, Mauricio Reyes-Ruiz of the National Autonomous University of Mexico, said the new findings were "very significant". "The fact such different pathways exist for the interchange of material between Earth and bodies in the Solar System suggests that if life is ever found, it may very well turn out to be our very, very distant relatives," he said.

<http://phys.org/news/2013-12-method-efficient-uranium-heavy-metals.html>

New method for efficient removal of uranium and other heavy metals from water

A new and efficient method for the removal of uranium and other heavy metals from water has been developed at the University of Eastern Finland.

Chemec Ltd., a Finnish chemicals industry company, has purchased the rights in the invention and will introduce the method to the commercial markets. Binding metal ions to a solid material, the CH Collector method can be used within the mining industry, and also in the removal of emissions caused by the chemicals and metals processing industries.

Chemec's CH Collector method is a potential solution to issues relating to the dangers and recovery of uranium, which have been a topic of much debate in Finland lately. Uranium is a mildly radioactive and poisonous heavy metal, which is naturally occurring in some parts of the Finnish bedrock. When mining other metals such as gold, uranium may be present as an impurity in mining wastewaters. A complete removal of uranium from solutions is difficult due to the fact that uranium takes different forms depending on the acidity of the solution. The removal of other heavy metal emissions such as lead, mercury, cadmium and zinc from waters is also challenging.

Recovering even small amounts of metal

Traditionally, metal ions are removed from solutions with the help of chemical coagulants or ion exchangers, which usually require adjustments to the solution's pH or significant extra energy in order to function efficiently. Professor Jouko Vepsäläinen's research group at the UEF School of Pharmacy has developed a new method enabling an efficient removal of metal ions from solutions without the need to use any auxiliary substances. The CH Collector method is based on the use of a solid material which collects metal ions directly from the solution. University researcher Petri Turhanen had a central role in the development of the new method.

The solid material developed by the researchers belongs to the aminobisphosphonate family, which are also used in, for example, osteoporosis medications. The invention is unique, as no other metal absorbents working on the same principle are in use. "Ion channels are formed inside the material, in which the metal ions are collected from the solution," Professor Vepsäläinen explains.

The new material collects metal ions directly from the solution. The collection of metals does not require a separate precipitation step or any adjustments to the solution's pH. For instance, an efficient recovery of uranium is possible from a very wide pH range and even in cases where the solution is rich in other naturally-occurring metal ions such as sodium, magnesium or calcium. "Unlike traditional methods, the CH Collector method also allows the recovery of metals occurring in very small concentrations."

The new method enabled practically a complete removal of uranium from water samples taken from Finnish mines. There was no need to pre-process the samples even though they contained very high concentrations of

other metals possibly disturbing the process. The efficiency of the method was also tested on an ore sample that contained scandium. The sample was dissolved and then treated with the new material. The two-phase process made it possible to recover 98% of the scandium.

The new method is well-suited for the removal of metals not only from the wastewaters of the mining industry, but also from the wastewaters of the metals processing and chemical industries, which may contain heavy metals and uranium in particular.

Selective recovery of metals moves forward

At the University of Eastern Finland, inventions are currently being commercialised more frequently than ever before. According to UEF Academic Rector Jukka Mönkkönen, this is one of the goals of academic research. "In the commercialisation of this invention, Tekes's New knowledge and business from research ideas funding instrument and the contacts found via Geological Survey of Finland played an important role. A number of companies were interested in purchasing commercial rights in the invention. The partner company was selected on the grounds of promoting as efficient and as wide a use of the invention as possible. This is why we regarded Chemec as our ideal partner," says Business Development Advisor Matti Höytö of the University of Eastern Finland.

R&D activities around the CH Collector method will continue. Chemec and the University of Eastern Finland are participating in Tekes's Green Mining Programme which seeks to enhance the selective recovery of metals and to create a novel, optimised concept for the treatment of mining industry wastewaters and process waters. "The goal is to create a toolkit for the selective recovery of different metals with the help of bisphosphonates. In the future, these kinds of methods could enable a targeted recovery of rare and valuable earth metals from complex mixtures containing metal ions," Professor Vepsäläinen says.

"This project strengthens the position of Chemec Group on the European export markets and opens possibilities for an increasingly broad mining customer base also outside Europe," Chemec CEO Tapani Niskanen says. Chemec has more than 25 years of experience in the manufacturing and supply of chemical solutions for industrial actors. *Provided by University of Eastern Finland*

http://www.eurekalert.org/pub_releases/2013-12/tmsh-msr121013.php

Mount Sinai researchers say new strain of bird flu packs a punch even after becoming drug-resistant

Study reveals that the drug-resistant strain retains its ability to replicate and cause severe illness

NEW YORK, NY - Researchers at the Icahn School of Medicine at Mount Sinai reported that a virulent new strain of influenza – the virus that causes the flu – appears to retain its ability to cause serious disease in humans even after it develops resistance to antiviral medications. The finding was included in a study that was published today in the journal *Nature Communications*. It is not uncommon for influenza viruses to develop genetic mutations that make them less susceptible to anti-flu drugs. However, these mutations usually come at a cost to the virus, weakening its ability to replicate and to spread from one person to another.

Initial reports suggested that H7N9, an avian strain of influenza A that emerged in China last spring, could rapidly develop a mutation that made it resistant to treatment with the antiviral medication Tamiflu (oseltamivir). However, patients in whom drug resistance developed often had prolonged, severe infections and poor clinical outcomes. No vaccine is currently available to prevent H7N9, which infected at least 135 people and caused 44 deaths during the outbreak. In the absence of a vaccine, antiviral drugs are the only means of defense for patients who are infected with new strains of the flu.

"In this outbreak, we saw some differences in the behavior of H7N9 and other avian influenza strains that can infect humans, beginning with the rapid development of antiviral resistance in some people who were treated with oseltamivir and the persistence of high viral loads in those patients," said lead investigator Nicole Bouvier, MD, Assistant Professor of Medicine, Infectious Diseases at the Icahn School of Medicine at Mount Sinai. Specifically, the investigators found that a drug-resistant H7N9 virus retained its ability to replicate in human respiratory cells and was comparable to a non-resistant form of the virus in producing severe illness in animal models. And although H7N9 appears to have a limited ability to spread readily from human to human, transmissibility in animal models was comparable between drug-susceptible and drug-resistant strains.

"Transmission was inefficient for both of the H7N9 viruses that we tested in our experiments," said Dr. Bouvier. "But surprisingly, transmission of the drug-resistant virus was no less efficient than that of the drug-sensitive version."

"Many of the people infected with H7N9 during the outbreak in China were elderly or had other conditions that predisposed them to severe influenza illness," observed Dr. Bouvier. "Nevertheless, our study suggests that flu viruses can indeed develop drug-resistant mutations without suffering a penalty in terms of their own fitness."

Older antiviral drugs such as amantadine are no longer effective in treating most strains of the flu that infect humans. Newer antiviral drugs called neuraminidase inhibitors block an enzyme that helps the virus replicate. These drugs include Tamiflu, a pill, and Relenza (zanamivir), a powder that is inhaled. Both medications have drawbacks: flu viruses can develop resistance to the medications in people who take them, and, in many parts of the world, neither drug is available in an intravenous form to treat those with severe infections.

"Our study underscores the need to develop a bigger arsenal of antiviral drugs and vaccines, which will allow us to outsmart the influenza virus," said Dr. Bouvier. "Researchers at Mount Sinai are actively engaged in identifying new targets for drug therapy and are working to develop a universal vaccine that will prevent multiple strains of influenza."

http://www.eurekalert.org/pub_releases/2013-12/vuot-rfa121013.php

Recipe for a universe

Apply heat and stir; an expanding universe can emerge in a remarkably simple way, say scientists at the Vienna University of Technology

When soup is heated, it starts to boil. When time and space are heated, an expanding universe can emerge, without requiring anything like a "Big Bang". This phase transition between a boring empty space and an expanding universe containing mass has now been mathematically described by a research team at the Vienna University of Technology, together with colleagues from Harvard, the MIT and Edinburgh. The idea behind this result is a remarkable connection between quantum field theory and Einstein's theory of relativity.

A Cookbook for Spacetime

Everybody knows of the transitions between liquid, solid and gaseous phases. But also time and space can undergo a phase transition, as the physicists Steven Hawking and Don Page pointed out in 1983. They calculated that empty space can turn into a black hole at a specific temperature.

Can a similar process create a whole expanding universe such as ours? Daniel Grumiller from the Vienna University of Technology looked into this, together with colleagues from the USA and Great Britain. Their calculations show that there is indeed a critical temperature at which an empty, flat spacetime turns into an expanding universe with mass. "The empty spacetime starts to boil, little bubbles form, one of which expands and eventually takes up all of spacetime", explains Grumiller.

For this to be possible, the universe has to rotate – so the recipe for creating the universe is "apply heat and stir". However, the required rotation can be arbitrarily small. In a first step, a spacetime with only two spatial dimensions was considered. "But there is no reason why the same should not be true for a universe with three spatial dimensions", says Grumiller.

Looking for the Structure of the Universe

Our own universe does not seem to have come into existence this way. The phase-transition model is not meant to replace the theory of the Big Bang. "Today, cosmologists know a lot about the early universe – we are not challenging their findings. But we are interested in the question, which phase transitions are possible for time and space and how the mathematical structure of spacetime can be described" says Grumiller.

The new theory is the logical next step after the so called "AdS-CFT correspondence", a conjecture put forward in 1997, which has strongly influenced fundamental physics research ever since. It describes a peculiar connection between theories of gravity and quantum field theories – two areas which, at first glance, do not have much in common. In certain limiting cases, according to AdS-CFT correspondence, statements from quantum field theories can be translated into statements concerning gravitational theories and vice versa. This is almost as surprising as the idea of making statements about a stone falling to the ground by actually calculating the temperature of a hot gas. Two completely different areas are being connected – but it works.

In this kind of correspondence, the quantum field theory is always described in one fewer dimension than the gravitational theory. This is called "holographic principle". Similar to a two dimensional hologram which can depict a three dimensional object, a quantum field theory with two spatial dimensions can describe a physical situation in three spatial dimensions.

A Correspondence Principle for Flat Spacetimes

To do this, the gravitational calculations usually have to be done in an exotic kind of geometry – in so-called "Anti-de-Sitter-spaces", which are quite different from the flat geometry we are used to. However, it has been suspected for a while, that there may be a similar version of the "holographic principle" for flat spacetimes. But for a long time there haven't been any models showing this.

Last year, Daniel Grumiller and colleagues established such a model (in two spatial dimensions, for simplicity). This led to the current question; phase transitions in quantum field theories are well known. But for symmetry reasons this would mean that gravitational theories should exhibit phase transitions too.

"At first, this was a mystery for us", says Daniel Grumiller. "This would mean a phase transition between an empty spacetime and an expanding universe. To us, this sounded extremely implausible." But the calculations showed exactly that. "We are only beginning to understand these remarkable correspondence relations", says Daniel Grumiller. Which new ideas about our own universe can be derived from this, is hard to say – only spacetime will tell.

http://www.eurekalert.org/pub_releases/2013-12/jhm-stb121113.php

Skip the balloon after placing carotid stent, surgeons suggest

Skipping one step during a procedure to insert a stent into a carotid artery appears to reduce patients' risk of serious complications

Johns Hopkins surgeons say skipping one commonly taken step during a routine procedure to insert a wire mesh stent into a partially blocked carotid artery appears to prevent patients from developing dangerously low blood pressure, an extremely slow heart rate or even a stroke or heart attack.

Reporting on results of a small study described online in the Journal of Vascular Surgery, the surgeons say inflating a balloon inside the artery after placing the stent greatly increases patients' risk of serious complications. Current standard practice by most physicians is to inflate the balloon to open up the artery before placing the carotid stent and again afterward.

Carotid stents are designed to open up the neck arteries, which carry oxygen-rich blood from the heart to the brain but have been narrowed over time by a buildup of cholesterol, fat and other substances that stick to blood vessel walls. Unstable pieces of this plaque-like debris can break off and travel into the brain, where they can cause strokes.

"In my mind, this is a study that should change medical practice," says study leader Mahmoud B. Malas, M.D., M.H.S., an associate professor of surgery at the Johns Hopkins University School of Medicine. "Our work suggests that doctors should never balloon a stent after placing it. There is no upside."

Malas and his team analyzed data from 103 patients who underwent placement of a carotid stent between 2005 and 2012 at the Johns Hopkins Bayview Medical Center. All patients underwent pre-stent ballooning. Seventy percent also underwent post-stent ballooning, while 30 percent did not. Patients who underwent post-stent ballooning were four times more likely to suffer from dangerously low blood pressure and/or a dangerously slow heart rate during or immediately after the procedure. Although Malas says the study was too small to absolutely end the practice of post-stent ballooning, that approach should be considered.

As part of his study, Malas also looked at data from a past study of more than 1,000 patients undergoing carotid stenting, which also hinted that post-stent ballooning increases the risk of stroke. The number of physicians forgoing this step, however, was too small to get a full picture, he says.

Stroke is the third leading cause of death and the number one cause of adult disability in the United States. Carotid artery disease is estimated to contribute to 20 percent of ischemic strokes, by far the most common type. Patients are typically referred for a carotid stent when they have a blockage of 70 percent or more in the carotid artery and would be unsuitable candidates for a surgical procedure that involves cutting open the artery and removing the buildup. That surgery, known as an endarterectomy, is a more permanent fix but involves general anesthesia, which not all people with severe blockages are healthy enough to undergo. Many people with carotid blockages also have blockages in other arteries, including the coronary arteries that supply the heart with blood.

Placing a carotid stent is a minimally invasive procedure that involves threading a catheter from the groin area up to the site of the blockage in the neck. Physicians gently inflate a balloon in the area that is constricted to open the artery wide enough to safely insert the stent. Those who again inflate the balloon afterward say it enables the stent to open as wide as possible and to show surgeons if the opening is large enough to reduce the risk of closing off in the future.

Malas says that the metals used in the stent will naturally expand over time and that this second ballooning step is unnecessary. He says there is also added risk that repeating the balloon step can push pieces of unstable plaque into the brain, causing the very stroke the procedure is designed to prevent.

Malas says he also believes post-stent ballooning wreaks havoc on blood pressure and heart rate, because the pressure of the post-stent balloon on the artery sends confusing signals to the brain. The receptors around the carotid artery falsely sense that blood pressure is high, so they send signals to the brain, which in turn sends signals to the heart to slow down and to the peripheral small arteries to dilate. This can stop the heart or cause dangerous hypotension. "Every time we use the balloon, there can be a major drop in heart rate, so we have to use it judiciously," he says. "It's just not needed after the stent is in place."

Other Johns Hopkins researchers involved in the study include Umair Qazi, M.D., M.P.H.; Tammam E. Obeid, M.B.B.S.; Ngozi Enwerem, M.B.B.S., M.P.H.; Eric Schneider, Ph.D.; Jessica R. White; Julie A. Freischlag, M.D.; and Bruce A. Perler, M.D.

http://www.eurekalert.org/pub_releases/2013-12/uonc-ngt121113.php

New gene therapy proves promising as hemophilia treatment

UNC researchers package specialized blood platelets with genes that express clotting factor, leading to fewer bleeding events

CHAPEL HILL, N.C. – Researchers at the UNC School of Medicine and the Medical College of Wisconsin found that a new kind of gene therapy led to a dramatic decline in bleeding events in dogs with naturally occurring hemophilia A, a serious and costly bleeding condition that affects about 50,000 people in the United States and millions more around the world.

Before the gene treatment, the animals experienced about five serious bleeding events a year. After receiving the novel gene therapy, though, they experienced substantially fewer bleeding events over three years, as reported in the journal *Nature Communications*.

"The promise and the hope for gene therapy is that people with hemophilia would be given a single therapeutic injection and then would express the protein they are missing for an extended period of time, ideally for years or even their entire lifetimes," said Tim Nichols, director of the Francis Owen Blood Research Laboratory at UNC and co-author of the paper. The hope is that after successful gene therapy, people with hemophilia would experience far fewer bleeding events because their blood would clot better.

People with hemophilia A lack the coagulation factor VIII in their blood plasma – the liquid in which red, white, and platelet cells are suspended.

"Bleeding events in hemophilia are severe, and without prompt factor VIII replacement, the disease can be crippling or fatal," said Nichols, a professor of medicine and pathology. "The random and spontaneous nature of the bleeding is a major challenge for people with hemophilia and their families."

In underdeveloped countries, people with hemophilia and many undiagnosed people typically die from bleeding in their late teens or early 20s. In developed countries, patients usually live fairly normal lives, as long as they receive preventive injections of recombinant protein therapy a few times a week. The disease requires life-long management that is not without health risks. The annual cost of medications alone is about \$200,000 a year.

However, about 35 percent of people with hemophilia A develop an antibody response that blocks the factor VIII therapy. They require continuous infusions of various protein factors and they face a higher mortality rate. Also, the cost of treatment can easily rise to \$2 million or more a year per patient.

Nichols and David Wilcox from the Medical College of Wisconsin figured out a potential way around the antibody response in dogs with naturally occurring hemophilia A.

Using a plasmapheresis machine and a blood-enrichment technique, the research team isolated specific platelet precursor cells from three dogs that have hemophilia A. The team then engineered those platelet precursor cells to incorporate a gene therapy vector that expresses factor VIII. The researchers put those engineered platelet precursors back into the dogs. As the cells proliferated and produced new platelets, more and more were found to express factor VIII.

Then, nature took over. Platelets naturally discharge their contents at sites of vascular injury and bleeding. In this experiment, the contents included factor VIII.

In the 2 1/2 years since the dogs received the gene therapy, researchers found that factor VIII was still being expressed in platelets that were coursing throughout the vascular systems of all three dogs. All three experienced much less bleeding. In the dog that expressed the most factor VIII in platelets, the bleeding was limited to just one serious event each year over the course of three years. And such bleeding events were easily treatable with current standard therapies.

"This has been very successful," Nichols said. "And now we want to explore the possibility of moving it into human clinical trials for people with hemophilia A, similar to what Paul Monahan and Jude Samulski at UNC are currently doing for people with hemophilia B, which is a deficiency of factor IX."

If approved, the platelet-targeted therapy would likely be restricted to patients who develop the antibody that stifles factor VIII therapy through normal injections. But as the gene therapy is refined, it could become a viable option for people with blood disorders who don't have inhibitory antibodies.

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This research was funded by the National Institutes of Health, the American Heart Association, the National Gene Vector Biorepository, and through gifts from the Children's Hospital Foundation, the MACC Fund, and John B. and Judith Gardetto. The research team included scientists from the UNC School of Medicine, the Medical College of Wisconsin, the Blood Center of Wisconsin, Indiana University School of Medicine, the MACC Fund Research Center, and Hospital Xavier Arnoz in France.

http://www.eurekalert.org/pub_releases/2013-12/osu-eai121113.php

East Antarctica is sliding sideways

Ice loss on West Antarctica affecting mantle flow below

SAN FRANCISCO--It's official: East Antarctica is pushing West Antarctica around.

Now that West Antarctica is losing weight--that is, billions of tons of ice per year--its softer mantle rock is being nudged westward by the harder mantle beneath East Antarctica.

The discovery comes from researchers led by The Ohio State University, who have recorded GPS measurements that show West Antarctic bedrock is being pushed sideways at rates up to about twelve millimeters--about half an inch--per year. This movement is important for understanding current ice loss on the continent, and predicting future ice loss.

They reported the results on Thursday, Dec. 12 at the American Geophysical Union meeting in San Francisco. Half an inch doesn't sound like a lot, but it's actually quite dramatic compared to other areas of the planet, explained Terry Wilson, professor of earth sciences at Ohio State. Wilson leads POLENET, an international collaboration that has planted GPS and seismic sensors all over the West Antarctic Ice Sheet.

She and her team weren't surprised to detect the horizontal motion. After all, they've been using GPS to observe vertical motion on the continent since the 1990's.

They were surprised, she said, to find the bedrock moving towards regions of greatest ice loss.

"From computer models, we knew that the bedrock should rebound as the weight of ice on top of it goes away," Wilson said. "But the rock should spread out from the site where the ice used to be. Instead, we see movement toward places where there was the most ice loss."

The seismic sensors explained why. By timing how fast seismic waves pass through the earth under Antarctica, the researchers were able to determine that the mantle regions beneath east and west are very different. West Antarctica contains warmer, softer rock, and East Antarctica has colder, harder rock.

Stephanie Konfal, a research associate with POLENET, pointed out that where the transition is most pronounced, the sideways movement runs perpendicular to the boundary between the two types of mantle. She likened the mantle interface to a pot of honey.

"If you imagine that you have warm spots and cold spots in the honey, so that some of it is soft and some is hard," Konfal said, "and if you press down on the surface of the honey with a spoon, the honey will move away from the spoon, but the movement won't be uniform. The hard spots will push into the soft spots. And when you take the spoon away, the soft honey won't uniformly flow back up to fill the void, because the hard honey is still pushing on it."

Or, put another way, ice compressed West Antarctica's soft mantle. Some ice has melted away, but the soft mantle isn't filling back in uniformly, because East Antarctica's harder mantle is pushing it sideways. The crust is just along for the ride.

This finding is significant, Konfal said, because we use these crustal motions to understand ice loss.

"We're witnessing expected movements being reversed, so we know we really need computer models that can take lateral changes in mantle properties into account."

Wilson said that such extreme differences in mantle properties are not seen elsewhere on the planet where glacial rebound is occurring.

"We figured Antarctica would be different," she said. "We just didn't know how different."

Ohio State's POLENET academic partners in the United States are Pennsylvania State University, Washington University, New Mexico Tech, Central Washington University, the University of Texas Institute for Geophysics and the University of Memphis. A host of international partners are part of the effort as well. The project is supported by the UNAVCO and IRIS-PASSCAL geodetic and seismic facilities.

POLENET is funded by the National Science Foundation.

<http://bit.ly/1efzBbt>

America's hidden epidemic of tropical diseases

Millions of US citizens suffer from neglected tropical diseases that most doctors there have barely heard of, linked to both poverty and the warming climate

- 11 December 2013 by [Debora MacKenzie](#)

WHEN the letter arrives, it must come as a shock. Would-be blood donors are politely rejected because they've tested positive for a deadly tropical infection – and their doctors aren't much help. Kristy Murray at Baylor College of Medicine in Houston, Texas, recalls one doctor telling a patient: "The test is wrong. That disease doesn't exist in the US!"

But an estimated 330,000 US citizens, and possibly as many as a million, carry the parasite that causes Chagas disease. It is a chronic, silent infection that leads to lethal heart or gut damage in 40 per cent of cases. It is the most common parasitic disease in the Americas, and it can be treated – if the doctor is aware of it. Most US doctors aren't.

Then there are intestinal worms, a chronic infestation that spreads in faeces and drains energy and nutrients from children across Africa. Cases aren't supposed to occur in rich countries. Yet *Toxocara canis*, an intestinal worm that can cause asthma and epilepsy, is carried by 21 per cent of black people in the US – compared with [31 per cent of people](#) in central Nigeria.

"It's so sad," says Peter Hotez of Baylor College of Medicine, who founded the US's first dedicated school of tropical medicine [in 2011](#). He estimates that Chagas, worms and other diseases typically associated with the developing world could afflict some 14 million impoverished people in the US (see "[Under the radar](#)", below).

"They are called neglected tropical diseases," says Hotez. "But in reality, this is about poverty, not climate."

Worryingly, both situations are getting worse (see "[A climate of disease](#)").

In recent years the world has begun to take notice. In 2000, the United Nations Millennium Development Goals highlighted the impact of neglected tropical diseases (NTDs) on economic development, and last year member countries of the World Health Organization pledged to eliminate or control 17 of the worst of them.

Such efforts focus on tackling NTDs in poor countries, however, particularly in Africa. But the same ailments afflict millions of people living in poverty within the world's richest countries – among them, the US. "We spend millions of dollars on diseases that currently have no cases," Hotez says, such as smallpox and other hypothetical bioweapons. He hopes that if countries like the US realise the threat within their own borders, they may do more research on NTDs, to everyone's benefit.

As previously uninsured Americans gain access to healthcare under the newly minted "Obamacare" programme, people with NTDs should increasingly turn up in hospitals and clinics. This could help focus attention on the problem, but only if doctors and nurses learn to look for the infections.

Even with proper diagnosis, treatment options may be lacking. The [Drugs for Neglected Diseases Initiative \(DNDi\)](#), based in Geneva, Switzerland, was launched in 2003 to promote deals between governments and drug companies to research these diseases. Yet last year DNDi reported that only 0.6 per cent of new drugs in the previous 25 years were for NTDs.

Bernard Pécoul, head of DNDi, says that's starting to change. For example, trials are beginning in Africa of a drug to treat leishmaniasis, an NTD that also threatens southern Europe. Mexican businessman Carlos Slim, one of the world's richest people, is starting to take an interest in Chagas research, Pécoul says, "but nothing will happen without governments".

The US government response has been tepid. A bipartisan bill was launched in Congress [in 2010](#) that was aimed at funding surveillance of NTDs in the US. It died. "The budget for fiscal year 2014 does include a request for funding [for] vector-borne and parasitic diseases," says Monica Parise, head of parasitic infections at the US Centers for Disease Control and Prevention in Atlanta, Georgia. Yet it is hard to convince officials to loosen the purse strings when researchers don't have a good handle on how many people are living with NTDs. "We have limited understanding about how many people are infected, and who is most at risk," Parise admits. The more researchers look for these diseases, though, the more they find. In 2008, Hotez made initial calculations of the number of cases in the US for several NTDs, most of which still stand as the best estimates available. Updated work on two parasites, however – *Trichomonas vaginalis* and *Toxoplasma gondii* – shows that many more people have the infections than was thought five years ago. Much is specific to minority communities: 29 per cent of black American women carry *T. vaginalis*, versus 38 per cent of women in Nigeria. In the US, black women are 10 times as likely as white or Hispanic women to have the parasite, which increases the heterosexual spread of HIV and boosts the risk of a low-birthweight baby. [Highly sensitive diagnostic tests](#) were recently developed, and trichomoniasis can be cured with one oral dose of a common drug, metronidazole. But the startling prevalence of the disease suggests neither test nor treatment is routinely used.

Meanwhile, [about 8 million people have Chagas disease](#) worldwide, mostly very poor people across Latin America. In the US it mainly affects Hispanic communities. "Kissing bugs" that live in cracks in poor housing pass it to people by defecating while sucking their blood. A doctor can get the drug to treat Chagas disease only by applying directly to the US Food and Drug Administration.

Hispanic people in the US are also more likely to ingest eggs of the pork tapeworm, shed in human faeces, which can cause epilepsy if they lodge in the brain. Called cysticercosis, this now causes 1 in 10 seizure cases taken to Los Angeles emergency rooms. Poor white people in Appalachia, meanwhile, suffer from the intestinal threadworms *Strongyloides stercoralis* and *Ascaris lumbricoides*, a leading global cause of impaired childhood development.

The mosquito-borne [dengue fever virus](#) was chased from the US by DDT spraying in the 1950s, but is making a comeback. This year Murray found that [dengue is being transmitted in Houston](#). Next year she will start testing random hospital patients for antibodies to see how widespread it is.

People working on these diseases in poor countries see the possibilities of the world's richest country looking after its own. "I hope it leads to new treatments," says Julien Potet of [Médecins Sans Frontières](#), based in Geneva. Such treatments could even help with the problem of poverty itself, as people relieved of chronic, debilitating infections can lead more productive lives. And that's as true in inner city Baltimore or a Louisiana bayou as in Bolivia.

A climate of disease

Although poverty is mainly to blame for the spread of neglected tropical diseases (NTDs), climate change is exacerbating the problem. Many NTDs are spread by parasites that like warm weather.

The WHO [warned last month](#) that warming will spread mosquitoes, putting an extra 2 billion people at risk of dengue fever by 2080. The snails that carry schistosomiasis are also [projected to invade new territory](#), as are the sandflies that carry [leishmaniasis in Europe and the Americas](#).

Extreme weather events also spread disease. There were more "kissing bugs" and vermin that can carry Chagas disease in Louisiana after hurricane Katrina in 2005, for example.

But climate's biggest impact on NTDs could simply be increased poverty, as changes puts pressure on crops, water sources and economic systems that people depend on for their food and livelihood. High temperatures [cut yields of staples such as wheat](#), for instance, and malnutrition also favours disease. "Poverty is the most serious obstacle to effective adaptation [to warming]", the [Intergovernmental Panel on Climate Change wrote in 2007](#). And the process feeds back on itself: failure to adapt in turn means increased poverty, and the diseases that come with it.

Under the radar

Diseases commonly associated with tropical climates and impoverished countries are hurting the US too. There is inadequate research to provide confident numbers, but the best estimates suggest that millions of US citizens are affected

Parasitic worms	
Toxocariasis	1.3-2.8 million cases
Strongyloidiasis	68,000–100,000
Ascariasis	4 million
Cysticercosis	41,000–169,000
Schistosomiasis	8,000
Protozoan parasites	
Chagas disease	330,000
Toxoplasmosis	1.1 million
Trichomoniasis	7.4 million
Virus	
Dengue fever	110,000-200,000 (acute cases annually)

<http://arstechnica.com/science/2013/12/melting-arctic-sea-ice-could-be-altering-jet-stream/>

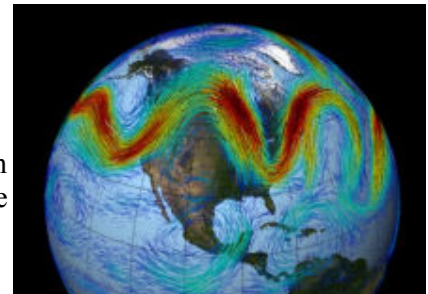
Melting Arctic sea ice could be altering jet stream

More studies look at links to extreme weather.

by Scott K. Johnson - Dec 12 2013, 3:30am TST

The rapidly warming Arctic isn't noteworthy only for its own sake. Changes there affect the rest of the planet in a number of ways. Recently, there has been a lot of interest in whether the dwindling Arctic summer sea ice could be weirding the weather in the mid-latitudes.

There have been a number of recent summer extremes—Russia's hellish summer in 2010, the drought in the US last summer, a very wet 2011 in Korea and Japan, plus a streak of soggy summers in the UK. There have been suggestions that lower summer sea ice in the Arctic could be gumming up the jet stream and contributing to these events, but some climate scientists aren't so sure. A new study in Nature Climate Change brings more evidence to the table in support of the idea.



The jet stream, here caught wiggling. NASA/GSFC

Qiuhong Tang and Xuejun Zhang, of the Chinese Academy of Sciences, and Jennifer Francis, of Rutgers, decided to look for patterns of atmospheric change correlated with the loss of Arctic summer sea ice and the

decline of early summer snow cover. Using reanalyses, which generate global datasets based on all the available measurements, they examined how the lower, middle, and upper troposphere responded to variations in sea ice and snow cover from 1979 (the start of the satellite era) to 2012.

They found modest correlations with the behavior of high-level winds and the differences in atmospheric pressure that drive them, more so for sea ice than snow cover. Over most regions, the average position of the jet stream moved a little northward when summer sea ice was smaller, while the opposite was true for the western edges of continents. The high-level, west-to-east winds of the jet stream also slowed a bit.

Those two factors are consistent with the hypothesized link between sea ice and weather extremes. When the jet stream slows, it gets wigglier, with ponderous meanders extending north and south. Because the temperature difference across the jet stream is so large, these slow-moving excursions can lead to temperature extremes. The early loss of snow cover can exacerbate this, as it means soils can dry out earlier in the summer. Not only does that make a region susceptible to drought, but low soil moisture allows temperatures to rise higher.

Another recent paper published in *Environmental Research Letters* focused on Northern Europe, using different techniques. There, an unusual run of six wet summers left people wondering if Arctic sea ice loss could have contributed.

Looking through the data, University of Exeter researcher James Screen saw that wet conditions are associated with the jet stream coming south from its average position. Conversely, it's drier when it stays far to the north. Screen ran two climate model simulations: one in which Arctic sea ice was present at its 1979 extent and one at its diminished 2009 extent. Each simulation was repeated for a century's worth of summers to calculate the average position of the jet stream over Europe.

Consistent with the study by Tang, Zhang, and Francis, the lower sea ice extent in the model was associated with the jet stream moving a little southward over Europe as part of its amplified "wiggleness." That brought more precipitation to Northern Europe in the model simulations.

However, Screen emphasizes that these things vary quite a lot from year to year on their own, and the simulated sea ice impact was only a slight shift. "This means that whilst low sea ice coverage increases the risk of wet summers, other factors can easily negate this influence and lead to dry summers during depleted ice conditions or wet summers during extensive ice conditions," he writes.

The details of how declining Arctic sea ice affects atmosphere circulation and weather patterns is very much a hot topic for research and debate, particularly when discussing potential contributions to specific, extreme weather events. In an article accompanying the Tang, Zhang, and Francis study in *Nature Climate Change*, NOAA researcher James Overland notes, "Skeptics remain unconvinced that Arctic/mid-latitude linkages are proven, and this work will do little to change their viewpoint." He's not talking about the self-professed "climate skeptics" who reject most of the conclusions of climate science here, but rather researchers in the field who have weighed in on this hypothesis.

"As most changes in the frequency of mid-latitude extreme events have occurred only in the past decade," Overland writes, "there is insufficient data to formally resolve the debate on whether these events are purely random or if their occurrence is enhanced by Arctic cryosphere changes." Work like this, however, is informing that debate.

Nature Climate Change, 2013. DOI: 10.1038/NCLIMATE2065, 10.1038/NCLIMATE2079

Open access at *Environmental Research Letters*, 2013. DOI: 10.1088/1748-9326/8/4/044015 (About DOIs).

http://www.eurekalert.org/pub_releases/2013-12/iof-apm121013.php

Asia Pacific must prepare for catastrophic increase in fragility fractures

New report shows aging populations and urbanization will drive increase in osteoporosis and related fractures; health authorities must take action now to reduce future costs and disability

A new report launched today by the International Osteoporosis Foundation (IOF) shows that osteoporosis is a serious problem throughout the Asia Pacific, with the number of fracture sufferers to rise dramatically in the coming decades. By 2050, more than half of the world's hip fractures will occur in Asia. The press conference kicked off the IOF Regionals 4th Asia-Pacific Osteoporosis Meeting, being held in Hong Kong from December 12.

The IOF Asia-Pacific Regional Audit provides new and updated information about the status of osteoporosis in the region. In addition to the 14 countries in the 2009 version, it now includes Australia and New Zealand, giving more comprehensive coverage of this geographical area. What is alarmingly clear is that some of the projections made in 2009 clearly underestimated the disease burden and the situation will dramatically worsen if immediate action is not taken.

Asia is ageing rapidly and life expectancy increasing. By 2050 nearly all 16 countries included in this Audit will have at least one-third of their population aged over 50 years, and 5 countries will have at least half of their

population aged over 50 years. This is the age group most at risk of osteoporosis. India, for example, will see a 416% rise by 2050, when 620 million (33%) of the population will be aged over 50. In China, more than 636 million people will be aged 50 or over, corresponding to a 78% increase from 2013 to 2050.

Even more alarming is that the majority of the countries represented in the Audit can expect a doubling, if not a tripling, of their populations aged 70 years or over. This is the age group at highest risk of hip fractures, the most serious in terms of disability and premature death. They are also the most costly fractures, requiring surgery, after-care and rehabilitation.

"Altogether, more than 606 million people will be aged over 70 in the Asia-Pacific by 2050 – a 230% increase from 2013. It is evident that prevention efforts and health-care resources must target age-related chronic diseases such as osteoporosis. Without effective prevention strategies, we can expect an enormous increase in fractures which will place a heavy burden on communities and on health-care budgets", said Professor Peter Ebeling, co-author of the report and IOF Board Member.

Additional findings include:

Asia is increasingly urbanized with a rise in sedentary indoor lifestyles that impact negatively on bone health and fracture risk.

In the majority of countries there is a scarcity of robust and current epidemiological research on osteoporosis, fracture incidence, and related relevant outcomes.

Due to urban versus rural disparities in service provision, rural populations generally have less knowledge of osteoporosis, less access to testing and treatment, and are less likely to have timely surgery after hip fracture.

While the majority of countries report that 95% or more of hip fractures are treated surgically, this may be more representative of urban areas. Pakistan, Philippines, Sri Lanka and Thailand report that only 50% of hip fractures are surgically treated, while Vietnam reports just 25%.

Timely surgery following hip fracture (ideally within two days) is essential to reduce disability and mortality. India, Malaysia, Philippines, Sri Lanka and Vietnam report waiting times of more than three days.

In more than half of the countries surveyed, there are insufficient numbers (i.e. fewer than 12 per million population) of DXA scanners, considered the gold standard for measurement of bone mineral density.

Although some form of reimbursement for medical treatment is provided in a majority of the countries surveyed, there are considerable barriers. These include high co-payments, provision by private health insurance only, age restrictions, or reimbursement only after first fracture. Reimbursement of the most common bisphosphonates is non-existent or extremely limited in several countries, including India, Indonesia, Philippines and Thailand.

Low levels of vitamin D and calcium consumption are reported throughout the region – and are also seen in the younger population which is building peak bone mass. This is detrimental to bone health at all ages, and in the young has implications for their future risk of osteoporosis.

Fracture Liaison Services to identify and treat fracture patients who are at high risk of subsequent fractures are lacking in the majority of countries.

The report reveals some welcome advances in the region, including wide availability of the FRAX tool and management guidelines, and increased efforts in health professional training. A notable development is also China's recent designation of osteoporosis as a national health priority, joining Australia, Chinese Taipei and Singapore as the only other countries in the region to do so.

Professor John A. Kanis, President, IOF, speaking at the Audit launch commented, "Despite the enormous and growing burden of fragility fractures, osteoporosis is being dangerously ignored as it competes with other diseases for scarce health-care resources and recognition. The disease remains greatly under-diagnosed and under-treated, and health professional training and service provision is suboptimal in many countries of the Asia Pacific. The result is premature death for many hip fracture sufferers, immense personal suffering, lost productivity and long-term dependence on family members".

He added, "IOF joins local osteoporosis societies throughout the region to urge concerted action to help prevent the rising tide of fractures and their profound socio-economic impact on millions of people and communities throughout the region".

Notes to Editors

Access the report: <http://bit.ly/1dgbkgy>

Production of the Audit was supported by unrestricted educational grants from GSK, Fonterra and Servier.

About IOF

The International Osteoporosis Foundation (IOF) is the world's largest nongovernmental organization dedicated to the prevention, diagnosis and treatment of osteoporosis and related musculoskeletal diseases. IOF leads World Osteoporosis Day marked on October 20 each year. IOF members, including committees of scientific researchers, leading companies, as well as more than 200 patient, medical and research societies, work together to make bone, joint and muscle health a worldwide health care priority. <http://www.iofbonehealth.org>; <http://www.facebook.com/iofbonehealth>; <http://www.twitter.com/iofbonehealth>

<http://www.bbc.co.uk/news/health-25337953>

Exam grades 'more nature than nurture'

Genetic influence explains almost 60% of the variation in GCSE exam results, twin studies suggest.

Scientists studied academic performance in more than 11,000 identical and non-identical 16-year-old twins in the UK. The team from King's College London found that on average, genes explained 58% of differences between GCSE scores in core subjects such as maths. Differences in grades due to environment, such as schools and families, accounted for about 36%. The remaining differences in GCSE scores in maths, English and science are explained by environmental factors unique to each person, say the researchers.

Environment 'still influential'

Study leader Nicholas Shakeshaft, from the Institute of Psychiatry at King's, said: "Our research shows that differences in students' educational achievement owe more to nature than nurture.

"Since we are studying whole populations, this does not mean that genetics explains 60% of an individual's performance, but rather that genetics explains 60% of the differences between individuals, in the population as it exists at the moment. "This means that heritability is not fixed - if environmental influences change, then the influence of genetics on educational achievement may change too." The researchers studied two sets of twins - identical and non-identical - to help distinguish between the effects of nature and nurture at the age of 16.

If identical twins' scores at GCSE are more alike than those of non-identical twins, it can be assumed that genetics plays a bigger role than the shared environment - attending the same school and family influences.

Professor Robert Plomin, director of the Twin Early Development Study, also from the Institute of Psychiatry, said it was important to recognise the major role that genetics plays in children's educational achievement.

"It means that educational systems which are sensitive to children's individual abilities and needs, which are derived in part from their genetic predispositions, might improve educational achievement," he said.

Nature-nurture debate

Previous research has shown large numbers of genes may be involved in academic ability, many of which have not been identified. Prof Michael O'Donovan, from the Medical Research Council, which funded the research, said: "Further research is needed to assess the implications of the findings for educational strategies."

Dr Simon Underdown, principal lecturer in biological anthropology at Oxford Brookes University, said the results must be treated with caution. "While the genetic influence is slightly more than 50%, that still leaves a massive role for environmental factors. "What this research does is show that complex traits like intelligence are not the product of one or two simple genes. Rather it is managed by an intricate process that relies on genetic factors and environmental influences. The nature-nurture debate is not over yet."

The findings are published in the journal [PLOS ONE](http://www.plosone.org).

http://www.eurekalert.org/pub_releases/2013-12/mu-gmt121213.php

Global map to predict giant earthquakes

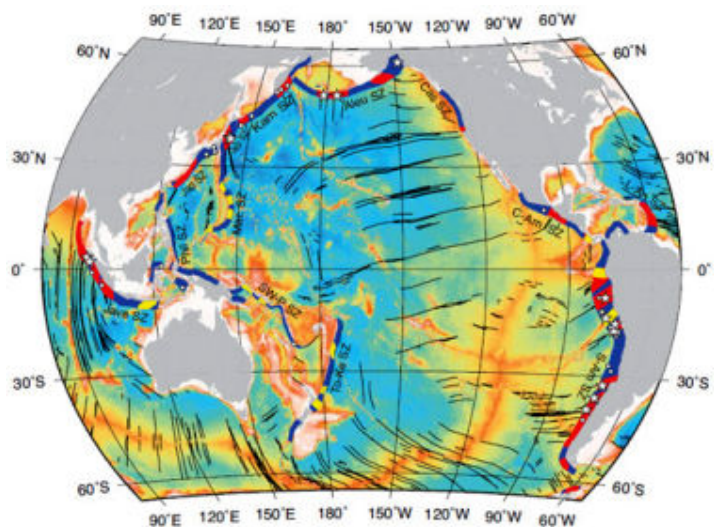
An international team has developed a new global map illustrating which subduction zones are predicted to be capable of generating giant earthquakes

A team of international researchers, led by Monash University's Associate Professor Wouter Schellart, have developed a new global map of subduction zones, illustrating which ones are predicted to be capable of generating giant earthquakes and which ones are not.

The new research, published in the journal *Physics of the Earth and Planetary Interiors*, comes nine years after the giant earthquake and tsunami in Sumatra in December 2004, which devastated the region and many other areas surrounding the Indian Ocean, and killed more than 200,000 people.

Since then two other giant earthquakes have occurred at subduction zones, one in Chile in February 2010 and one in Japan in March 2011, which both caused massive destruction, killed many thousands of people and resulted in billions of dollars of damage.

Most earthquakes occur at the boundaries between tectonic plates that cover the Earth's surface. The largest earthquakes on Earth only occur at subduction zones, plate boundaries where one plate sinks (subducts) below



the other into the Earth's interior. So far, seismologists have recorded giant earthquakes for only a limited number of subduction zone segments. But accurate seismological records go back to only ~1900, and the recurrence time of giant earthquakes can be many hundreds of years.

"The main question is, are all subduction segments capable of generating giant earthquakes, or only some of them? And if only a limited number of them, then how can we identify these," Dr Schellart said.

Dr Schellart, of the School of Geosciences, and Professor Nick Rawlinson from the University of Aberdeen in Scotland used earthquake data going back to 1900 and data from subduction zones to map the main characteristics of all active subduction zones on Earth. They investigated if those subduction segments that have experienced a giant earthquake share commonalities in their physical, geometrical and geological properties. They found that the main indicators include the style of deformation in the plate overlying the subduction zone, the level of stress at the subduction zone, the dip angle of the subduction zone, as well as the curvature of the subduction zone plate boundary and the rate at which it moves.

Through these findings Dr Schellart has identified several subduction zone regions capable of generating giant earthquakes, including the Lesser Antilles, Mexico-Central America, Greece, the Makran, Sunda, North Sulawesi and Hikurangi.

"For the Australian region subduction zones of particular significance are the Sunda subduction zone, running from the Andaman Islands along Sumatra and Java to Sumba, and the Hikurangi subduction segment offshore the east coast of the North Island of New Zealand. Our research predicts that these zones are capable of producing giant earthquakes," Dr Schellart said.

"Our work also predicts that several other subduction segments that surround eastern Australia (New Britain, San Cristobal, New Hebrides, Tonga, Puysegur), are not capable of producing giant earthquakes."

<http://nyti.ms/IXyZbG>

F.D.A. Restricts Antibiotics Use for Livestock

Major new policy to phase out the indiscriminate use of antibiotics in livestock

By SABRINA TAVERNISE

WASHINGTON — The Food and Drug Administration on Wednesday put in place a major new policy to phase out the indiscriminate use of antibiotics in cows, pigs and chickens raised for meat, a practice that experts say has endangered human health by fueling the growing epidemic of antibiotic resistance.

This is the agency's first serious attempt in decades to curb what experts have long regarded as the systematic overuse of antibiotics in healthy farm animals, with the drugs typically added directly into their feed and water. The waning effectiveness of antibiotics — wonder drugs of the 20th century — has become a looming threat to public health. At least two million Americans fall sick every year and about 23,000 die from antibiotic-resistant infections.

"This is the first significant step in dealing with this important public health concern in 20 years," said David Kessler, a former F.D.A. commissioner who has been critical of the agency's track record on antibiotics. "No one should underestimate how big a lift this has been in changing widespread and long entrenched industry practices."

The change, which is to take effect over the next three years, will effectively make it illegal for farmers and ranchers to use antibiotics to make animals grow bigger. The producers had found that feeding low doses of antibiotics to animals throughout their lives led them to grow plumper and larger. Scientists still debate why. Food producers will also have to get a prescription from a veterinarian to use the drugs to prevent disease in their animals.

Federal officials said the new policy would improve health in the United States by tightening the use of classes of antibiotics that save human lives, including penicillin, azithromycin and tetracycline. Food producers said they would abide by the new rules, but some public health advocates voiced concerns that loopholes could render the new policy toothless.

Health officials have warned since the 1970s that overuse of antibiotics in animals was leading to the development of infections resistant to treatment in humans. For years, modest efforts by federal officials to reduce the use of antibiotics in animals were thwarted by the powerful food industry and its substantial lobbying power in Congress. Pressure for federal action has mounted as the effectiveness of drugs important for human health has declined, and deaths from bugs resistant to antibiotics have soared.

Under the new policy, the agency is asking drug makers to change the labels that detail how a drug can be used so they would bar farmers from using the medicines to promote growth.

The changes, originally proposed in 2012, are voluntary for drug companies. But F.D.A. officials said they believed that the companies would comply, based on discussions during the public comment period. The two drug makers that represent a majority of such antibiotic products — Zoetis and Elanco — have already stated

their intent to participate, F.D.A. officials said. Companies will have three months to tell the agency whether they will change the labels, and three years to carry out the new rules.

Additionally, the agency is requiring that licensed veterinarians supervise the use of antibiotics, effectively requiring farmers and ranchers to obtain prescriptions to use the drugs for their animals.

"It's a big shift from the current situation, in which animal producers can go to a local feed store and buy these medicines over the counter and there is no oversight at all," said Michael Taylor, the F.D.A.'s deputy commissioner for foods and veterinary medicine.

Some consumer health advocates were skeptical that the new rules would reduce the amount of antibiotics consumed by animals. They say that a loophole will allow animal producers to keep using the same low doses of antibiotics by contending they are needed to keep animals from getting sick, and evading the new ban on use for growth promotion.

More meaningful, said Dr. Keeve Nachman, a scientist at the Johns Hopkins Center for a Livable Future, would be to ban the use of antibiotics for the prevention of disease, a step the F.D.A. so far has not taken. That would limit antibiotic uses to treatment of a specific sickness diagnosed by a veterinarian, a much narrower category, he said.

Another skeptic, Representative Louise M. Slaughter, a Democrat from New York, said that when the European Union tried to stop companies from using antibiotics to make farm animals bigger, companies continued to use antibiotics for disease prevention. She said antibiotic use only declined in countries like the Netherlands that instituted limits on total use and fines for noncompliance.

But another longtime critic of the F.D.A. on antibiotics, Dr. Stuart B. Levy, a professor of microbiology at Tufts University and the president of the Alliance for the Prudent Use of Antibiotics, praised the new rules. He was among the first to identify the problem in the 1970s. "I'm kind of happy," he said. "For all of us who've been struggling with this issue, this is the biggest step that's been taken in the last 30 years."

Mr. Taylor, the agency official, said the F.D.A. had detailed what veterinarians needed to consider when they prescribed such drugs. For example, use has to be for animals at risk for developing a specific disease, with no reasonable alternatives to prevent it.

"It's far from being a just-trust-them system," he said. "Given the history of the issue, it's not surprising that there are people who are skeptical."

He added that some food producers had already curbed antibiotic use.

A spokeswoman for Zoetis, a major drug producer that said it would abide by the new rules, said the new policy was not expected to have a big effect on the revenues of the company because many of its drug products were also approved for therapeutic uses. (Dr. Nachman said that was an indication that overall use might not decline under the new rules.)

The Animal Health Institute, an association of pharmaceutical companies that make drugs for animals, said that it supported the policy and "will continue to work with the F.D.A. on its implementation."

The National Pork Producers Council was less enthusiastic, saying, "We expect that hog farmers, and the federally inspected feed mills they purchase feed from, will follow the law."

"It is part of our ethical responsibility to utilize antibiotics responsibly and part of our commitment to public health and animal health," the council said in a statement.

The National Chicken Council said in a statement that its producers already worked closely with veterinarians, and that much of the antibiotics used in raising chickens were not used in human medicine.

http://www.eurekalert.org/pub_releases/2013-12/cu-ngm121213.php

Noble gas molecule discovered in space

A molecule containing a noble gas has been discovered in space by a team including astronomers from Cardiff University.

The find was made using a Cardiff-led instrument aboard Europe's Herschel Space Observatory. The molecule, argon hydride, was seen in the Crab Nebula, the remains of a star that exploded 1,000 years ago. Before the discovery, molecules of this kind have only been studied in laboratories on Earth.

The noble gases, which include helium, argon, radon and krypton, usually do not react easily with other chemical elements, and are often found on their own. In the right circumstances, however, they can form molecules with other elements. Such chemical compounds have only ever been studied in laboratories on Earth, leading astronomers to assume the right conditions simply do not occur in space.

"The Crab Nebula was only formed 1000 years ago when a massive star exploded", said Dr Haley Gomez of Cardiff University's School of Physics and Astronomy. "Not only is it very young in astronomical terms, but also relatively close, at just 6,500 light years away, providing an excellent way to study what happens in these

stellar explosions. Last year, we used the European Space Agency's Herschel Space Observatory to study the intricate network of gas filaments to show how exploding stars are creating huge amounts of space dust."

Further measurements of the Crab Nebula were made using Herschel's SPIRE instrument. Its development and operation was led by Professor Matt Griffin, from the School of Physics and Astronomy. As molecules spin in space, they emit light of very specific wavelengths, or colours, called "emission lines". The precise wavelength is dictated by the composition and structure of the molecule. Studying the emission lines observed by the SPIRE instrument allows astronomers to study the chemistry of outer space.

The team, led by Professor Mike Barlow from University College London, did not set out to make the discovery, but stumbled upon it almost by accident. "We were really concentrating on studying the dust in the filaments with SPIRE, and out pops these two bright emission lines exactly where we see the dust shining", says Dr Gomez. "The team had a hard time figuring out what these lines were from, as no-one had seen them before."

Professor Barlow said, "At first, the discovery of argon seemed bizarre. With hot gas still expanding at high speeds after the explosion, a supernova remnant is a harsh, hot and hostile environment, and one of the places where we least expected to find a noble-gas based molecule."

It now seems the Crab Nebula provides exactly the right conditions to form such molecules. The argon was produced in the initial stellar explosion, and then ionised, or energised, with electrons stripped from the atoms in resulting intense radiation as shockwaves. These shockwaves led to the formation of the network of cool filaments containing cold molecular hydrogen, made of two hydrogen atoms. The ionised argon then mixed with the cool gas to provide perfect conditions for noble gas compounds to form.

The measurements allowed the team to gauge other properties in argon molecules. "Finding this kind of molecule allowed us to evaluate the type (or isotope) of argon we discovered in the Crab Nebula," said Dr Gomez. "We now know that it is different from argon we see in rocks on the Earth. Future measurements will allow us to probe what exactly took place in the explosion 1000 years ago."

"What a great detective story", added Prof Matt Griffin, from Cardiff University, and lead scientist of the team behind the SPIRE instrument. "Here we see the excellent performance of the Herschel-SPIRE spectrometer, the expertise of the instrument team in producing the highest quality data, and the tenacity and vision of the scientists analysing it, all coming together to make an intriguing new discovery."

The results described in this article are reported in "Detection of a Noble Gas Molecular Ion, 36ArH+, in the Crab Nebula", by M. J. Barlow et al., published in the Dec 13th issue of Science, Volume 342, Issue 6164, DOI: 10.1126/science.1243582

The argon isotope found in the Crab Nebula is different from the one that dominates in Earth's atmosphere, 40Ar, which derives from the decay of a radioactive isotope of potassium (40K) present in our planet's rocks. At almost one per cent, argon is the third most abundant gas in the atmosphere of Earth after nitrogen and oxygen, and was discovered at the end of the 19th century.

http://www.eurekalert.org/pub_releases/2013-12/cp-sdd120513.php

Surprise: Duck-billed dinosaurs had fleshy 'cocks comb'

Edmontosaurus regalis heads were adorned with a fleshy comb, most similar to the roosters' red crest

A rare, mummified specimen of the duck-billed dinosaur *Edmontosaurus regalis* described in the Cell Press journal *Current Biology* on December 12 shows for the first time that those dinosaurs' heads were adorned with a fleshy comb, most similar to the roosters' red crest.

The most common dinosaurs in North America between 75 and 65 million years ago, duck-billed dinosaurs were gentle giants, about 12 meters long, and filled the same ecological role that kangaroos or deer play today. But no one had suspected that they—or other dinosaurs, for that matter—had fleshy structures on the tops of their heads.



This is an Edmontosaurus regalis reconstruction. Bell, Fanti, Currie, Arbour, Current Biology

"Until now, there has been no evidence for bizarre soft-tissue display structures among dinosaurs; these findings dramatically alter our perception of the appearance and behavior of this well-known dinosaur and allow us to comment on the evolution of head crests in this group," says Phil Bell from Australia's University of New England. "It also raises the thought-provoking possibility of similar crests among other dinosaurs."

The dinosaur specimen in question was found in deposits west of the city of Grande Prairie in west-central Alberta, Canada. Bell, along with Federico Fanti from the University of Bologna, Italy, knew they had

something special when they found skin impressions on parts of the mummified body. But it wasn't until Bell put a chisel through the top of the crest that he realized they really had something incredible.

"An elephant's trunk or a rooster's crest might never fossilize because there's no bone in them," Bell explains.

"This is equivalent to discovering for the first time that elephants had trunks. We have lots of skulls of Edmontosaurus, but there are no clues on them that suggest they might have had a big fleshy crest. There's no reason that other strange fleshy structures couldn't have been present on a whole range of other dinosaurs, including T. rex or Triceratops."

Of course, it's hard to tell what that cocks comb might have done for the duck-billed dinosaurs. In roosters and some other birds, bright red crests are a way to get the girls. "We might imagine a pair of male Edmontosaurus sizing each other up, bellowing, and showing off their head gear to see who was the dominant male and who is in charge of the herd," Bell says.

We may never know exactly, but the new study is a useful reminder of just how bizarre and amazing dinosaurs really were, the researchers say. There is much left to discover.

Current Biology, Bell et al.: "A mummified duck-billed dinosaur with a soft-tissue cock's comb."

<http://phys.org/news/2013-12-d-implants-complex-injuries.html>

3-D printed implants may soon fix complex injuries

In an age where 3-D printers are becoming a more and more common tool to make custom designed objects, some researchers are using the technology to manufacture replacement parts for the most customized and unique object of all—the human body.

With funding from the National Science Foundation, a husband and wife duo—materials scientist Susmita Bose and materials engineer Amit Bandyopadhyay—are leading a team of researchers at Washington State University to create implants that more closely mimic the properties of human bone, and can be custom-designed for unusual injuries or anatomy.

"In the majority of cases, results are fantastic with off-the-shelf implants," Bandyopadhyay says. "However, physicians come across many patients in which the anatomy or injury is so unique they can't take a part off the shelf. In these unique situations, the surgeon becomes a carpenter."

Using a technology called Laser Engineered Net Shaping (LENS), these new implants integrate into the body more effectively, encouraging bone regrowth that ultimately results in a stronger, longer lasting implant.

Parts on demand

In the LENS® process, tiny particles are blown into the path of a laser and melted. The material cools and hardens as soon as it is out of the laser beam, and custom parts can be quickly built up layer by layer. The process is so precise that parts can be used straight off the printer without the polishing or finishing needed in traditional manufacturing. Implant manufacturers using this strategy could simply start with a CT scan or MRI and use that to make a 3-D model of the injury. A consultation with a physician would determine where the problem was and how to repair it.

According to Bandyopadhyay, "the most exciting part is it doesn't take months. Within a few hours the first iteration of a design can be done. It then takes another five to six hours to manufacture it. As long as the physician is connected to the Internet, within three days he or she can have a custom, patient-specific implant in hand." There is a real need for these sorts of solutions for people with complex injuries, such as victims of traffic accidents or natural disasters.

Making the best even better

Not every implant needs to be custom manufactured. In most cases, surgeons can choose a standard-size implant based on the anatomy of the patient.

The standard materials for weight-bearing implants—titanium or stainless steel—are well-tolerated by the human body. Nevertheless, these metals have different properties from the bone they replace. Although bone seems stiff and solid, it in fact has some "spring" and millions of microscopic pores.

Because a metal implant is much stiffer, the surrounding bone doesn't have to support as much weight as it normally would. This is a significant problem with today's implants. Bones weaken and break down when they aren't properly exercised.

LENS® can be used to make parts out of many different materials, including metals and ceramics. Unlike many traditional manufacturing processes, LENS allows different kinds of materials to be easily combined into a single part. The heating and cooling processes are so fast that the component materials don't react with one another to create unexpected materials or properties.

"Once we built confidence that the properties of LENS-manufactured implants were the same as standard implants, we then focused on materials that were difficult to manufacture, like tantalum. We can make a

tantalum implant or coating in less than 15 minutes, even though its melting temperature is over 3000 degrees Celsius," Bandyopadhyay says.

Tantalum is non-irritating and can directly bond to hard tissue like bone. This gives researchers like Bandyopadhyay greater control over how implants interact with the body.

A metal core can be coated with a thin ceramic layer, for example, so that new bone is more likely to grow and bond with the implant. And because LENS® builds a layer at a time, implants can be manufactured with structures that are difficult to make using traditional techniques. They can have pores in the center but be solid at the edges, or have texture on the surface to help bond with bone or other biological materials.

Porous structures are particularly challenging to make using traditional manufacturing, yet they are potentially critical in making implants that more closely mimic natural bone. The LENS® process allows implants to be manufactured with microscopic holes for bone to grow into and attach. The holes have the added benefit of making the metal part less stiff and more like the bone it replaces, also helping the bone grow.

When bone grows into an implant, it forms a strong bond between the two and makes the bone less likely to degrade. The less the bone degrades, the less chance a replacement might be needed.

Wave of the future

Early in development the greatest challenge was to show that the material produced using the LENS process showed similar mechanical and physical properties compared to standard implants. Over time, the technology has matured to a level where it is reliable enough to become commercially feasible.

Bandyopadhyay expects that by 2020 custom-designed and manufactured implants will become commonplace.

According to Bandyopadhyay, "Biomedical device companies have invested heavily in this research and are setting up 3-D printing facilities. The FDA approved its first 3-D printed device last year."

Provided by National Science Foundation

<http://www.bbc.co.uk/news/health-25346638>

Breast cancer: Drug 'halves' risk of tumours

A "landmark study" shows a drug can more than halve the development of breast cancer in high-risk women.

By James Gallagher Health and science reporter, BBC News

A trial on 4,000 women, published in the Lancet, showed anastrozole was more effective, cheaper and had fewer side effects than current medications.

It stops the production of the hormone oestrogen, which fuels the growth of the majority of breast cancers.

Doctors and campaigners are asking health services to consider offering the drug to healthy women.

Some countries already offer the drugs tamoxifen and raloxifene to prevent breast cancer.

They both block oestrogen activity, however, they also increase the risk of cancers of the womb, deep vein thrombosis and hot flushes. Aromatase inhibitors, such as anastrozole, stop oestrogen being produced in the first place and are already used as a treatment for breast cancer.

'More effective'

The study at Queen Mary University of London has followed women with a high risk of breast cancer, based on their family history, for an average of five years. It showed that out of 2,000 high-risk women given no treatment there were 85 cases of breast cancer in the study.

But in the same number of women given anastrozole there were 40 cases, with virtually no side-effects.

Lead researcher Prof Jack Cuzick, who also pushed for the introduction of tamoxifen, told the BBC: "I think this is an exciting moment, breast cancer is by far the most common cancer in women and we have a chance to reduce cases." He added: "This class of drugs is more effective than previous drugs such as tamoxifen and crucially, it has fewer side effects." Prof Cuzick said there was now enough evidence to consider offering the drug.

Prof Montserrat Garcia-Closas, from the Institute of Cancer Research in London, who led the world's largest study into the causes of breast cancer, told the BBC: "This is a very significant and very important finding.

"The question now is will it reduce mortality and that will require longer term studies.

"But it adds very important evidence for recommending the drug as an alternative to tamoxifen, we now need to identify those women at highest risk who will benefit the most from this treatment."

Post-menopause

Both tamoxifen and anastrozole are cheap as the patents have run out on the drugs. For five years of treatment, tamoxifen would cost £157 and anastrozole £137. However, anastrozole cannot prevent the ovaries producing oestrogen so it would work only after the menopause. Tamoxifen works both before and after.

In 2013, the National Institute for Health and Care Excellence, in England and Wales, said high-risk women, over 35, should be offered tamoxifen or raloxifene.

The decision affected around 500,000 women. Cancer Research UK estimates that 240,000 of them would be suitable for anastrozole.

Prof Mark Baker, from NICE, commented: "We will certainly consider this research - along with all other available evidence - when the NICE guideline on familial breast cancer is next updated."

But he cautioned that tamoxifen was recommended for just a "relatively small percentage" of people so far.

Dr Caitlin Palframan, the head of policy at the charity Breakthrough Breast Cancer, commented: "The challenge will be ensuring drugs like these are actually offered on the NHS, as many eligible women still don't have access to the risk-reducing treatments already recommended in national guidelines."

Kate Law, the director of clinical research at Cancer Research UK, which part funded the study, said: "This landmark study shows that anastrozole could be valuable in helping to prevent breast cancer in women at higher-than-average risk of disease. "We now need accurate tests that will predict which women will most benefit from anastrozole and those who will have the fewest side-effects."

<http://phys.org/news/2013-12-revolutionary-method-gluing-gels-biological.html>

Revolutionary method for gluing gels and biological tissues

Researchers have discovered an efficient and easy-to-use method for bonding together gels and biological tissues.

A team of French researchers has succeeded in obtaining very strong adhesion between two gels by spreading on their surface a solution containing nanoparticles. Until now, there was no entirely satisfactory method of obtaining adhesion between two gels or two biological tissues. Published online in Nature on 11 December 2013, this work could pave the way for numerous medical and industrial applications.

Gels are materials that are mainly composed of a liquid, for example water, dispersed in a molecular network that gives them their solidity. Examples of gels in our everyday lives are numerous: gelatin used in desserts, redcurrant jelly, contact lenses or the absorbent part of children's nappies. Biological tissues such as skin, muscles and organs have strong similarities with gels but, until now, gluing these soft and slippery liquid-filled materials using adhesives normally composed of polymers was a seemingly impossible task.

Leibler is recognized for inventing completely original materials combining real industrial interest with profound theoretical concepts. The work he carried out in collaboration with Alba Marcellan and their colleagues at the Laboratoire Matière Molle et Chimie (CNRS/ESPCI ParisTech) and the Laboratoire Physico-Chimie des Polymères et Milieux Dispersés (CNRS/ UPMC/ESPCI ParisTech) has resulted in a novel idea: gluing gels together by spreading a solution of nanoparticles on their surface.

The principle is the following: the nanoparticles of the solution bind to the molecular network of the gel, a phenomenon known as adsorption and, at the same time, the molecular network binds the particles together. In this way, the nanoparticles establish innumerable connections between the two gels.

With his colleagues at the Laboratoire Matière Molle et Chimie, he has developed supramolecular rubbers capable of self-healing through simple contact, after being cut to pieces. He also invented a new class of organic materials known as vitrimers. Repairable and recyclable, these materials, like glass, can be shaped as desired and in a reversible manner, while remaining insoluble, light and strong. Revolutionary method for gluing gels - and biological tissues adhesion process only takes a few seconds. The method does not require the addition of polymers and does not involve any chemical reaction.

An aqueous solution of nanoparticles of silica, a compound that is readily available and widely used in industry, particularly as a food additive, makes it possible to glue together all types of gel, even when they do not have the same consistency or the same mechanical properties. Apart from the rapidity and simplicity of use, the adhesion provided by the nanoparticles is strong since the junction often withstands deformation better than the gel itself. In addition to offering excellent resistance to immersion in water, the adhesion is also self-repairing: two pieces that have become unstuck can be repositioned and glued back together without adding nanoparticles. Silica nanoparticles are not the only materials that display these properties. The researchers have obtained similar results using cellulose nanocrystals and carbon nanotubes.

Finally, to illustrate the potential of this discovery in the field of biological tissues, the researchers successfully glued together two pieces of calf's liver cut with a scalpel using a solution of silica nanoparticles.

This discovery opens up new applications and areas of research, particularly in the medical and veterinary fields and especially in surgery and regenerative medicine. It may for example be possible to use this method to glue together skin or organs having undergone an incision or a deep lesion. This method could moreover be of interest to the food processing and cosmetics industries as well as to manufacturers of prostheses and medical devices (bandages, patches, hydrogels, etc.).

More information: "Nanoparticle solutions as adhesives for gels and biological tissues." Séverine Rose, Alexandre PrevotEAU, Paul Elzière, Dominique Hourdet, Alba Marcellan & Ludwik Leibler. Nature online 11 December 2013

<http://www.sciencedaily.com/releases/2013/12/131212095648.htm>

Blood Can Transmit Creutzfeldt-Jakob Disease

First time presence of infectivity in the blood of patients affected by sporadic and the new variant of CJD was established

Creutzfeldt-Jakob disease (CJD) is a rare but fatal disease in humans. For the first time, the presence of infectivity^[1] in the blood of patients affected by sporadic and the new variant of CJD was established by scientists from the French National Institute for Agricultural Research (INRA) and the French National Veterinary School (ENVT), in collaboration with European partners. Complementary investigations are underway, but the available results support the contention that CJD might be transmitted by blood transfusion and/or the use of blood derived products. These results are published in the journal *Emerging Infectious Diseases* on 11 December 2013.

Creutzfeldt-Jakob disease (CJD) is a neurodegenerative disorder caused by the accumulation of a misfolded protein, called prion, in the tissues of affected individuals. In humans, there are different forms of the disease. A familial form (genetic origin), a sporadic form (unknown origin) and a form called 'variant', appeared in 1996 as a consequence of dietary exposure to the Bovine Spongiform Encephalopathy agent (BSE or 'mad cow disease'). Several countries (France, UK, USA, Japan...) have reported that the use of a growth hormone or meninx graft, originating from patients affected or incubating the disease, were responsible for the transmission between individuals of CJD. In the UK, based on epidemiological data, at least four variant CJD contaminations were considered to be the consequence of the transfusion of non leuko-depleted blood units that had been prepared from donors incubating the disease.

Breaking result: the blood of patients affected by CJD carries infectivity

A team of scientists from INRA and ENV Toulouse (France), in collaboration with the Georg August University (Germany) and the Centro de Investigación en Sanidad Animal (Spain), characterized the presence and distribution of CJD agents (sporadic and variant forms) in the blood. They quantified, by bioassays, the levels of infectivity associated with different blood fractions from CJD affected patients. The blood cells (white and red blood cells) and the plasma from a variant CJD affected patient contained infectivity. Regarding sporadic CJD, infectivity was detected in the plasma of two out of the four investigated cases.

These experiments demonstrate for the first time the presence of infectivity in the blood of CJD affected patients. The results support the contention that CJD might be transmitted by blood transfusion and/or the use of blood derived products. This work also indicates that the distribution of infectivity and the infectious load in the blood of CJD affected patients are similar to the one reported in various animal models of Prion diseases. This confirms the value of animal models to characterize transmission risk associated with prion disease. Complementary studies involving a greater number of CJD cases are being carried out. Meanwhile, the available results shall allow a refinement of the quantitative risk assessment models related to the CJD blood-borne transmission risk.

Jean Yves Douet, Saima Zafar, Armand Perret-Liaudet, Caroline Lacroux, Séverine Lugan, Naima Aron, Herve Cassard, Claudia Ponto, Fabien Corbière, Juan Maria Torres, Inga Zerr, Olivier Androletti. Detection of Infectivity in Blood of Persons with Variant and Sporadic Creutzfeldt-Jakob Disease. Emerging Infectious Diseases, 2014; 20 (1): 114 DOI: 10.3201/eid2001.130353

<http://www.wired.com/wiredscience/2013/12/europa-water-plumes/>

200-Kilometer-High Jets of Water Discovered Shooting From Europa

Jupiter's icy moon Europa may be showing us its insides

By Adam Mann

SAN FRANCISCO - Data from the Hubble space telescope suggests that enormous jets of water more than 200 kilometers tall (roughly twice as high as Earth's atmosphere) may be spurting intermittently from the moon's surface.

The frozen body Europa is known to have a vast liquid water ocean beneath its cold crust, a potential home for life. Should these newly observed water plumes be tapping into some European sea, they could be bringing material to the surface that would otherwise stay hidden. Follow-up observations from Earth or with probes around Europa could sample the fountains, hunting for organic material and perhaps finding evidence of living organisms beyond Earth.

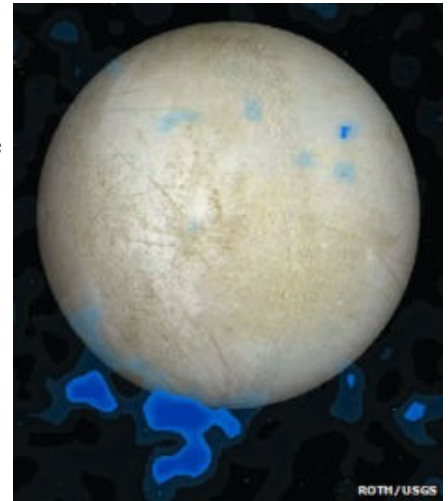
The findings, presented today at the annual meeting of the American Geophysical Union, await independent confirmation. But if the jets are real, the frozen world would join the tiny number of others known to have active jets, including Saturn's moon Enceladus and Neptune's moon Triton.

Scientists spotted the plumes in ultraviolet images from Hubble taken in December 2012. "We found that there's one blob of emission at Europa's south pole," astronomer Lorenz Roth of the Southwest Research

Institute in Texas, co-author of a paper about the research appearing today in Science. “It was always there over the 7 hours we observed and always at the same location.”

Previous observations from NASA’s Galileo mission, which visited the Jupiter system in the 1990s and early 2000s, suggest that Europa’s south pole is full of ridges and cracks quite similar to features called tiger stripes on Enceladus that spew water.

Lorenz and his team looked back through previous Hubble data to see if the plumes could have been spotted earlier but saw nothing, suggesting that they are likely transient. Europa happened to be at the point in its orbit where it was farthest away from Jupiter in December 2012, which could explain why the jets appeared only then. Researchers recently determined that Enceladus’ plumes are weakest when the moon is closest to Saturn, likely because the ringed planet’s gravity squeezes the tiger stripes shut. When the moon is far away, its crust relaxes, tripling the plumes power.



Signatures of water (blue) detected by Hubble are overlaid on an image of Europa

“We actually saw this press release on Enceladus,” said astronomer Kurt Retherford, also of SwRI and another co-author. “And we thought, ‘Oh my god! This is the explanation’” for why Europa’s plumes might only appear when it’s far from Jupiter.

Because of its oceanic subsurface, scientists have looked in the past for Europa jets. When the Voyager probes flew by in the 70s, one image showed a fuzzy spot that some thought to be a plume, though most considered it an artifact of imaging. Galileo also saw a row of dark spots on a ridge of Europa, perhaps similar to spots that appear on Earth in active places like Hawaii or Iceland before an eruption begins. But nothing conclusive was ever seen.

Because of previous false positives, scientists should be cautious when interpreting these newest results, said planetary scientist Robert Pappalardo of JPL, who was not involved in the recent work. The findings are exciting and impressive, he says, but also “on the hairy edge” of Hubble’s signal. “This is really pushing the limits of what can be observed from Earth,” he added. “I’ll sleep better when it’s confirmed.”

Even with those reservations, Pappalardo, who leads the planning team for a proposed mission to Europa, said that he’s already discussing with other scientists how these new results should affect their study priorities. Some future orbiter headed to Europa could for instance carry detectors specifically to search for heavy organic molecules that could be indicative of life in the subsurface. When it passed over the geyser’s spray, it would be bathed in material from the moon’s interior, giving scientists a window into Europa’s ocean.

Pappalardo hopes that the finding will help push Europa to a place of high priority in NASA’s exploration agenda. Administrators have recently made comments regarding the agency’s lack of funding for a big costly mission. But a probe to Europa was singled out as the one mission that could justify the expenditure.

<http://www.livescience.com/41909-new-clues-permian-mass-extinction.html>

Earth’s Greatest Killer Finally Caught

Lava flows exposed near Norilsk, Russia, are part of the Siberian Traps, the largest set of volcanic eruptions in recorded geologic history.

By Becky Oskin, Staff Writer | December 12, 2013 01:07pm ET

SAN FRANCISCO — Geology is partly detective work, and scientists now have enough evidence to book a suspect in the biggest environmental catastrophe in Earth’s history.

Painstaking analysis of rocks from China and Russia prove the culprit is a series of massive volcanic eruptions, which flooded ancient Siberia with thick lava flows just before Earth’s worst mass extinction almost 252 million years ago, researchers said here yesterday (Dec. 11) at the annual meeting of the American Geophysical Union. Thanks to new computer models of the eruption’s devastating effects, and detailed mapping of rocks deposited around the time of the mass dying, researchers now have their best case ever for pinning the extinction on the enormous lava outpouring.

The eruptions — now called the Siberian Traps — lasted less than 1 million years but left behind Earth’s biggest “large igneous province,” a pile of lava and other volcanic rocks about 720,000 cubic miles (3 million cubic kilometers) in volume. More than 96 percent of marine creatures and 70 percent of land species perished at the end of the Permian Period, versus 85 percent of life in the later dinosaur-killer extinction. In the Permian, all trilobites died out, along with 97 percent of the gorgeous marine creatures called ammonites. Sharks, fish and reptiles were hard hit.

"We can resolve the timing of the Siberian Traps and show that magmatism did precede the onset of mass extinction," said Seth Burgess, an MIT geochemistry graduate student who presented some of the research here.

Ticking clock

Many suspects have been named in the environmental mass murder at the end of Permian, including the Siberian Traps, comet impacts, climate change and the breakup of a supercontinent. Resolving the question by dating ancient rocks often leaves a large margin of error, so scientists have been loathe to point a finger at any one cause.

"This link between mass extinction and large igneous provinces [such as the Siberian Traps] is not a new hypothesis, but showing temporal overlap between the mass extinction and magmatism, the uncertainty [was] too high," Burgess said.

Burgess and his colleagues attacked the timing problem with a high-resolution, uranium-lead dating technique. The team tested volcanic rocks from the Siberian Traps and marine rocks from Meishan, China. Meishan is one of the best-preserved records of the mass extinction, as well as the transition between the Permian and the following Triassic Period. Burgess said the rocks were all analyzed in the same lab, on the same machine, with the same chemicals and by the same lab tech — all to minimize that extra few thousand years of error that scientists must report when estimating rock ages.

Burgess's new age for Meishan's Bed 25 (a thin rock layer that is the global reference point for the onset of extinction) is 251.941 million years ago, plus or minus 37,000 years. And volcanism started at the Siberian Traps 252.28 million years ago, plus or minus 11,000 years, Burgess said.

New ages for Meishan rock layers above and below Bed 25 also narrow down the duration of the mass extinction event to 60,000 years, plus or minus 40,000 years, Burgess said. The new timeline fits well with a remarkable new rock section from Penglaitan in South China, presented yesterday by Shu-zhong Shen, a paleontologist at the Nanjing Institute of Geology and Paleontology in China.

At Penglaitan, the extinction lasted only a few thousand years, based on abundant fossil and rock evidence, Shen said. Sixty Permian species disappear in the Penglaitan extinction layer. "The end-Permian mass extinction is sudden," he said. And chemical signatures preserved in the ancient rocks indicate local temperatures jumped 14.4 to 18 degrees Fahrenheit (8 to 10 degrees Celsius) just after the extinction, an extreme warming seen in other places on the planet close to this age.

Environmental catastrophe

Other evidence of a major climatic change after the Permian die-off include sudden shifts in ratios of elements such as carbon and oxygen, found worldwide. Researchers have long thought that volcanic gases from the Siberian Traps could have altered Earth's climate. Because the Siberian Traps' magma punched through sedimentary rocks such as coals and carbonates, the eruptions could have cooked the rocks, pouring extra billions of tons of greenhouse gases and toxic metals into Earth's atmosphere, according to modeling studies presented yesterday. Particles similar to fly ash from coal-fired power plants appear in lake sediments on Canada's Ellesmere Island, downwind of Siberia in the Permian, said Stephen Grasby, a geochemist at Canada's Geological Survey.

Gases such as carbon dioxide and methane warmed the Earth, and sulfur dioxide pelted the Northern Hemisphere with acid rain, researchers said. (Siberia was in the high latitudes 252 million years ago, so gases and ashes circled in the north.) "Rain in the Northern Hemisphere could have been really intensely acidic," said Benjamin Black, a postdoctoral researcher at MIT. "The pH was comparable to undiluted lemon juice." Black created a computer model of Earth's atmosphere during the Siberian Trap eruptions, when most of Earth's landmasses were jammed together in a supercontinent called Pangaea. A giant ocean called Panthalassa covered the rest of the globe.

Just one year's worth of volcanism from the Siberian Traps, or about 57 cubic miles (240 cubic km) of lava, could generate 1.46 billion tons of sulfur dioxide and devastate the Northern Hemisphere, Black's study found. The toxic gases pouring from the Earth also created chemical reactions that destroyed the protective ozone layer, raising DNA-damaging ultraviolet radiation over much of the planet, Black said. "Globally, average ozone levels fall below those observed in the Antarctic ozone hole in the 1990s," he said.

In total, more than 1,200 billion tons of methane and 4,000 billion tons of sulfur dioxide could have emerged from the Siberian Traps eruption, said Henrik Svensen, a geologist at the University of Oslo in Norway.

A better lineup

Because Siberia's volcanic eruptions flooded from the Earth for some 900,000 years, geologists are keen to further investigate which events were the killers, and which caused the environmental changes seen after the Permian extinction. "The future of this work is resolving which part of the Siberian magmatism is related to the mass extinction and which part is the effective driver of environmental change," Burgess said.

Geologists are already trying to solve that puzzle, with new, more precise maps that reveal the eruption history of the Siberian Traps. It turns out the earliest layers, along the Kureika River, have been misidentified, independent volcanologist Dougal Jerram said yesterday.

Instead of rocks formed by volcanic explosions, as previously mapped, Jerram and his colleagues discovered thin lava flows. Then, higher up in the pile where the rocks are younger, the researchers saw a sharp transition appear: The thin layers suddenly grow thicker, meaning more lava started coming out with each eruption. (Like water from a tap, the amount of magma pouring from the Earth — from multiple gashes and vents — waxed and waned through time at the Siberian Traps.)

At this transition zone, "it's like the volcanic taps suddenly switched on," Jerram told LiveScience. Further work could reveal if the massive gush matches with any of the Permian or Triassic disasters.

"We're starting to understand a little bit more about what's happening with the volcanic sequence. There's still quite a lot of work to do," Jerram said.

<http://nyti.ms/ISMNnO>

Experts Eye Oil and Gas Industry as Quakes Shake Oklahoma

Oklahoma has never been known as earthquake country, but in the past three years, the state has had thousands of quakes

By HENRY FOUNTAIN

OKLAHOMA CITY — Mary Catherine Sexton has been rattled enough.

This fall her neighborhood in the northeastern part of this city has been shaken by dozens of minor earthquakes.

"We would just have little trembles all the time," she said. Even before a magnitude 4.5 quake on Saturday knocked objects off her walls and a stone from above her neighbor's bay window, Ms. Sexton was on edge.

"People are fed up with the earthquakes," she said. "Our kids are scared. We're scared."

Oklahoma has never been known as earthquake country, with a yearly average of about 50 tremors, almost all of them minor. But in the past three years, the state has had thousands of quakes. This year has been the most active, with more than 2,600 so far, including 87 last week.

While most have been too slight to be felt, some, like the quake on Saturday and a smaller one in November that cracked a bathroom wall in Ms. Sexton's house, have been sensed over a wide area and caused damage. In 2011, a magnitude 5.6 quake — the biggest ever recorded in the state — injured two people and severely damaged more than a dozen homes, some beyond repair.

State officials say they are concerned, and residents accustomed to tornadoes and hail are now talking about buying earthquake insurance. "I'm scared there's going to be a bigger one," Ms. Sexton said.

Just as unsettling in a state where more than 340,000 jobs are tied to the oil and gas industry is what scientists say may be causing many of the quakes: the widespread industry practice of disposing of billions of gallons of wastewater that is produced along with oil and gas, by injecting it under pressure into wells that reach permeable rock formations. "Disposal wells pose the biggest risk," said Austin Holland, a seismologist with the Oklahoma Geological Survey, who is studying the various clusters of quakes around the state.

Oklahoma has more than 4,000 disposal wells for waste from tens of thousands of oil and gas wells. "Could we be looking at some cumulative tipping point? Yes, that's absolutely possible," Dr. Holland said. But there could be other explanations for the increase in earthquakes, he added.

Scientists have known for years that injection wells and other human activities can induce earthquakes by changing pressures underground. That can have the effect of "unclamping" old stressed faults so the rocks can slip past each other and cause the ground to shake.

The weight of water behind a new dam in China, for example, is thought to have induced a 2008 quake in Sichuan Province that killed 80,000 people. In Australia, a 1989 quake that killed 13 people was attributed in part to the opposite effect — the removal of millions of tons of coal during more than two centuries of mining. In other places, including California and Switzerland, enhanced geothermal projects, in which water is pumped into hot rocks deep underground to produce energy, have caused quakes.

In Texas, some earthquakes have been connected to the industry practice of "water flooding," increasing the yield of older oil wells by pumping water into nearby wells to force the oil out, said Cliff Frohlich, a University of Texas scientist. In other cases, Dr. Frohlich said, just the extraction of oil and gas from a long-producing field has been seen to induce quakes.

The practice of hydraulic fracturing, or fracking — injecting liquid at high pressures into shale rock - causes very small tremors as the rocks break, releasing trapped oil or gas. The technique has also been linked to a few minor earthquakes - in Oklahoma about a year ago, and in England and British Columbia. Yet unlike the continuing clusters of quakes elsewhere, the fracking-related earthquakes occurred only over short time periods, scientists say.

Of greater potential concern, scientists say, is wastewater disposal — from fracked or more conventional wells. Disposal wells linked to quakes have been shut down in a few states, including Arkansas and Ohio.

Along with oil and gas, water comes out of wells, often in enormous amounts, and must be disposed of continuously. Because transporting water, usually by truck, is costly, disposal wells are commonly located near producing wells.

The oil and gas industry points out that many of Oklahoma's disposal wells are in areas with no earthquake activity, and that the practice of injecting wastewater has been going on for years. "We've been doing this for a long time and it hasn't been an issue before," said Chad Warmington, president of the Oklahoma Oil and Gas Association.

But Dr. Frohlich said that what had changed was where the disposal was occurring. With the boom in production of oil and gas from shale formations, he said, "People are disposing of fluids in places they haven't before."

Still, it is difficult to show a definitive link between a group of quakes and nearby disposal wells, and Dr. Holland thinks there may be other explanations for some of the recent quakes, including the largest one, which occurred on a known fault line about 50 miles east of Oklahoma City.

Oklahoma does have natural seismic activity, he noted, and has had a few powerful quakes in the past, including one with a magnitude of 5.5 in 1952 and one estimated at about a magnitude of 7 that the geological record shows occurred 1,300 years ago. He also thinks changes in the water level of a large nearby lake may be responsible for some of the quakes around Oklahoma City, although he says this is not the most likely explanation.

The swarm of quakes has state regulators concerned, but cautious. "We have to look at what data and scientific evidence supports some connection," before deciding on steps to manage the risk, said Dana L. Murphy, a commissioner with the Oklahoma Corporation Commission. Theoretically, at least, the commission could order some wells to be shut.

Already the commission has reached an agreement with a disposal well operator in Love County, about 100 miles south of Oklahoma City, to reduce the amount of wastewater injected into his well. The facility had been operating for only two weeks, injecting up to 400,000 gallons of water a day from nearby fracking operations, when earthquakes started occurring in September, including one that toppled a chimney and caused other damage.

All the shaking in the state has people talking about what to do if a bigger one were to hit. "I've been through a lot of tornadoes - you can go hide from them," said Bill Hediger, whose home in Edmond, just north of Oklahoma City, shows cracks in the walls from the magnitude 5.6 quake. "But you can't hide from an earthquake."

Dr. Holland said that given the geological record, he could not rule out the possibility that a larger quake may occur in the state.

Ms. Sexton said she was not against the oil and gas industry, but added that if the quakes in her area were definitively linked to disposal wells, they should be shut down. "It would hurt oil and gas," she said. "But it's oil and gas hurting homeowners and making people fearful."

<http://www.medscape.com/viewarticle/817736?src=rss>

Sudden Cardiac Death in Untreated Lyme Carditis

Quick-thinking pathologists at a Georgia tissue bank recently found Lyme disease in sudden cardiac death patients whose tissues were being examined for transplant use

Janis C. Kelly

The Centers for Disease Control and Prevention (CDC) reported details of those cases in an article published in the December 13 issue of the Morbidity and Mortality Weekly Report to alert pathologists, medical examiners, and coroners of the need to consider Lyme carditis in cases of sudden cardiac death. CDC investigators warned clinicians to check cardiac status in patients with Lyme disease and Lyme exposure in patients with acute, unexplained cardiac symptoms.

"Health-care providers should ask patients with suspected Lyme disease about cardiac symptoms and obtain an [electrocardiogram] if indicated. Conversely, they should ask patients with unexplained heart block about possible exposure to infected ticks. Health-care providers also should remind their patients of steps to prevent infection, including use of repellent, daily tick checks, prompt showering after potential exposure, and landscape management," the authors write.

3 Lyme Carditis Sudden Cardiac Deaths Reported Within 1 Year

"Lyme carditis is a known manifestation of Lyme disease. In surveillance data reported to CDC, approximately 1% of Lyme disease patients had Lyme carditis, which we define as second or third degree heart block. There

were 4 previously reported deaths associated with Lyme carditis. What made these 3 new cases so striking is that they were reported within 1 year, from November 2012 through July 2013. We attribute that to the very astute pathologists at the tissue bank who recognized a pattern consistent with Lyme carditis. They not only recognized it but went through the appropriate channels to report and bring attention to it," lead investigator Joseph D. Forrester, MD, told Medscape Medical News.

"A goal of the...report is to alert pathologists, medical examiners, and coroners (particularly in high-incidence Lyme disease regions) [that] Lyme carditis can be a cause of some cardiac deaths," said Dr. Forrester, who is an epidemic intelligence service officer with the CDC's National Center for Emerging and Zoonotic Infectious Disease, Fort Collins, Colorado.

"We are involved with medical examiners and pathologists in several states looking for possible cases, but at this time we have no additional cases under investigation, and pathologists at the tissue bank reviewed reports for 20,000 cardiac specimens received since 2004 and found no additional cases," Dr. Forrester said.

Time to See a Physician About Lyme Carditis If...

"Symptoms of Lyme carditis that should prompt a person to see a physician include shortness of breath, lightheadedness, fainting, palpitations, or chest pain, particularly if you are or have recently been in an area where there is a high incidence of Lyme disease," Dr. Forrester said.

Borrelia burgdorferi spirochetes

According to the report, Lyme carditis symptoms occur a median of 21 days after infection and resolve within 1 to 6 weeks with appropriate antibiotic treatment.

The 3 cases included 1 woman and 2 men ranging in age from 26 to 38 years who were from states with high incidence of Lyme disease and who died of sudden cardiac death. In all 3 cases, cardiac tissue, corneas, skin, and other tissues had been recovered for potential transplantation. In 2 cases, evidence of Lyme carditis was discovered by pathologists at the tissue bank who were examining hearts for possible valve recovery. In the third case, CDC investigators confirmed Lyme carditis in heart tissues submitted for evaluation of suspected viral myocarditis. Lyme infection was confirmed by serology, and spirochetes were detected in the myocardium by immunohistochemistry in all 3 cases. "The *Borrelia burgdorferi* spirochetes actually make it into the heart tissue. Whether the resulting carditis is due to the spirochetes themselves or to the immune responses to them or to a combination of both is unclear," Dr. Forrester said.

The most common manifestation of Lyme carditis is atrioventricular (AV) conduction blockade. Dr. Forrester said that sudden cardiac death might be the result of the conduction abnormality leading to fatal arrhythmia. "I suspect that there are risk factors that make some people more susceptible to Lyme carditis," Dr. Forrester added.

Lyme Carditis Treatment Extremely Effective

"The current article further reiterates the importance of identification of Lyme carditis as a cause of heart block. I think this is more relevant to primary care physicians who manage the patients at the front end. The diagnosis of Lyme carditis can be challenging if it is the initial presentation of the disease process and [the] patient does not remember having a tick bite. AV block may be the first and only sign of Lyme disease," said Paras Karmacharya, MD, who recently reported a case of nonfatal Lyme carditis. Dr. Karmacharya, from Department of Medicine, Reading Health System, West Reading, Pennsylvania, was not involved in the CDC study.

"Although more than 90% of patients with Lyme carditis have complete recovery, patients with more severe conduction system disturbances (first-degree AV block with a PR interval >0.3 seconds, second- or third-degree AV block) should be referred immediately to the emergency department and hospitalized in a coronary care unit for treatment with intravenous antibiotics like ceftriaxone or high-dose penicillin G. Insertion of a temporary transvenous pacemaker may be required. As in the case described in our article, the degree of heart block can fluctuate from first degree to second degree to complete AV block very quickly in minutes to hours, so careful observation is prudent. Treatment with an antibiotic can revert the AV block within 48 hours of therapy, so identification of this potentially reversible cause of heart blocks may help prevent significant morbidity and mortality," Dr. Karmacharya said.

"Once you start treatment for Lyme carditis, the prognosis is excellent," Dr. Forrester emphasized.

No Risk for Lyme Infection Seen for Transplant Recipients

Recipients of transplanted corneas from 1 of the 3 Lyme carditis sudden death patients were subsequently treated prophylactically with doxycycline, but the CDC does not think there is a serious possibility of Lyme disease transmission from transplanted tissues.

Dr. Forrester said, "There has never been a documented case of Lyme disease transmission via transplanted organs, tissues, or transfused blood. Given how common Lyme disease is, such transmission would probably have happened if it were possible, so we feel that there is no such risk."

Recommendations for Avoiding Infection

Dr. Forrester, who has long been active in climbing, kayaking, and other outdoors activities, told Medscape Medical News that he carefully follows all of the CDC's recommendations for avoiding tick bites, including use of tick repellent, showering as soon as possible after coming indoors, conducting a full-body tick check, examining gear and pets, and tumbling clothes in a dryer on high heat for an hour to kill remaining ticks. "One thing this investigation has highlighted is the need for better methods of primary prevention for Lyme disease," Dr. Forrester said.

Dr. Forrester reported no relevant financial interests and Dr. Karmacharya have disclosed no relevant financial relationships. Morb Mortal Wkly Rep. 2013;62:993-996. Full text

<http://www.wired.com/wiredscience/2013/12/titan-lakes-seas/>

Titan's Rivers, Lakes, and Seas Mapped in Incredible Detail

Using data from NASA's Cassini spacecraft, scientists have created this beautiful mosaic mapping the northern hemisphere of Saturn's moon Titan, which is full of rivers, lakes, and seas.

By Adam Mann

SAN FRANCISCO - "Titan is a very alien place that looks very Earth-like," said planetary scientist Stephen Wall, leader of Cassini's radar team, during a press conference here at the American Geophysical Union conference.

The material filling Titan's lakes is not water but rather hydrocarbons such as methane and ethane, which are typically gases on Earth but remain liquid at Titan's average temperature of -180 degrees Celsius. Ever since Cassini started radar mapping the frozen moon in 2004, researchers have seen that Titan is a weird and wet world. But Cassini's scans missed the true extent of some seas, including the biggest, Kraken Mare. This new map fills in almost all the area of Titan's north pole and provides scientists with important answers to some of their questions.

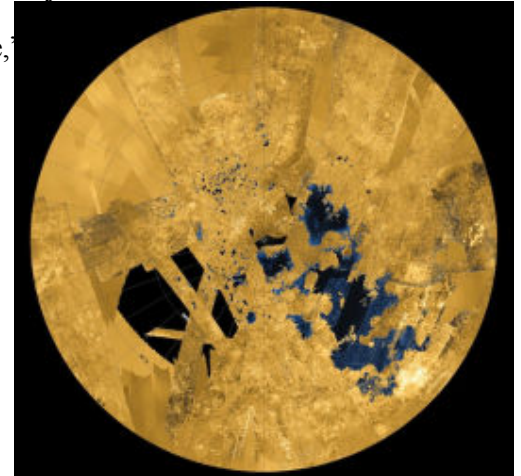


Image: NASA/JPL-Caltech/ASI/USGS

While the northern hemisphere is dotted all over with hundreds of tiny lakes, the large seas seem confined to a specific area, mainly on the lower right side of the image above. As geophysicist Randolph Kirk of the USGS pointed out during the briefing, you could almost draw a rectangular box around this area, suggesting that geological processes are at play. The team thinks that Titan's crust has fractured here when active tectonics created almost straight lines of parallel mountain chains. The low-lying areas are what gets filled with liquid, creating Kraken Mare and its smaller neighbor, Ligeia Mare. The scientists think the process may be analogous to flooding 12,000 years ago of similar geology in Nevada that likely created large bodies of water.

Other tectonic processes are probably behind the smaller dotted lakes, though scientists don't yet know precisely what. Some of the lakes could be infilled calderas of former active volcanoes on Titan (which would spew molten water instead of lava). But there isn't enough volcanic activity on the moon to account for all of them. Instead, many were probably created when liquid hydrocarbons dissolved the frozen ice, in the same way that water on Earth dissolves limestone to create features like the Bottomless Lakes in New Mexico.

"This creates a kind of exciting prospect that under the northern pole of Titan is a network of caves," said Kirk. Caves on Earth are often filled with life, so perhaps Titan's caves could be as well.

Other radar data has shown the depth and volume of one of Titan's seas, Ligeia Mare. Because the radar can penetrate below the liquid surface it reaches the bottom of Ligeia, which has a maximum depth of about 170 meters, on the same order as a body like Lake Michigan. Cassini has measured the surface area of Ligeia Mare, and scientists can calculate that it has a volume of about twice that of Lake Michigan as well.

<http://www.bbc.co.uk/news/science-environment-25349983>

Hydrogen squeezed from stone could be new energy source

Scientists from the University of Lyon have discovered a new way to split hydrogen gas from water, using rocks

By Simon Redfern Reporter, BBC News

The method promises a new green energy source, providing copious hydrogen from a simple mixture of rock and water. It speeds up a chemical reaction that takes geological timescales in nature. In the reaction, the mineral olivine strips one oxygen and hydrogen atom from an H₂O molecule to form a mineral called serpentine, releasing the spare hydrogen atom. The results were discussed at this week's meeting of the American Geophysical Union in San Francisco, and have been published in the journal American Mineralogist.

The researchers heated olivine minerals in water to a couple of hundred degrees Celsius, and added a little bit of ruby (aluminium oxide) to the mix to provide a source of aluminium atoms. The whole mix was placed into a miniature pressure cooker, formed of two diamonds, that squeezed the mixture to 2,000 atmospheres pressure. The transparent diamonds allowed the scientists to watch the reaction take place.

The process occurs, albeit very slowly, in the rocks that form the ocean floors around the globe. In these natural settings it is thought that the hydrogen that is produced either reacts with carbon to form methane, or is used by microbes that live deep in the rocks to sustain life deep beneath the Earth's surface. It is not yet clear exactly how much of this non-biologically generated methane is being produced within rocks across the planet.

Olivine is a common green mineral, sometimes mined as the semi-precious stone "peridot". The serpentine mineral that forms from it is beloved of sculptors and is often used as a decorative facing stone for buildings. The mineralogists at Lyon were expecting the reaction to take weeks, if not months, so having set the experiment running one afternoon they were shocked to discover that half of the olivine crystal had already reacted when they took a look at it the next morning.

They realised that the addition of aluminium, dissolved from the ruby crystal, was key, speeding up the rate at which the olivine crystals dissolve in water and new serpentine minerals grow. Any source of aluminium could be used, and at the lower temperature experiments the researchers also used bauxite.

Describing their finds, Dr Isabelle Daniel told BBC News: "Serpentinisation is very common in nature and occurs along mid-ocean ridges. "Hydrogen is measured at all the hydrothermal vents from these places and a huge amount of hydrogen and methane is produced: it is a general feature of the mid-ocean ridges. It is a major source of energy for chemo-synthetic bacteria in rocks."

Scouring CO₂

At the moment, the production of hydrogen is mostly performed by a process called steam reforming, combining hydrocarbons like gas or oil with water at around 700 to 900 °C.

The new method uses much lower temperatures and involves no fossil fuel. This type of "green chemistry" promises a route to new sources of carbon-free energy at low environmental cost.

The experiments suggest serpentinisation could provide a possible long-term sustainable energy source. "If you were to process around 10% of the current hydrogen production by this method it would require a volume of rock similar to that used for cement production today," said Dr Daniel.

An interesting further application of the serpentine that is produced by this reaction, is the capture of atmospheric carbon. Serpentine in nature is known to actively scour CO₂ by carbonation, and has previously been suggested as a feedstock for sequestering atmospheric carbon on a global scale. There is evidence that weathering of olivine to serpentine in nature has, in the geological deep past, played a part in controlling atmospheric CO₂.

http://www.eurekalert.org/pub_releases/2013-12/uotm-bcl121313.php

Breakthrough could lead to protection from fatal infections

Research shows that deletion of the *Epa1* gene protects from fatal rickettsiosis

Researchers at the University of Texas Medical Branch at Galveston have discovered a way to block a disease pathway that could be a breakthrough in defeating some of the world's most devastating human infections.

Rickettsioses are a group of insect-borne diseases caused by bacteria. One type, typhus fever, has been cited as a high-level threat by the National Institutes of Health because the bacteria can spread and multiply very easily, and the untreated infection can lead to death.

What researchers at UTMB have found is a way to protect against what can be a fatal rickettsial infection. Their findings appear in the Proceedings of the National Academy of Sciences. "Even more exciting, there is preliminary evidence that the experimental drug we have identified as being effective against rickettsiae may also be effective against viruses," said Dr. David Walker, chairman of the department of pathology at UTMB and executive director for the Center for Biodefense and Emerging Infectious Diseases.

Many scientists are concerned that temperature increases due to global climate change will lead to more widespread cases of rickettsioses, since the bacteria are spread by ticks, lice, fleas and chiggers that thrive in warmer climates. In addition, because the bacteria are easily transmitted, they could pose a bioterrorism threat, Walker said. The diseases, which include Rocky Mountain spotted fever, can lead to death. In fact, a fatality rate as high as 32 percent has been reported in hospitalized patients with Mediterranean spotted fever.

"We believe that it is imperative that we find a way to control this disease," Walker said.

In their study at UTMB, scientists know signals to cells can be controlled by a molecular messenger known as cyclic AMP, which plays crucial roles in the development of many human diseases, including those caused by bacteria and viruses.

In humans and animals, the effects of this messenger are controlled by two types of receptors, one known as protein kinase A, or PKA, and a newly identified protein known as Epac. PKA and Epac can act in concert or in opposition to control many cell functions.

Two leading scientists of this multidisciplinary, cutting-edge research collaboration at UTMB, Dr. Bin Gong and Dr. Xiaodong Cheng, used mice in which the gene for the Epac receptor was inactivated. They found that mice infected with deadly Rickettsia bacteria are resistant to fatal infection.

The mechanism by which this happens is being identified, and now a new candidate drug that inhibits Epac, known as ESI for Epac-specific inhibitor, has also been shown to protect normal mice from a fatal rickettsial infection. The researchers are currently designing a second-generation ESI that is more potent and is not toxic even at high doses. There are also indications from preliminary experiments that ESI protects animals against some lethal viral infections. "This is an exciting development, given that our arsenal of treatments for these bacteria is quite limited," Walker said.

The PNAS study's other authors include Thomas Shelite, Fang C. Mei, Tuha Ha, Yaohua Hu, Guang Xu, Qing Chang, Maki Wakamiya, Thomas G. Ksiazek, Paul J. Boor, Donald H. Bouyer and Vsevolod L. Popov from UTMB and Ju Chen of the University of California, San Diego. Funding was provided by the Center for Biodefense and Emerging Infectious Diseases, the Carmage and Martha Walls Distinguished University Chair in Tropical Diseases and the National Institutes of Health.

http://www.eurekalert.org/pub_releases/2013-12/aafc-nct120413.php

New combination therapy fails to delay progression of advanced breast cancer

Adding the antibody therapy ramucirumab to the chemotherapy drug docetaxel did not delay disease progression for patients with HER2-negative, advanced breast cancer

SAN ANTONIO - Adding the antibody therapy ramucirumab to the chemotherapy drug docetaxel did not delay disease progression for patients with HER2-negative, advanced breast cancer, according to results of a placebo-controlled, randomized, phase III clinical trial presented here at the 2013 San Antonio Breast Cancer Symposium, held Dec. 10-14.

"Patients with metastatic or recurrent breast cancer, as well as those with locally advanced disease that cannot be surgically removed, have no curative options," said John R. Mackey, M.D., professor of oncology at the University of Alberta in Edmonton. "Standard cytotoxic chemotherapy is an option, but the efficacy of current treatments is modest and patients experience many adverse side effects.

"We had hoped that ramucirumab would give patients a new option for metastatic breast cancer. The outcome is disappointing, especially for the patients who participated on the trial and the many others suffering with this disease," added Mackey, who is also director of Translational Research in Oncology (TRIO). "Antiangiogenic agents have been successful in prolonging survival in a number of solid tumor types, including colon cancer and gastric cancer, but unfortunately, for reasons that we don't understand, they have not yet been shown to work for breast cancer."

"But we must work with the results that we have, and there were some patients on the trial who responded to treatment with ramucirumab," continued Mackey. "As a result, we will be conducting biomarker analyses to see if we can identify a subgroup of patients for whom the antibody therapy might be beneficial, but it will be a while before we have results."

For tumors to thrive, they need a good blood supply, and many tumors release factors that trigger nearby blood vessels to grow, a process called angiogenesis. Ramucirumab blocks angiogenesis by attaching to the protein on blood vessels that is key to the new blood vessel growth, vascular endothelial growth factor receptor 2 (VEGFR2). According to Mackey, other antiangiogenic therapies have not yielded great success in breast cancer but it had been hoped that ramucirumab would benefit patients because it is the only antiangiogenic antibody therapy to directly target VEGFR2.

Between August 2008 and December 2011, Mackey and colleagues enrolled 1,144 patients in the placebo-controlled, randomized, multinational, phase III clinical trial called the ramucirumab overall survival evaluation (ROSE) trial or the TRIO-12 trial. Patients were randomly assigned 1:2 to docetaxel plus placebo or docetaxel plus ramucirumab. To be eligible for the trial, patients had to have HER2-negative breast cancer that could not be removed surgically or HER2-negative, locally recurrent or metastatic breast cancer.

After a median follow-up of 16.2 months, progression-free survival was 9.5 months in the ramucirumab arm and 8.2 months in the control arm.

"The biggest positive that we can take from the trial is that we showed that a global academic group, TRIO, can successfully partner with industry to run a large, late-stage cancer clinical trial," said Mackey.

This study was funded by Eli Lilly and Company. Mackey declares no conflicts of interest.

<http://bit.ly/1cLLSkz>

Why China and India Love U.S. Universities

Can the U.S. stave off the erosion of its longtime preeminence in science and engineering?

By Harold O. Levy

For decades the nation's stature in those disciplines has attracted many of the brightest and most talented students from around the world to America's advanced degree programs. Citizens of other countries now receive more than half the Ph.D.s awarded by U.S. universities in engineering, computer science and physics, on top of earning one third of all college degrees in science and engineering. In certain subfields, the disparity is much higher: in electrical engineering, for example, foreign students received 65 percent of all doctoral diplomas in 2001.

These figures should inspire alarm, not pride. The unpleasant truth is that the U.S. public education system simply does not produce enough high school graduates who are qualified for college work of any kind, let alone students with a vigorous appetite for math and the sciences.

The full depth of America's educational failure is actually masked by the diversity of nationalities among grad students in those fields: Of the 1,777 physics doctorates awarded in 2011, for example, 743 went to temporary visa holders from many lands—and that figure excludes foreign nationals who had won permanent resident status. Only 15 of those 1,777 doctorates were earned by African-Americans.

The influx of students from abroad may now be reaching critical mass. Where economists used to bemoan the “brain drain” that afflicted much of the developing world, many foreign graduates are now taking their American diplomas and returning to their home countries in search of opportunities greater than those they see in the U.S. Stateside university master's programs are packed with foreign students who are scheduled to leave the country as soon as they graduate.

In 2009, the most recent year for which such data exist, students on temporary visas earned 27 percent of all master's degrees in science and engineering, including 36 percent of those in physics and 46 percent in computer science. And a 2002 survey found that nearly 30 percent of those candidates had no firm commitment to lives in the U.S. after graduation. That study was conducted before the post-2007 decimation of the U.S. job market—and unless Congress can break its current stalemate, at press time, over immigration reform, the retention rate most likely will drop even further.

If and when those students depart from America, they will in effect constitute an unacknowledged version of foreign aid. The advanced education they receive in the U.S. is underwritten by American taxpayers in the form of sponsored research, financial aid (for foreign students as well as Americans), and a wide array of subsidies and grants.

In addition, many state governments provide their local universities (including wholly private institutions) with land; buildings; subsidized construction loans; fire and police protection; massive real-estate and sales-tax exemptions; and, in a few states, annual budget allocations. Foreign nations—particularly China, India and South Korea—benefit hugely from U.S. investments in higher education.

Of course, just as with more conventional, overt foreign aid, America also stands to benefit from its own largesse. The presence of U.S.-educated people in other, developing countries makes it easier for America's style of commerce and manufacturing to be accepted there, and a shared understanding of professional norms, competencies and perspectives can only facilitate business relations with U.S. firms.

But there are risks as well. If current trends continue, America's scientists and engineers—the basic drivers of innovation and prosperity—will ultimately be surpassed by U.S.-educated competitors in other countries that are more serious about teaching their youngsters.

To keep that from happening, America needs to strengthen math and science programs from kindergarten through grade 12. In April a consortium of 26 states took a major step in the right direction by issuing the Next Generation Science Standards, a set of curricular guidelines for elementary and secondary schools to get more students ready for college-level work.

At least seven states have adopted the standards. The program, which is designed to emphasize hands-on investigative learning and to encourage critical examination of scientific evidence, has provoked resistance from some quarters where science itself is viewed with suspicion.

Implementing the standards will cost money, too: America's stinginess in supporting K–12 science education is a persistent national problem. But we have little choice. The alternative is to keep on allowing the country's great universities to be used as a funnel for unintended foreign aid.

<http://bit.ly/1gBfPaq>

Earth's poles are shifting because of climate change

Climate change is causing the North Pole's location to drift, owing to subtle changes in Earth's rotation that result from the melting of glaciers and ice sheets.

17:13 13 December 2013 by Anil Ananthaswamy

The finding suggests that monitoring the position of the pole could become a new tool for tracking global warming. Computer simulations had suggested that the melting of ice sheets and the consequent rise in sea level could affect the distribution of mass on the Earth's surface. This would in turn cause the Earth's axis to shift, an effect that has been confirmed by measurements of the positions of the poles. Now, Jianli Chen of the University of Texas at Austin and colleagues have shown that melting due to our greenhouse-gas emissions is making its own contribution to the shift.

The wobble in Earth's axis of rotation is a combination of two major components, each with its own cause. One is called the Chandler wobble and is thought to arise because the Earth is not rigid. Another is the annual wobble, related to Earth's orbit around the sun.

Additional wobble

Remove these wobbles, and you are left with an additional signal. Since observations began in 1899, the North Pole has been drifting southwards 10 centimetres per year along longitude 70° west – a line running through eastern Canada. This drift is due to the changes in the distribution of Earth's mass as the crust slowly rebounds after the end of the last ice age. But Chen's team found something surprising. In 2005, this southward drift changed abruptly. The pole began moving eastwards and continues to do so, a shift that has amounted to about 1.2 metres since 2005.

To work out why the pole changed direction, Chen's team used data from NASA's GRACE satellite, which measures changes in Earth's gravity field over time. The data allowed them to calculate the redistribution of mass on Earth's surface due to the melting of the Greenland and Antarctic ice sheets and mountain glaciers, and the resulting rise in sea level. It correlated perfectly with the observed changes in the mean pole position (MPP). "Ice melting and sea level change can explain 90 per cent of the [eastward shift]," says Chen. "The driving force for the sudden change is climate change."

Greenland thaw

Chen's team calculated that the biggest contribution is coming from the melting of the Greenland ice sheet, which is losing about 250 gigatonnes of ice each year. Another big factor is the melting of mountain glaciers, which contributes about 194 gigatonnes per year. The contribution from Antarctica adds up to 180 gigatonnes per year, but there is considerable uncertainty here because changes in the gravity field due to Earth's crust rebounding are less well understood over Antarctica than elsewhere.

Since the MPP can be accurately measured using multiple independent techniques, its position and drift can be used to gauge the extent of ice sheet melting, especially in between the end of the ageing GRACE mission and the launch of the next generation of gravity-field-measuring satellites, says Chen.

Jean Dickey of NASA's Jet Propulsion Laboratory in Pasadena, California, who was not associated with the study, agrees. "It's a way to monitor climate change by continuing to measure the deviation [of the MPP] from what we have seen in the past," she says.

Chen presented his findings this week at the annual meeting of the American Geophysical Union in San Francisco.

<http://www.sciencedaily.com/releases/2013/12/131213201152.htm>

Strobe Glasses Improve Hockey Players' Performance

Professional hockey players who trained with special eyewear that only allowed them to see action intermittently showed significant improvement in practice drills, according to a Duke University study with the NHL's Carolina Hurricanes.

The eyewear features lenses that switch between transparent and opaque, producing stroboscopic visual conditions, much like a strobe light in your favorite dance club.

Earlier research using the stroboscopic eyewear during training showed improved vision, visual attention, and ability to anticipate the timing of moving items. But the small pilot study with Hurricanes players is the first to directly explore whether those effects can improve sports performance. The study appears online in the November-December issue of Athletic Training & Sports Health Care.

Players who trained with the strobe eyewear experienced an 18 percent performance improvement in a series of on-ice skill tests. A control group showed no change. "From a sports perspective, you want to know if something is going to be an actual, viable training tool," said Stephen Mitroff, Ph.D., associate professor of

psychology and neuroscience in the Duke Center for Cognitive Neuroscience. "If players train with it, will they likely get the benefits? Our previous work showed that stroboscopic training affected vision and attention, and here we explored if those changes can benefit sports performance."

The strobe eyewear forces the wearer's visual system to train in difficult conditions in much the same way that wearing ankle weights makes training harder for a runner, he said. The eyewear's lenses alternated at different rates, always with a clear state for a tenth of a second, and various opaque states ranging in intervals from 67 milliseconds to nine-tenths of a second.

Mitroff collaborated with Hurricanes athletic trainers and strength and condition coaches Peter Friesen and Doug Bennett to test players during the team's 16-day pre-season training camp. Eleven players completed the full study wearing eyewear called the Nike SPARQ Vapor Strobe.

The athletes were randomly divided into a five-player control group that completed normal training and a six-player strobe group that wore the eyewear once daily during normal training. Each group completed a performance assessment before and after training. Forwards were asked to perform a task that involved difficult skating before taking shots on goal, and defensemen were asked to skate in a circle before completing long passes.

"That 18-percent improvement for on-ice skills for professional players is huge," Mitroff said. "This is a dramatic improvement observed in professional athletes."

Mitroff cautioned however, that these results are preliminary due to the small size of the pilot study. More research is needed to determine the true impact of the eyewear on performance. "That we observed an 18 percent improvement in professional athletes is pretty amazing," Mitroff said. "So, given that this is a small sample size, I would imagine that with more data the effect will be significant and real, but a smaller percent improvement."

Although the most immediate application of the strobe eyewear is in athletics, Mitroff said the potential does exist for it to have future impact in medical, military, and physical rehabilitation settings.

Stephen R. Mitroff, Peter Friesen, Doug Bennett, Herb Yoo, Alan W. Reichow. Enhancing Ice Hockey Skills Through Stroboscopic Visual Training. Athletic Training & Sport Health Care, Nov/Dec, 2013

<http://phys.org/news/2013-12-japan-lacks-decommissioning-experts-fukushima.html>

Japan lacks decommissioning experts for Fukushima

Japan is incapable of safely decommissioning the devastated Fukushima nuclear plant alone and must stitch together an international team for the massive undertaking, experts say, but has made only halting progress in that direction.

Unlike the U.S. and some European countries, Japan has never decommissioned a full-fledged reactor. Now it must do so at the Fukushima Dai-Ichi plant. Three of its six reactors melted down after the 2011 earthquake and tsunami, making what is ordinarily a technically challenging operation even more complex.

The cloud over Japan's capacity to get the decades-long job done has further undermined the image of the nuclear industry with the public. Opinion surveys show a majority of Japanese are opposed to restarting 50 reactors that were put offline for safety and other checks in the aftermath of the disaster. Japan has been forced to import oil and gas to meet its power needs, burdening its already feeble economy.

"Even for the U.S. nuclear industry, such a cleanup and decommissioning would be a great challenge," said Akira Tokuhira, a University of Idaho professor of mechanical and nuclear engineering who is among those calling for a larger international role at Fukushima.

Decommissioning a nuclear power plant normally involves first bringing the reactor cores to stable shutdown, and then eventually removing them for long-term storage. It is a process that takes years. Throughout, radiation levels and worker exposure must be monitored.

At Fukushima, there is the daunting challenge of taking out cores that suffered meltdown, which is the most dangerous type of nuclear power accident. Their exact location within the reactor units isn't known and needs to be ascertained so their condition can be analyzed. That will require development of nimble robots capable of withstanding high radiation. The lack of experts is worse at the regulatory level. The tally is zero.

Japan's Nuclear Regulation Authority has no one devoted to decommissioning, said spokesman Juntaro Yamada, though it has experts dealing with the ongoing removal of fuel rods from one of the Fukushima reactor units.

Its predecessor organization was criticized after the Fukushima disaster for being too close to the nuclear industry, so the members chosen for the new agency launched last year don't have direct ties to the industry to ensure their objectivity.

The government-funded Nuclear Energy Safety Organization, which is to be folded into the regulatory authority to beef up its expertise, has one expert on decommissioning, a person who studies overseas

regulations on the process. The group mainly helps with routine nuclear plant inspections, but since the 2011 catastrophe has been involved with bringing the Fukushima plant under control.

In contrast, the U.S. Nuclear Regulatory Commission has 10 people devoted to decommissioning including four project managers, four health physicists, and a hydro-geologist. It says it has the equivalent of more than 200 years of experience in decommissioning and has overseen the termination of 11 power reactors and 13 research reactors. France has decommissioned nine reactors, and its regulatory agency has seven decommissioning experts at the national level, and 10 more at the local level.

Lake Barrett, a retired nuclear engineer who took part in decommissioning Pennsylvania's Three Mile Island after the meltdown of its reactor core in 1979, was hired as a consultant by Fukushima operator Tokyo Electric Power Co. He visits about once a year or so to give advice, and is not assigned daily to the job.

The cleanup at Fukushima would be more difficult than Three Mile Island because the damage is more numerous, involving three reactors instead of one, and more serious because of the greater damage from the bigger explosions.

Barrett said one reason he wanted to help Fukushima was that Japanese engineers had helped out at Three Mile Island. He had asked about their whereabouts but got no answers. He fears they are all retired or working in other industries. "The most challenging area is skilled nuclear engineers and managers that can plan, integrate and communicate effectively in Japanese," he said.

Japan's nuclear program started later than the U.S. and it has scrapped only a small test reactor. Five reactors are in various stages of decommissioning, including two experimental reactors and three commercial ones. The furthest along is Tokai Power Station's No. 1 reactor, which is 15 years into a planned 22-year process. About 70 experts are working on the decommissioning, but the experience gained with Japan's oldest reactor is not directly transferable to Fukushima.

The decommissioning of two reactors similar to Fukushima's began in 2009 at Hamaoka nuclear power plant west of Tokyo, but it is in the early stages and is expected to take nearly 30 more years.

It took until August this year, nearly two and half years after the tsunami, for Japan to set up the International Research Institute for Nuclear Decommissioning, to bring together ideas, both inside and outside Japan, on Fukushima decommissioning and encourage communication.

Tokuhiro, who has more than 20 years in the nuclear design and safety fields, calls it a step in the right direction but too small, given the huge task at hand. The organization acknowledges much remains to be done, including responding to unprecedented challenges that will require the development of robotics and other new technology.

Tokuhiro is advocating the creation of an international team to help Japan, including those with experience at Three Mile Island and Chernobyl in the Ukraine. "It is clear that this very large undertaking requires an international effort," he said. "It is in the spirit of a global nuclear energy partnership."