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Ginseng can treat and prevent influenza and RSV, researcher finds

Ginseng can help treat and prevent influenza and respiratory syncytial virus (RSV), a respiratory virus that infects the lungs and breathing passages, according to research findings by a scientist in Georgia State University's new Institute for Biomedical Sciences.

ATLANTA - In a recent issue of *Nutrients* and an upcoming publication of the *International Journal of Molecular Medicine*, Sang-Moo Kang reports the beneficial effects of ginseng, a well-known herbal medicine, on human health.

Kang's primary research focuses on designing and developing effective vaccines against viral diseases such as influenza virus and RSV, but he partnered with a university and research institutes in South Korea that wanted international collaborative projects to study if ginseng can be used to improve health and protect against disease because of the potential benefit in fighting these viruses. Ginseng has been reported to have anticancer, anti-inflammatory and immune modifying abilities.

Seasonal influenza is a serious respiratory disease that causes annual epidemics in humans worldwide, resulting in about three to five million cases of severe illness and about 250,000 to 500,000 deaths, according to the World Health Organization. Influenza can spread quickly, and new, unexpected pandemic influenza viruses may emerge at any time and cross over to different species. The H1N1 influenza virus, a new strain known as swine flu that emerged in 2009, spread rapidly to more than 74 countries. There are also challenges with existing influenza vaccines, such as required annual updates and no protection against pandemic strains and bird flu. In addition, there are no vaccines available for RSV, which affects millions and is the leading cause of inflammatory bronchiolitis pneumonia and viral death in infants and in some elderly adults.

In his study published in *Nutrients*, Kang investigated whether red ginseng extract has preventive effects on influenza A virus infection. He found that red ginseng extract improves the survival of human lung epithelial cells infected with influenza virus. Also, treatment with red ginseng extract reduced the expression of genes that cause inflammation.

After infection with influenza A virus, mice that were orally administered ginseng over a long time showed multiple immune modifying effects, such as stimulated antiviral production of proteins important in immune response and fewer inflammatory cells in their bronchial walls. The study indicates the beneficial effects of red ginseng extract on preventing influenza A virus infections could result from immune modifying capabilities of ginseng.

In his upcoming publication in the *International Journal of Molecular Medicine*, Kang investigated whether Korean red ginseng extract has antiviral effects, or the ability to treat RSV infection. Kang found Korean red ginseng extract improved the survival of human lung epithelial cells against RSV infection and inhibited the virus from replicating, or multiplying, in the body. In addition, treatment with Korean red ginseng extract suppressed the expression of RSV-induced inflammatory genes and the formation of chemically reactive molecules containing oxygen, which play a role in virus-induced epithelial damage in RSV.

Also, mice that were orally administered Korean red ginseng extract had lower viral levels after infection with RSV. The results suggest that Korean red ginseng extract has antiviral activity against RSV infection. Kang has further demonstrated ginseng's beneficial effects on influenza and RSV in previously published studies.

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New approach may help manage the most troubling symptoms of dementia, lessen use of drugs

Technique called DICE empowers caregivers, patients and health providers to work together to reduce behavioral problems

ANN ARBOR, Mich. - A new approach to handling agitation, aggression and other unwanted behaviors by people with dementia may help reduce the use of antipsychotics and other psychiatric drugs in this population, and make life easier for them and their caregivers, a team of experts says.

Publishing their recommendations under the easy-to-remember acronym of "DICE", the panel of specialists in senior mental health hope to spark better teamwork among those who care for dementia patients at home, in residential facilities and in hospitals and clinics. In fact, the federal agency that runs Medicare and funds much dementia-related care has made the DICE approach an official part of its toolkit for reducing the use of antipsychotic drugs and other mental health medications in people with dementia.

Though these drugs may still help some patients, the new paper in the Journal of the American Geriatrics Society says, many non-medication approaches could also help reduced unwanted behaviors, also known as neuropsychiatric symptoms of dementia. But it will take teamwork and communication to do it.

Most people with Alzheimer's disease and other memory-affecting conditions also get aggressive, agitated, depressed, anxious, or delusional from time to time, says senior author Helen C. Kales, M.D., head of the U-M Program for Positive Aging and Geriatric Psychiatry at the University of Michigan Health System and investigator at the VA Center for Clinical Management Research. Or, they might have delusions, hallucinations, or lose inhibitions.

"Often more than memory loss, behavioral symptoms of dementia are among the most difficult aspects of caring for people with dementia. These symptoms are experienced almost universally, across dementia stages and causes," she says. "Sadly, these symptoms are often associated with poor outcomes including early nursing home placement, hospital stays, caregiver stress and depression, and reduced caregiver employment."

Doctors often prescribe these patients medications often used in patients with mental health disorders, despite little hard evidence that they work well and despite the risks they can pose - including hastening death.

Meanwhile, studies have shown promise from non-medication approaches to changing dementia patients' behavior and reducing triggers for behavioral issues in their environment and daily life. But too few health teams are trained in their use.

Kales and her colleagues Laura N. Gitlin, Ph.D. and Constantine G. Lyketsos, M.D. from Johns Hopkins University authored the new paper on behalf of a group of experts, called the Detroit Expert Panel on the Assessment and Management of the Neuropsychiatric Symptoms of Dementia, who developed the DICE approach. Sponsored by Kales' program, the national multidisciplinary panel of experts met in Michigan to create a comprehensive approach to behavioral management.

Dubbed "DICE" for Describe, Investigate, Evaluate, and Create, it details key patient, caregiver and environmental considerations with each step of the approach and describes the "go-to" behavioral and environmental interventions that should be considered. Briefly described, the components are:

D: Describe - Asking the caregiver, and the patient if possible, to describe the "who, what, when and where" of situations where problem behaviors occur and the physical and social context for them. Caregivers could take notes about the situations that led to behavior issues, to share with health professionals during visits.

I: Investigate – Having the health provider look into all the aspects of the patient's health, dementia symptoms, current medications and sleep habits, that might be combining with physical, social and caregiver-related factors to produce the behavior.

C: Create – Working together, the patient's caregiver and health providers develop a plan to prevent and respond to behavioral issues in the patient, including everything from changing the patient's activities and environment, to educating and supporting the caregiver.

E: Evaluate – Giving the provider responsibility for assessing how well the plan is being followed and how it's working, or what might need to be changed.

The authors say that doctors should prescribe psychotropic drugs only after they and the patient and caregiver have made significant efforts to change dementia patients' behavior through environmental modifications and other interventions, with three exceptions related to severe depression, psychosis or aggression that present risk to the patient or others. Now, the authors say, health providers of all kinds who care for dementia patients should familiarize themselves with the DICE approach – as should the spouses, adult children and others who care for dementia patients at home.

"Innovative approaches are needed to support and train the front-line providers for the burgeoning older population with behavioral symptoms of dementia," says Kales, a professor in the U-M Medical School's Department of Psychiatry and member of the U-M Institute for Healthcare Policy & Innovation. "We believe that the DICE approach offers clinicians an evidence-informed structured clinical reasoning process that can be integrated into diverse practice settings."

Gitlin, who directs the Center for Innovative Care in Aging at the Johns Hopkins School of Nursing, adds, "The DICE approach is inherently patient- and caregiver-centered because the concerns of individuals with dementia and their caregivers are integral to each step of the process. DICE also enables clinicians to consider the roles of nonpharmacologic, medical and pharmacologic treatments concurrently."

Lyketsos, chair of the Department of Psychiatry at Johns Hopkins Bayview, stresses that the approach "has tremendous utility in clinical trials of treatments for behavioral symptoms, particularly in testing new medications. DICE can be used to better subtype behaviors, or focus on particular behaviors at randomization coupled with systematic treatment approaches".

Reference: Journal of the American Geriatrics Society, Volume 62, Issue 4, pp 762-769, April 2014

http://www.eurekalert.org/pub_releases/2014-04/aaon-non041614.php#rssowlmlink

Narrowing of neck artery without warning may signal memory and thinking decline
Narrowing of the carotid artery in the neck without any symptoms may be linked to problems in learning, memory, thinking and decision-making

PHILADELPHIA – For the first time, researchers have demonstrated that narrowing of the carotid artery in the neck without any symptoms may be linked to problems in learning, memory, thinking and decision-making, compared to people with similar risk factors but no narrowing in the neck artery, according to a study released today that will be presented at the American Academy of Neurology's 66th Annual Meeting in Philadelphia, April 26 to May 3, 2014.

"To date, the focus of diagnosis and management of carotid artery blockages has been prevention of stroke since that was the only harm that these blockages were thought to cause to patients," said Brajesh K. Lal, MD, with the VA Maryland Health Care System's Baltimore VA Medical Center and the University of Maryland School of Medicine in Baltimore. "These results underscore the importance of assessing the status of memory and thinking in people with carotid artery narrowing."

Narrowing of arteries occurs when plaques build up in the artery, and they can harm the brain by restricting proper blood flow or by showering little pieces of plaque into the brain.

The study involved 67 people with the condition, called asymptomatic carotid stenosis (ACS), with a 50-percent reduction in the diameter of the artery and 60 people with vascular risk factors but without the condition. Risk factors included diabetes, high blood pressure, high blood cholesterol and coronary artery disease. The participants underwent extensive testing for overall thinking abilities, and for specific aspects of thinking such as: processing speed, learning, memory, decision-making and language.

The study found that the ACS group performed significantly worse on the overall memory and thinking tests. On testing of specific aspects of thinking, they performed worse on tests for motor and processing speed, and learning and memory. Language scores did not differ between the two groups.

"If these findings are confirmed in larger studies, they hold significant implications for new treatment targets and open the door for more questions such as: should these patients be treated more aggressively with medications, cognitive rehabilitation, or even surgery to open up the artery," said Lal. "I anticipate a large number of follow-up studies searching for causes and the best treatment option for this newly identified morbidity associated with carotid narrowing." *The study was supported by the US Department of Veterans Affairs.*

http://www.eurekalert.org/pub_releases/2014-04/yy-tar042114.php#rssowlmlink

Today's Antarctic region once as hot as California, Florida

Parts of ancient Antarctica were as warm as today's California coast, and polar regions of the southern Pacific Ocean registered 21st-century Florida heat, according to scientists using a new way to measure past temperatures.

The findings, published the week of April 21 in the Proceedings of the National Academy of Sciences, underscore the potential for increased warmth at Earth's poles and the associated risk of melting polar ice and rising sea levels, the researchers said. Led by scientists at Yale, the study focused on Antarctica during the Eocene epoch, 40-50 million years ago, a period with high concentrations of atmospheric CO₂ and consequently a greenhouse climate. Today, Antarctica is year-round one of the coldest places on Earth, and the continent's interior is the coldest place, with annual average land temperatures far below zero degrees Fahrenheit.

But it wasn't always that way, and the new measurements can help improve climate models used for predicting future climate, according to co-author Hagit Affek of Yale, associate professor of geology & geophysics.

"Quantifying past temperatures helps us understand the sensitivity of the climate system to greenhouse gases, and especially the amplification of global warming in polar regions," Affek said.

The paper's lead author, Peter M.J. Douglas, performed the research as a graduate student in Affek's Yale laboratory. He is now a postdoctoral scholar at the California Institute of Technology. The research team included paleontologists, geochemists, and a climate physicist.

By measuring concentrations of rare isotopes in ancient fossil shells, the scientists found that temperatures in parts of Antarctica reached as high as 17 degrees Celsius (63F) during the Eocene, with an average of 14 degrees Celsius (57F) - similar to the average annual temperature off the coast of California today.

Eocene temperatures in parts of the southern Pacific Ocean measured 22 degrees Centigrade (or about 72F), researchers said - similar to seawater temperatures near Florida today. Today the average annual South Pacific sea temperature near Antarctica is about 0 degrees Celsius.

These ancient ocean temperatures were not uniformly distributed throughout the Antarctic ocean regions - they were higher on the South Pacific side of Antarctica - and researchers say this finding suggests that ocean currents led to a temperature difference.

"By measuring past temperatures in different parts of Antarctica, this study gives us a clearer perspective of just how warm Antarctica was when the Earth's atmosphere contained much more CO₂ than it does today," said Douglas. "We now know that it was warm across the continent, but also that some parts were considerably warmer than others.

This provides strong evidence that global warming is especially pronounced close to the Earth's poles.

Warming in these regions has significant consequences for climate well beyond the high latitudes due to ocean circulation and melting of polar ice that leads to sea level rise."

To determine the ancient temperatures, the scientists measured the abundance of two rare isotopes bound to each other in fossil bivalve shells collected by co-author Linda Ivany of Syracuse University at Seymour Island, a small island off the northeast side of the Antarctic Peninsula. The concentration of bonds between carbon-13 and oxygen-18 reflect the temperature in which the shells grew, the researchers said. They combined these results with other geo-thermometers and model simulations.

The new measurement technique is called carbonate clumped isotope thermometry. "We managed to combine data from a variety of geochemical techniques on past environmental conditions with climate model simulations to learn something new about how the Earth's climate system works under conditions different from its current state," Affek said. "This combined result provides a fuller picture than either approach could on its own."

The paper is titled "Pronounced zonal heterogeneity in Eocene southern high-latitude sea surface temperatures."

Other co-authors are Alexander J. P. Houben, Willem P. Sijp, Appy Sluijs, Stefan Schouten, and Mark Pagani.

Support for the research was provided by the National Science Foundation, Statoil, and the European Research Council.

<http://arstechnica.com/science/2014/04/venus-crust-heals-too-fast-for-plate-tectonics/#rssowlmlink>

Venus' crust heals too fast for plate tectonics

On Earth, fractures stayed fractured and created plate boundaries.

by Shannon Palus Apr 21 2014, 10:30pm TST

The planet is clearly geologically active, but hasn't developed plate tectonics.

The emergence of plate tectonics is arguably Earth's defining moment, the authors of a new Nature paper write. Out of all the planets we've looked at carefully, Earth is the only one that has a hard outer crust with distinct pieces that shift and move. Our home is unique in its continents and quakes.

Some scientists think that plate tectonics are essential for life - so much so that if they could figure out a way to spot tectonic action on exoplanets, they think it would be a good indication that there might be life there, too.

Tectonic activity recirculates minerals and recycles carbon. As one plate slides under another (a process called subduction), it pushes carbon down into the mantle with it.

Without plate tectonics, carbon would build up in the atmosphere. Venus, which does not have tectonics, shows the results: an atmosphere that is 96 percent carbon dioxide. It's toxic. Yet Venus is about the same size and composition as our planet, so why doesn't it have plate tectonics?

Some researchers made a model to explore how Earth initiated plate movements, and these same researchers made one model of its neighbor for comparison. A 1.5-billion-year-old Earth and a similarly aged Venus were modeled as a hot, mushy material made of tiny particles of rock. The model uses physics at the one-millimeter rock grain scale to explain how the whole planet behaves.

According to David Bercovici, a geophysicist at Yale who was an author on the paper, the model also shows how plate tectonics emerged on Earth but not on her twin.

The mantle moved material around beneath the material, causing it to sink or drip down in some places. This sinking of the mushy pre-plate material is called proto-subduction to contrast it with modern subduction, where one plate meets and slides under another. At this point, you reach the core of the paper: the concept of damage mechanics. This describes what happens once the proto-subduction begins. If a nascent crust starts to bend, does it repair itself or snap into distinct plates?

Dripping causes the grains of rock to get smaller. With heat, these clusters rebuild or heal the crust. The researchers calculated dimensionless damage parameters based on the way the material responded to stress. Earth had a damage parameter of 100. On the other hand, Venus had a mere 10. Similarly, they input two healing numbers, determined from earlier experimental work: Venus has 10, and 10⁻⁴; Earth 1 and 10⁻¹.

In the Earth-crust simulation, the damage accumulated faster than the grains could rebuild into clusters and heal it. By contrast, the Venus model, which was a couple hundred Kelvin hotter, saw damage that tended to heal faster than it accumulated. The tiny grains of minerals were able to accumulate and stick together faster than the mantle caused them to drip and pull apart.

The new model explains why plates may have taken a billion years to form. A plate boundary does not form from one instance of damage - it's the product of several cycles of damage. A weak zone forms, repairs itself a little, and remains in a weakened state for a while. The mantle shifts and puts pressure on other areas, which also become weak. After years (and years and years), a network of weak zones forms.

When the mantle shifts again to put pressure on already weakened areas of the crust, further damage can result in a complete rupture. The process of dormancy and damage accumulation eventually results in distinct plates. The amount of time needed to drive this cycle to completion may be why the plates took so long to form. On Earth, it took place over about one billion years. In that time, Earth went from having a mushy outer shell to one that was broken and moving in distinct pieces.

Venus wasn't able to accumulate damage because its warm, soft crust continually repaired it. Three billion years later, Earth's cracked crust helps make it home to life

Nature, 2014. DOI: 10.1038/nature13072 (About DOIs).

<http://phys.org/news/2014-04-equatorial-ridge-iapetus-exogenic.html#rssowlmlink>

Study of equatorial ridge on Iapetus suggests exogenic origin

A combined team of researchers from Brown University in Rhode Island and the Lunar and Planetary Institute in Texas is suggesting in a paper they've uploaded to the preprint server arXiv, that an equatorial mountainous ridge on one of Saturn's moons has an exogenic origin.

Phys.org - They are basing their theory on 3D models of the moon they've created and an analysis of the types of peaks present.

Iapetus, the 3rd largest of Saturn's approximately 60 moons, is distinct for two reasons. One is its odd two-tone coloring; the other is the back-bone looking mountain range straddling part of its equator. Scientists have been puzzled by the origin of the mountain range as the moon doesn't have other geologic qualities that could have given rise to it, such as shifting plates or volcanic activity.

Thus, some have suggested that the mountains came from above, rather than below, or in other words, they have an exogenic origin, meaning they came from somewhere else.

To gain a better understanding of the mountain range, the research team built a 3D model of it on a computer in their lab, faithfully replicating the 12 mile high by 12 mile wide by 800 miles long range in miniature, using data from the Cassini space probe. Once created, the team set to work measuring the shape of the peaks, which they believed should offer clues as to their origin.

They found that the majority of the peaks sat in what is known as their angle of repose, which is the maximum angle at which material can rest on a peak without falling down to its base. Normal geologic activity tends to create peaks that are shallower and have less uniformity. This suggests, the researchers claim, that the mountains did not form due to geologic activity but more likely are part of a ring of material that once circled the moon and was pulled down to the surface.

A ring around the moon would most likely have come about due to a collision, either between another body and the moon, or two other bodies nearby. The resulting material would have formed a ring around the equator which over time, would have been pulled to the surface by gravity. Such a theory, the team notes, would also explain Iapetus's asymmetrical orbit and also why it orbits with the same face pointing at Saturn all of the time.

More information: Topographic Constraints on the Origin of the Equatorial Ridge on Iapetus, arXiv:1404.2337 [astro-ph.EP] arxiv.org/abs/1404.2337

Abstract

Saturn's moon Iapetus has an equatorial ridge system, which may be as high as 20 km, that may have formed by endogenic forces, such as tectonic and convective forces, or exogenic processes such as debris infall. We use high-resolution topographic data to conduct a topographic analysis of the ridge, which suggests a predominantly triangular morphology, with some ridge face slopes reaching 40 degrees, allowing for an exogenic formation mechanism.

<http://bit.ly/1fzohT8>

Neanderthals Had Shallow Gene Pool, Study Says

Neanderthals were remarkably less genetically diverse than modern humans, with Neanderthal populations typically smaller and more isolated, researchers say.

Apr 21, 2014 02:07 PM ET // by Charles Q. Choi, IEEE Spectrum

Although Neanderthals underwent more genetic changes involving their skeletons, they had fewer such changes in behavior and pigmentation, scientists added. Modern humans are the only humans alive today, but Earth was once home to a variety of other human lineages.

The Neanderthals were once the closest relatives of modern humans, with the common ancestors of modern humans and Neanderthals diverging between 550,000 and 765,000 years ago. Neanderthals and modern humans later interbred - nowadays, about 1.5 to 2.1 percent of DNA of people outside Africa is Neanderthal in origin.

Researchers first sequenced the Neanderthal genome in 2010. "One of the next goals was obviously to begin to explore the variation among Neanderthals," said study author Svante Pääbo, an evolutionary geneticist at the Max Planck Institute for Evolutionary Anthropology in Leipzig, Germany.

Pääbo and his colleagues analyzed three Neanderthal genomes. One came from a 49,000-year-old specimen from Spain; another from a 44,000-year-old specimen from Croatia; and one from a Siberian specimen at least 50,000 years old. "For the first time we begin to get a detailed picture of genetic variation among Neanderthals," Pääbo told Live Science.

The scientists found that Neanderthals "had even less variation than present-day humans, who are already known to have less than chimpanzees and most other apes," Pääbo said. "The amount of genetic diversity in the Neanderthals was about a quarter of that in Africans today, and about a third of that in Europeans or Asians." To pinpoint why Neanderthals might have been less genetically diverse, the researchers focused on 17,367 genes that encoded instructions for generating proteins.

They concentrated on mutations that changed what amino acids went into those proteins. Such mutations have a good chance of altering the structure or function of those proteins.

Although mutations that change the amino acid makeup of proteins can have benefits, more often than not, they have detrimental effects.

One should expect natural selection to weed out these mutations over time, as anyone bearing them is probably less fit and thus not as likely to survive to reproduce.

However, such mutations can accumulate in small, isolated populations, since those groups have fewer normal versions of those genes in their gene pools to replace any mutant genes.

The investigators found Neanderthals carried more copies of mutations that would alter the amino acid makeup of proteins than modern humans possess. This suggests that Neanderthal populations across Eurasia were likely small and isolated.

"Neanderthals seem to have been few in numbers either over a long time or for some periods," Pääbo said.

"There is also an indication that they have been subdivided in populations that had little contact with each other."

The fact that Neanderthals carried more copies of potentially detrimental mutations did not necessarily contribute to their extinction, said lead study author Sergi Castellano, at the Max Planck Institute for Evolutionary Anthropology.

"No claim should be made that this is related to their extinction," Castellano told Live Science.

The researchers also found skeleton genes changed more than expected within the Neanderthal lineage.

"For example, genes that affect the curvature of the spine have changed in Neanderthals," Pääbo said. "This fits with how their skeletons have changed quite drastically during their evolution."

On the other hand, genes involved with pigmentation and behavior changed more in the modern human lineage.

"We do not yet know if and how these very mutations affect behavior," Pääbo said. "Clearly, it will be interesting to study more Neanderthals so that one can begin to reconstruct their history in more detail."

The scientists detailed their findings online today (April 21) in the journal *Proceedings of the National Academy of Sciences*.

<http://arstechnica.com/science/2014/04/using-radioactive-krypton-to-find-ancient-glacial-ice/#rssowlmlink>

Using radioactive krypton to find ancient glacial ice

Not kryptonite in the Fortress of Solitude - the noble gas trapped in air bubbles.

by Scott K. Johnson - Apr 22 2014, 4:00am TST

There's a reason that one ice core drilled from the Greenland Ice Sheet has been referred to as The Two-Mile Time Machine - the annual layers of snow (compressed to ice) provide remarkable records of Earth's climate and atmosphere.

Studying past changes in atmospheric gases is just so much easier when you can pluck a bubble of air dutifully archived by the ice, which acts like a relative with an inconveniently large collection of National Geographics. The only problem with the "Two-Mile Time Machine" is that it's only two miles long. Ice cores in Greenland can only go back about 130,000 years, and the oldest (so far) core from Antarctica goes back about 800,000 years.

If we could go a little further back in time, about 1.2 million years ago, we'd be able to examine a terribly interesting climatic transition. Prior to that time, glacial cycles were roughly 40,000 years long; after, we've experienced 100,000 year ones. We can study that period with some ocean sediment cores, but they can't provide the same detail.

There could, however, be Antarctic ice still around from that particular interval of antiquity. The hard part is finding it, which requires recognizing it. Now, some researchers in Oregon State have used radioactive krypton to figure out the age of ice, a technique that may help us spot older samples.

The age of ice

Most ice cores are drilled at high points in the ice sheets, called “domes.” The ice is piled thick here, and just as importantly, it isn’t contorted by flow. When it’s thick enough, ice spreads under its own weight, a bit like pancake batter, but there’s actually no lateral flow right at the center.

But the lack of distortion doesn’t mean that the record is easy to read deep into the core. The closer to the bottom of the ice sheet you get, the more the ice is compressed. While layers can simply be counted down to a considerable depth, they soon become less visible and identification gets more complicated.

This job would be easier if there were another way of measuring age. If you’re lucky enough to find a layer of volcanic ash in the ice, it can be dated, but there are only so many eruptions that spread ash to the poles. There have been attempts to apply radiometric dating using other things that can be found in the ice - like carbon-14, uranium-238, and argon-40 - but all suffer from large error bars or confounding complications.

The noble gas krypton presents another possibility. One unstable isotope, krypton-81, is produced by collisions between cosmic rays and other isotopes of krypton in the atmosphere. Its half-life is 229,000 years, meaning it can be used to date air samples as old as 1.5 million years. The problem is that it’s only present in very small amounts, meaning you need a lot of air to make an accurate measurement. The amount of ice in a core won’t cut it.

Cores aren’t the only way to get old ice, though. There are also areas, especially at the end of the glacier, where flow brings old ice to the surface. In these places, you can essentially walk to the “Two-Mile Time Machine,” climbing older layers up to younger ones. But while you can tell their relative ages, it’s hard to tell how old they are relative to the present.

Without being able to clearly count back from the present day like you can in an ice core, figuring out the age of that ice is trickier - especially as the layers have been disturbed by flow.

In order to do that, scientists have had to compare the measurements used as climate records to the well-dated ice cores. It’s a bit like taking an unlabeled week of Google’s stock prices and comparing it to the full chart to figure out which week you have.

A team led by Oregon State University researcher Christo Buizert tested the usefulness of krypton dating in that situation.

They collected ice from the end of Taylor Glacier in Antarctica’s McMurdo Dry Valleys, just a short helicopter ride from McMurdo Station. Samples - about 350 kilograms apiece - were collected a few meters below the surface at four locations on the ice.

The samples were first dated using the standard method - comparison to nearby ice cores. The researchers then very carefully measured the isotopes of krypton trapped in the ice.

The oldest sample was dated in the standard way at 123,500 ±4,200 years old. The error bars on the krypton dates are pretty large, but the technique yielded an accurate age of 120,000 ±26,000 years. The other three samples had matching ages within the error as well.

Those results are good enough to be of use in finding Antarctic ice older than existing cores. They could also come in handy for other investigations that take advantage of exposed ice, like isotope analyses of low-concentration gases that require large samples.

Age isn’t just a number

Aside from the interests of scientific research, these techniques also demonstrate how much robust evidence we have against notions that the Earth is only a few thousand years old. The annual layers of ice cores, better than tree rings, can show how completely incompatible this idea is with reality. Nevertheless, proponents of a young Earth frequently attack the reliability of the radiometric dating techniques that allow us to put exact numbers on geologic history.

Multiple radiometric dating methods provide numbers consistent with the simple layer counting of glacial ice - and even the calculations of the cycles in Earth’s orbit that drove the ice ages. It’s not just that one of the methods is reliable; it’s that all the evidence hangs together.

The lower layers of ice at Taylor Glacier are clearly more than a few thousand years old - and now we have yet another method that can show us that fact.

PNAS, 2014. DOI: 10.1073/pnas.1320329111 (About DOIs).

<http://bit.ly/TiVsSDz>

Humans May Have Dispersed Out of Africa Earlier Than Thought

Modern humans may have dispersed in more than one wave of migration out of Africa, and they may have done so earlier than scientists had long thought, researchers now say.

By Charles Q. Choi, Live Science Contributor | April 21, 2014 03:37pm ET

Modern humans first arose between 100,000 and 200,000 years ago in Africa. But when and how the modern human lineage then dispersed out of Africa has long been controversial. Scientists have suggested the exodus from Africa started between 40,000 and 70,000 years ago. However, stone artifacts dating to at least 100,000 years ago that were recently uncovered in the Arabian Desert suggested that modern humans might have begun their march across the globe earlier than once suspected.

Out of Africa models

To help solve this mystery, Katerina Harvati, a paleoanthropologist at the University of Tübingen in Germany, and her colleagues tested four competing out-of-Africa models. Two models involved a single dispersal - one involved a route northward, up the Nile River valley and then eastward across the northern end of the Arabian Peninsula into Asia; the other involved a "beachcomber" route along the southern coast of the Arabian Peninsula into Asia. Two other models involved multiple dispersals, with both models involving routes along the northern and southern ends of the Arabian Peninsula - one involved connections and gene flow between these routes, and the other did not.

The investigators used these models to predict how much the genes and skull measurements of different groups in Africa, Asia and Australia might have diverged from one another given how separated they were by space and time. Then, the researchers compared these predictions with actual gene and skull data from 10 African, Asian and Australian human populations. The researchers found that both the genetic and skull data supported a multiple-dispersal model involving several migrations. "It is really exciting that our results point to the possibility of a multiple-dispersals model of modern humans out of Africa," Harvati said. "A multiple-dispersals scenario, with earlier modern humans leaving Africa as early as 130,000 before present, can perhaps account for part of the morphological and genetic patterns that we see among modern human populations."

The first wave of migrations probably followed the southern coast of the Arabian Peninsula as early as 130,000 years ago to Australia and the west Pacific region, while the second wave traveled along the northern route about 50,000 years ago, the researchers said. These waves of migration appear relatively isolated from each other. "Australian Aborigines, Papuans and Melanesians were relatively isolated after the early dispersal along the southern route," study lead author Hugo Reyes-Centeno, of the University of Tübingen, said in a statement. Other Asian populations apparently descended from members of the later northern wave of migration, the researchers said. The delay between these waves of migration could be due to ancient environmental factors, "specifically climatic conditions that might have impeded the crossing of the Arabian Peninsula, such as desert conditions," Harvati said.

Ancient environmental factors might not only have prevented migrations, but also spurred them, Harvati said. "For example, the documentation of severe droughts throughout eastern Africa between about 75,000 to 135,000 years ago could have encouraged a dispersal into other parts of Africa as well as outside of the continent," Harvati said. "More favorable conditions within Africa could have limited migrations out of the continent between 75,000 to 50,000 years ago."

Effects of interbreeding

The researchers cautioned that interbreeding between modern humans and other lineages of humans might influence the results of this new study. For example, instances of interbreeding with the now-extinct Denisovan lineage might have introduced ancient genes into certain modern human groups, perhaps making them look as if they left Africa earlier than they actually did. "Our study did not specifically test for hybridization with archaic humans, and, of course, it is possible that such admixture could contribute to our results," Harvati said. "We feel, however, that the very low levels of admixture that have been proposed are not sufficient to drive our findings."

The researchers said continued fieldwork and genetic advancements might help confirm this model of multiple, relatively isolated waves of migration. "The story of human evolution tends to be simplified," Harvati said. "However, more complex models, such as multiple dispersals versus a single dispersal out of Africa, gain strength as more data and new methods become available." "Further fieldwork in the region of the southern route - for example, the Arabian Peninsula, southeast Asia, Melanesia - is essential in order to further understand the timing and route of early modern human dispersals," Harvati said. "Of course, this is a vast geographical space that has been largely understudied, but it is crucial in developing our knowledge of the first Eurasians."

The scientists detailed their findings online April 21 in the journal *Proceedings of the National Academy of Sciences*.

<http://phys.org/news/2014-04-low-cost-3d-daily-video.html#rssowlmlink>

Low-cost 3D printed hand suits man for daily needs (w/ video)

Jose Delgado, Jr., a 53-year-old man born without most of his left hand, has given positive feedback about a \$50 3D prosthetic hand.

Phys.org - He talked about all it can help him do in a video that was presented by the person who helped make the hand. Delgado's account, praising the hand for enabling good day to day functionality, made the rounds of tech sites this week.

The story drew interest not only because this is a 3D-printed prosthesis but also because he said that, in a number of ways, he liked it better than his \$42K myoelectric prosthesis. (A myoelectric-controlled prosthesis is an artificial limb that you control with the electrical signals generated naturally by your own muscles.)

Delgado's myoelectric hand tapped into muscle signals on his arm to trigger the closing or opening of the fingers.

The story involves Jeremy Simon, founding partner at 3D Universe. Delgado asked if Simon could help make a 3D printed prosthesis for him. Simon worked with Delgado in developing a suitable 3D-printed hand. "Jose found his way to me and asked if I could help make a 3D printed prosthesis for him."

The total cost of materials for a 3D printed e-NABLE Hand, a mechanical design, was about \$50. Acrylonitrile Butadiene Styrene (ABS) plastic, a common printing material, was used. This device design is referred to as the Cyborg Beast model.

Delgado and Simon got together again for some "fine-tuning," said Simon, of the tension on the tendon cords. These are fundamental to how the 3D printed device operates, as they are a series of non-flexible cords running along the underside of each finger, connecting to a tensioning block on the top rear of the device, the "gauntlet". Tension is caused by bending the wrist downward. With the wrist in its natural resting position, the fingers are extended, with a natural inward curve. When the wrist is bent 20 to 30 degrees downward, the non-flexible cords are pulled, causing fingers and thumb to bend inwards.

A second series of flexible cords run along the tops of the fingers, causing the fingers to return automatically when tension is released.

When asked what he liked about the hand, Delgado said the 3D rendition enabled more fingers to function, and he liked the way the hand supported the gripping function of the steering wheel. He also was pleased with the way his prosthetic hand worked in gripping handles on grocery bags.

Simon said Delgado's feedback provided a unique perspective, as Delgado has been using multiple types of prosthetic devices including the myoelectric hand, for years.

It generally has been acknowledged in prosthetic design that recreating a human hand's functions is a technical challenge. The human hand is one of the body's more complex parts, with its muscles, nerves, tendons and bones. Nor can the 3D printed hand and the far costlier prosthetic device be considered an either-or proposition. "Since the prosthetic devices Jose has used are completely different types, his statements do not represent an apples to apples comparison. The comparison here is simply in terms of how useful Jose has found each device to be on a day-to-day basis."

Delgado works in an environment that involves a lot of box-lifting and moving. Simon had anticipated that the Cyborg Beast's ABS plastic might not hold up for long. "To my surprise, however," said Simon, "Jose says it's been doing very well."

Nonetheless, Simon said next on his to do list for Delgado will be printing another e-NABLE hand but using a Bridge nylon material. Simon said the Bridge nylon has enhanced strength properties while remaining lightweight. "I'll also provide him with an alternate thumb mount to enable a different kind of grip."

More information: www.3duniverse.org/2014/04/19/jose-delgado-jr-compares-his-new-3d-printed-hand-to-his-more-expensive-myoelectric-prosthesis/

http://www.eurekalert.org/pub_releases/2014-04/thuo-wgu042214.php#rssowlmlink

What gave us the advantage over extinct types of humans?

The answer lies in changes in the way our genes work

Jerusalem - In parallel with modern man (Homo sapiens), there were other, extinct types of humans with whom we lived side by side, such as Neanderthals and the recently discovered Denisovans of Siberia. Yet only Homo sapiens survived. What was it in our genetic makeup that gave us the advantage?

The truth is that little is known about our unique genetic makeup as distinguished from our archaic cousins, and how it contributed to the fact that we are the only species among them to survive. Even less is known about our unique epigenetic makeup, but it is exactly such epigenetic changes that may have shaped our own species.

While genetics deals with the DNA sequence itself and the heritable changes in the DNA (mutations), epigenetics deals with heritable traits that are not caused by mutations.

Rather, chemical modifications to the DNA can efficiently turn genes on and off without changing the sequence. This epigenetic regulatory layer controls where, when and how genes are activated, and is believed to be behind many of the differences between human groups.

Indeed, many epigenetic changes distinguish us from the Neanderthal and the Denisovan, researchers at the Hebrew University of Jerusalem and Europe have now shown.

In an article just published in Science, Dr. Liran Carmel, Prof. Eran Meshorer and David Gokhman of the Alexander Silberman Institute of Life sciences at the Hebrew University, along with scientists from Germany and Spain, have reconstructed, for the first time, the epigenome of the Neanderthal and the Denisovan.

Then, by comparing this ancient epigenome with that of modern humans, they identified genes whose activity had changed only in our own species during our most recent evolution.

Among those genetic pattern changes, many are expressed in brain development.

Numerous changes were also observed in the immune and cardiovascular systems, whereas the digestive system remained relatively unchanged.

On the negative side, the researchers found that many of the genes whose activity is unique to modern humans are linked to diseases like Alzheimer's disease, autism and schizophrenia, suggesting that these recent changes in our brain may underlie some of the psychiatric disorders that are so common in humans today.

By reconstructing how genes were regulated in the Neanderthal and the Denisovan, the researchers provide the first insight into the evolution of gene regulation along the human lineage and open a window to a new field that allows the studying of gene regulation in species that went extinct hundreds of thousands of years ago.

<http://bit.ly/lilgp06>

Eye-Opener: Naps Linked with Higher Risk of Death

Middle-age and older adults who take daytime naps may be at increased risk of dying, a new study from England suggests.

Apr 22, 2014 06:40 PM ET // by Rachael Rettner, LiveScience

In the study, people ages 40 to 79 who napped daily, for less than an hour, were 14 percent more likely to die over a 13-year period, compared to those who did not nap. Longer naps were linked with a higher risk: people whose daily naps lasted an hour or more were 32 percent more likely to die over the study period.

The findings held even after the researchers took into account many factors that could affect people's risk of death, such as their age, gender, body mass index (BMI), whether they smoked, how much they exercised, and whether they had certain pre-existing medical conditions (such as diabetes, cancer or asthma).

In particular, naps were linked with an increased risk of dying from respiratory diseases. And the link between napping and risk of dying was highest among the younger people in the study, those between ages 40 and 65, who were nearly twice as likely to die during the study period if they napped for an hour or more, compared to those who did not nap.

The reason for the link is not known. It may not be napping per se that's unhealthy, but rather, that those who tend to nap also have undiagnosed medical conditions that affect their risk of dying, the researchers said.

"Further studies are needed before any recommendations can be made," the researchers, from the University of Cambridge, wrote in the May issue of the American Journal of Epidemiology.

"Excessive daytime napping might be a useful marker of underlying health risks, particularly respiratory problems, especially among those 65 years of age or younger," they said.

The study involved more than 16,000 people in England (where napping is not a cultural norm) who answered questions about their napping habits between 1998 and 2000, and were followed for 13 years.

Some studies have suggested that "power naps" of less than 30 minutes can be beneficial, but the new study could not specifically look at the effect of power naps, because it asked participants only whether their naps lasted more or less than an hour.

Sleep apnea, or frequent pauses in breathing during sleep, can make people sleepy during the day, and is also linked with an increased risk of dying over a given period.

The new study could not directly take into account whether people had sleep apnea, but people who had a high BMI and took medications for high blood pressure were considered likely to have sleep apnea, the researchers said.

Future studies should more precisely measure sleep apnea, and should investigate whether daily naps are linked with physiological changes that might be harmful, the researchers said.

http://www.eurekalert.org/pub_releases/2014-04/uov-rut042314.php#rssowlmlink

Ravens understand the relations among others

Like many social mammals, ravens form different types of social relationships – they may be friends, kin, or partners and they also form strict dominance relations.

From a cognitive perspective, understanding one's own relationships to others is a key ability in daily social life ("knowing who is nice or not"). Yet, understanding also the relationships group members have with each other sets the stage for "political" maneuvers ("knowing who might support whom"). The results of this study have been published in the scientific journal Nature Communications.

A team of researchers led by Thomas Bugnyar of the Department of Cognitive Biology at the University of Vienna, set out to test third-party knowledge in captive groups of ravens. Using a playback design, they let individuals hear a dominance interaction between two other ravens. These interactions were either in accordance with the existing dominance hierarchy in that group or they reflected a possible rank reversal, whereby a low-ranking individual was showing off to a higher-ranking bird. In the latter case, the ravens reacted strongly with information seeking and stress-related behaviors, such as head turns and body shakes, suggesting that their expectations about how the dominance relations among others should look like were violated. Similar to primates, ravens thus keep track of the rank relations of their group members.

Importantly, the researchers found that the ravens not only responded to simulated rank reversals in their own group but also to those in the neighboring group. These findings suggest that ravens can deduce others' rank relations just by watching them. Moreover, it is the first time that animals are shown to be capable of tracking rank relations among individuals that do not belong to their own social group.

Lead-author Jorg Massen underlines the importance of this latter finding by referring to an example from the popular television series "The Sopranos": "When Tony Blundetto made fun about Tony Soprano, as spectators of the show, we immediately recognized that this was inappropriate with regard to the dominance order within the Soprano family. As we are not part of the Soprano family, we make this inference not by comparing our own rank relation with the two Tony's with each other, but instead we have a mental representation of the rank relation of the two that gets violated in the turn of these events", and: "As the birds in our experiment never had any physical contact with their neighboring group and could only see and hear them, these results suggest that ravens also have mental representations about others", ends Massen.

Publication in Nature Communications:

Massen, J.J.M., Pašukonis, A., Schmidt, J. & Bugnyar, T. (2014). Ravens notice dominance reversals among conspecifics within and outside their social group. *Nature Communications*, 5: 3679. Published online April 22, 2014.

<http://dx.doi.org/10.1038/ncomms4679>

http://www.eurekalert.org/pub_releases/2014-04/cshl-hog041814.php#rssowlmlink

Hundreds of genetic mutations found in healthy blood of a supercentenarian

Genetic mutations are commonly studied because of links to diseases such as cancer; however, little is known about mutations occurring in healthy individuals.

In a study published online in Genome Research, researchers detected over 400 mutations in healthy blood cells of a 115-year-old woman, suggesting that lesions at these sites are largely harmless over the course of a lifetime. Our blood is continually replenished by hematopoietic stem cells that reside in the bone marrow and divide to generate different types of blood cells, including white blood cells. Cell division, however, is error-prone, and more frequently dividing cells, including the blood, are more likely to accumulate genetic mutations. Hundreds of mutations have been found in patients with blood cancers such as acute myeloid leukemia (AML), but it is unclear whether healthy white blood cells also harbor mutations.

In this new study, the authors used whole genome sequencing of white blood cells from a supercentenarian woman to determine if, over a long lifetime, mutations accumulate in healthy white blood cells. The scientists identified over 400 mutations in the white blood cells that were not found in her brain, which rarely undergoes cell division after birth. These mutations, known as somatic mutations because they are not passed on to offspring, appear to be tolerated by the body and do not lead to disease. The mutations reside primarily in non-coding regions of the genome not previously associated with disease, and include sites that are especially mutation-prone such as methylated cytosine DNA bases and solvent-accessible stretches of DNA.

By examining the fraction of the white blood cells containing the mutations, the authors made a major discovery that may hint at the limits of human longevity. "To our great surprise we found that, at the time of her death, the peripheral blood was derived from only two active hematopoietic stem cells (in contrast to an estimated 1,300 simultaneously active stem cells), which were related to each other," said lead author of the study, Dr. Henne Holstege.

The authors also examined the length of the telomeres, or repetitive sequences at the ends of chromosomes that protects them from degradation. After birth, telomeres progressively shorten with each cell division. The white blood cell telomeres were extremely short – times shorter than telomeres in the brain. "Because these blood cells had extremely short telomeres, we speculate that most hematopoietic stem cells may have died from 'stem cell exhaustion,' reaching the upper limit of stem cell divisions," said Holstege. Whether stem cell exhaustion is likely to be a cause of death at extreme ages needs to be determined in future studies.

The white blood cells in this study were donated by a supercentenarian woman, who at the time of her death in 2005, was the oldest person in the world, and likely the oldest person ever to donate her body to science.

Scientists from VU University Medical Center, Delft University of Technology, Scripps Translational Science Institute, Life Technologies, University of California San Francisco, Leiden University, and University of Queensland contributed to this study.

This work was supported by funding from the National Institutes of Health, Life Technologies, and a Scripps Health Dickinson fellowship.

*The manuscript will be published online ahead of print on 23 April 2014. Its full citation is as follows: Holstege H, Pfeiffer W, Sie D, Hulsman M, Nicholas TJ, Lee CC, Ross T, Lin J, Miller MA, Ylstra B, Meijers-Heijboer H, Brugman MH, Staal FJT, Holstege G, Reinders MJT, Harkins TT, Levy S, Sistermans EA. 2014. Somatic mutations found in the healthy blood compartment of a 115-year-old woman demonstrate oligoclonal hematopoiesis. *Genome Res* doi: 10.1101/gr.162131.113*

http://www.eurekalert.org/pub_releases/2014-04/iu-sic042314.php#rsslwmlink

Study: Iron consumption can increase risk for heart disease

A new study from the Indiana University School of Public Health-Bloomington has bolstered the link between red meat consumption and heart disease by finding a strong association between heme iron, found only in meat, and potentially deadly coronary heart disease.

The study found that heme iron consumption increased the risk for coronary heart disease by 57 percent, while no association was found between nonheme iron, which is in plant and other non-meat sources, and coronary heart disease.

The study was published online ahead of print in the *Journal of Nutrition*. Along with first author Jacob Hunnicutt, a graduate student in the school's Department of Epidemiology and Biostatistics, the study's co-authors are Ka He and Pengcheng Xun, faculty members in the department.

Hunnicutt said the link between iron intake, body iron stores and coronary heart disease has been debated for decades by researchers, with epidemiological studies providing inconsistent findings. The new IU research, a meta-analysis, examined 21 previously published studies and data involving 292,454 participants during an average 10.2 years of follow-up.

The new study is unique because it looks at the associations of total iron consumption as well as heme and nonheme iron intake in comparison to the risk of coronary heart disease. The only positive association involved the intake of heme iron. The body treats the two kinds of iron differently. It can better control absorption of iron from vegetable sources, including iron supplements, but not so with iron from meat sources.

"The observed positive association between heme iron and risk of CHD may be explained by the high bioavailability of heme iron and its role as the primary source of iron in iron-replete participants," the researchers wrote in the journal article. "Heme iron is absorbed at a much greater rate in comparison to nonheme iron (37 percent vs. 5 percent). Once absorbed, it may contribute as a catalyst in the oxidation of LDLs, causing tissue-damaging inflammation, which is a potential risk factor for CHD."

Iron stores in the body increase over time. The only way to reduce iron in the body is by bleeding, donating blood or menstruation. Some dietary choices, such as coffee and tea, also can inhibit iron absorption.

http://www.eurekalert.org/pub_releases/2014-04/acs-ilt042314.php#rsslwmlink

In lab tests, the antimicrobial ingredient triclosan spurs growth of breast cancer cells

Some manufacturers are turning away from using triclosan as an antimicrobial ingredient in soaps, toothpastes and other products over health concerns.

And now scientists are reporting new evidence that appears to support these worries. Their study, published in the ACS journal *Chemical Research in Toxicology*, found that triclosan, as well as another commercial substance called octylphenol, promoted the growth of human breast cancer cells in lab dishes and breast cancer tumors in mice.

Kyung-Chul Choi and colleagues note that hormonal imbalances seem to play a role in the development of breast cancer. Given that link, researchers are investigating whether endocrine-disrupting chemicals (EDCs), which are compounds that act like hormones, might spur cancer cell growth. EDCs have become ubiquitous in products, in the environment and even in our bodies. Research has found that two EDCs - triclosan, an antimicrobial ingredient in many products, including soaps, cosmetics and cutting boards; and octylphenol,

which is in some paints, pesticides and plastics - have accumulated in the environment. Additionally, triclosan is reportedly in the urine of an estimated 75 percent of Americans. Choi's team wanted to see what effect the two compounds have on breast cancer cells.

In tests on human breast cancer cells and in special immunodeficient mice with tissue grafts, the scientists found that both agents interfered with genes involved with breast cancer cell growth, resulting in more cancer cells. Mice that were exposed to the two compounds had larger and denser breast cancer tumors than the control group.

"Although the doses of EDCs were somewhat high, we did this to simulate their effects of daily exposure, as well as body accumulation due to long-term exposure, simultaneously in animal experiments," said Choi. "Thus, exposure to EDCs may significantly increase the risk of breast cancer development and adversely affect human health," the researchers state in the paper.

The authors cite funding from the National Research Foundation of Korea and the Rural Development Administration of Korea.

http://www.eurekalert.org/pub_releases/2014-04/siob-mof042314.php#rssowlmlink

Male or female?

The first sex determining genes appeared in mammals some 180 million years ago

Man or woman? Male or female? In humans and other mammals, the difference between sexes depends on one single element of the genome: the Y chromosome. It is present only in males, where the two sexual chromosomes are X and Y, whereas women have two X chromosomes. Thus, the Y is ultimately responsible for all the morphological and physiological differences between males and females.

But this has not always been the case. A very long time ago, the X and Y were identical, until the Y started to differentiate from the X in males. It then progressively shrank to such an extent that, nowadays, it only contains about 20 genes (the X carries more than one thousand genes). When did the Y originate and which genes have been kept? The answer has just been brought to light by the team of Henrik Kaessmann, Associate Professor at the CIG (UNIL) and group leader at the SIB Swiss Institute of Bioinformatics, and their collaborators in Australia. They have established that the first "sex genes" appeared concomitantly in mammals around 180 million years ago.

4,3 billion genetic sequences

By studying samples from several male tissues – in particular testicles – from different species, the researchers recovered the Y chromosome genes from the three major mammalian lineages: placentals (which include humans, apes, rodents and elephants), marsupials (such as opossums and kangaroos) and monotremes (egg-laying mammals, such as the platypus and the echidna, a kind of Australian porcupine). In total, the researchers worked with samples from 15 different mammals, representing these three lineages, as well as the chicken, which they included for comparison.

Instead of sequencing all Y chromosomes, which would have been a "colossal task" according to Diego Cortez, researcher at CIG and SIB and main author of the study, the scientists "opted for a shortcut". By comparing genetic sequences from male and female tissues, they eliminated all sequences common to both sexes in order to keep only those sequences corresponding to the Y chromosome. By doing so, they established the largest gene atlas of this "male" chromosome to date.

This study required more than 29,500 computing hours! A gigantic task, which could not have been performed without important technical means: the high-throughput DNA sequencers of the genomics platform at the Center for Integrative Genomics, for the generation of the genetic sequences, and the calculation means of Vital-IT, SIB's high-performance computing centre, for the biological analyses.

Two independent sex-determining genes

The study shows that the same sex-determining gene, named SRY, in placentals and marsupials had formed in the common ancestor of both lineages around 180 million years ago. Another gene, AMHY, is responsible for the emergence of Y chromosomes in monotremes and appeared some 175 million years ago. Both genes, which according to Henrik Kaessmann are "involved in testicular development", have thus emerged "nearly at the same time but in a totally independent way".

The nature of the sex-determination system present in the common ancestor of all mammals remains unclear, given that mammalian Y chromosomes did not yet exist at that time - at least not those discovered in this study. So what triggered back then that an individual was born male or female? Was this determination linked to other sex chromosomes, or even environmental factors such as the temperature? The latter is not an unreasonable scenario, given that temperature determines sex in present-day crocodiles. As far as mammals are concerned, "the question remains open", concludes Diego Cortez.

http://www.eurekalert.org/pub_releases/2014-04/msu-ndh042314.php#rssowlmlink

New discovery helps solve mystery source of African lava

Floods of molten lava may sound like the stuff of apocalyptic theorists, but history is littered with evidence of such past events where vast lava outpourings originating deep in the Earth accompany the breakup of continents.

EAST LANSING, Mich. - New research at Michigan State University shows that the source of some of these epic outpourings, however, may not be as deep as once thought. The results, published in the Journal Geology, show that some of these lavas originated near the surface rather than deep within the mantle.

When geoscientists want to learn more about massive lava flows – the kind that accompany continental rifting and continent break up – they conduct field studies of the African tectonic plate. Here, the Great Rift Valley of East Africa provides a snapshot of how a continent can be torn apart. Armed with new technology, scientists can better translate the story that is stored in the rift's fossilized lava flows. What they learn is applicable to continental breakup around the globe, said Tyrone Rooney, MSU geologist.

"For decades, there's been a big debate as to where the lavas from this massive outpouring came from," he said. "Did they emit from deep within the Earth? Or was there some contribution from shallower sources? Our paper shows that some lavas came from within the African tectonic plate itself."

To clarify, many nonscientists think of big eruptions in terms of Mount St. Helens or Vesuvius. These were mere drops in a bucket compared to what Rooney and his colleagues are studying. The ancient African outpouring is estimated to have poured out 350,000 cubic kilometers of lava about 30 million years ago. That's comparable to twice the amount of water in all the world's lakes, Rooney explained.

While much of this lava is probably derived from deep sources, Rooney's team found that some parts of the tectonic plate also have melted to form an unusual group of lavas in Ethiopia. The researchers showed that the rocks, artifacts from the ancient outpouring, had chemical signatures of materials found in the lithosphere and were distinctly different from most of the other rocks in Ethiopia.

Rooney and his team were able to confirm their findings because, in part, of having access to tools that their predecessors merely imagined. The new approaches are allowing them to challenge long-standing theories in their field. For example, mass spectrometers are employed to reveal the rocks' chemical signatures. By identifying the lavas' elemental characteristics, the scientists can trace their origin to the surface or from deep in the mantle. Using lasers, scientists can transform rock into a fine mist and measure its composition.

In a surprise finding, the team's lab experiments revealed that the Ethiopian samples matched rocks collected from other distant regions. The lavas in Arabia, Jordan, Egypt and Sudan are similar, which means that some of the ingredients that supply the massive outpourings, or basalt floods, have a shallow source that is tapped as the continents split apart. Indeed the seeds of the lithosphere's own destruction maybe contained within it, Rooney said.

"We're interested in this because these massive outpourings happen around the same time continents break apart, create new oceans and affect the planet and the environment on a global scale," he said. "So knowing the source of the lava gives us insights into a process that we still know little about."

Rooney's research laid the groundwork for a National Science Foundation grant that will allow him to continue to unlock the secrets of tectonic forces and continental rifting.

<http://bit.ly/1hyoTZ1>

Protein that shrinks depressed brains identified

Could preventing the brain shrinkage associated with depression be as simple as blocking a protein?

12:13 23 April 2014 by Michael Slezak

Post-mortem analysis of brain tissue has shown that the dendrites that relay messages between neurons are more shrivelled in people with severe depression than in people without the condition. This atrophy could be behind some of the symptoms of depression, such as the inability to feel pleasure. As a result, drugs that help repair the neuronal connections, like ketamine, are under investigation.

But how this shrinkage occurs has remained a mystery, limiting researchers' ability to find ways of stopping it. Ronald Duman at Yale University wondered whether a protein called REDD1, which was recently shown to reduce myelin, the fatty material that protects neurons, was the key. To find out, his team bred rats unable to produce REDD1 and exposed them to a prolonged period of unpredictable stress. In normal rats, this stress resulted in depressive-like behaviour and brain shrinkage, but Duman's rats were unaffected.

Stressed-out rats

In contrast, rats engineered to overproduce REDD1 became depressed and had brain shrinkage, even without being stressed. What's more, injecting normal rats with a stress hormone boosted levels of REDD1 in the brain.

Giving them a drug that blocked the production of stress hormones stopped them producing the protein, even when they were externally stressed.

Taken together, the experiments show that REDD1 is necessary to produce the brain shrinkage seen in stressed rats, and that stress hormones are involved in its production – offering a possible way to prevent the shrinkage. Finally, Duman's team looked for the protein in post-mortem brain tissue from people who had depression and those who didn't. They found that those who had depression had more REDD1 than those who didn't.

Ketamine boost

Duman thinks that REDD1 causes brain shrinkage by inhibiting the production of another protein called mTORC1. mTORC1 enables the production of a substance that brain cells use to repair themselves. Earlier work by the group showed that ketamine boosted the levels of mTORC1, providing one explanation for its antidepressant affects.

But if REDD1 is behind the reduction in mTORC1, targeting it directly could be a good treatment strategy, says Duman. "Acute stress is a normal part of life, and you bounce back and that's fine," says Colleen Loo at the University of New South Wales in Sydney, Australia, who is studying ketamine as a treatment for depression.

"But the longer you're depressed the more likely you are to have shrinkage in the brain. This study is teasing out what are the molecular pathways by which stress translates to shrinkage of brain cells."

"But knowing the complexity of humans, it doesn't mean this is the whole story," says Loo.

Journal reference: *Nature Medicine*, doi.org/sc9

<http://www.nature.com/news/chile-quake-defies-expectations-1.15092>

Chile quake defies expectations

Smaller-than-expected tremor has scientists scrambling to redefine rules for areas of extreme seismic stress.

Alexandra Witze

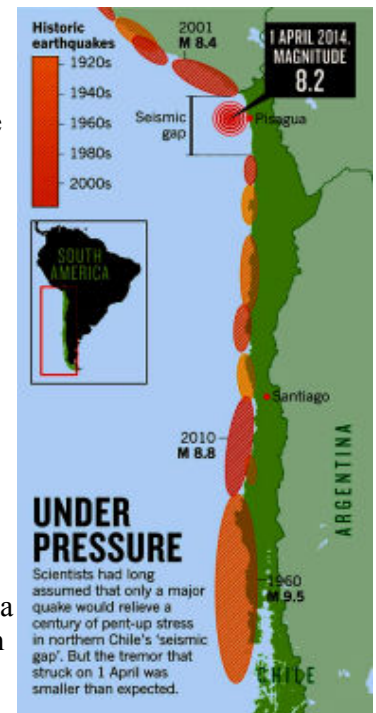
Monika Sobiesiak wasn't expecting the morning of 2 April to start with such an adrenaline jolt. But as she scrolled through a list of earthquakes on her mobile phone, she saw that overnight a series of quakes had rocked the coast of northern Chile - almost exactly where she had installed a seismometer network a few years earlier.

"I saw the 8.2," says the geophysicist, who works at the University of Kiel in Germany, "and I rushed to get to my desk."

That 1 April quake, which struck offshore near the village of Pisagua, was the largest in Chile since a magnitude-8.8 quake hit farther south in 2010. Although the Pisagua quake was not as big and not particularly damaging, it will still go down in the annals of seismology - as an intensively studied earthquake that upends some assumptions about how and when big quakes happen.

In one sense, seismologists knew it was coming. Northern Chile, near the border with Peru, was the only stretch of the country's coastline that had not broken in a large earthquake in the past century (see 'Under pressure'). In 2006, expecting it to go, a German-French-Chilean collaboration blanketed the region with seismometers, tiltmeters and other ground-measuring instruments, creating the Integrated Plate boundary Observatory Chile (IPOC). It captured the Pisagua quake in action, as did Sobiesiak's network.

But the earthquake was not the 'Big One' that seismologists had expected. Only a monstrous earthquake, of around magnitude 9, would have relieved all the geological stress built up in the region. More quakes, on the order of magnitude 8, are still possible, but when they might strike is a mystery. More broadly, the Pisagua event has seismologists rethinking some basic ideas about the risk of earthquakes in similar geological settings elsewhere - places with deep-diving crustal plates, such as Japan and Indonesia.



Source: R. Pritchard & R. Allmendinger, Cornell Univ.

Over time, earthquakes rupture particular portions of a long fault zone; the unbroken portions are 'seismic gaps' considered ripe for future quakes. Officials in these areas are often told to prepare for the worst-case scenario - the biggest possible earthquake in a given seismic gap. But the Pisagua quake shows that this does not always happen, says Susan Beck, a seismologist at the University of Arizona in Tucson. Instead, it underscores that seismic gaps can rupture in all sorts of ways, from lots of smaller quakes to just a few big ones.

Chile is an ideal laboratory in which to study such questions because it lies on the margin of a subduction zone, where the Nazca tectonic plate dives - or subducts - beneath the South American plate. Geological stress builds up and then is released in the occasional massive jolt. Chile is home to the largest earthquake ever recorded -

one of magnitude 9.5 in 1960 - and accounts for more than one-quarter of the planet's total seismic-energy release.

Pisagua had not seen a major earthquake since 1877, when a tremor of around magnitude 9 ripped through the area. Seismic activity began to pick up last August, when a swarm of small earthquakes struck the area. Another set followed over the new year, and a third cluster occurred in March. These three swarms seem to have prepared the subduction zone to rupture in the big 1 April quake, says Onno Oncken, a geophysicist at the German Research Centre for Geosciences in Potsdam.

Until recently, researchers had thought that the next large earthquake in northern Chile would break the entire interface between the Nazca and South American plates, says Jean-Pierre Vilotte, a seismologist at the Paris Institute of Earth Physics. The Pisagua quake and a magnitude-7.6 aftershock two days later, "are a clear counterexample of this simplistic classification", he says. Together they ruptured just a small portion of the entire region at risk.

Intriguingly, the part of the subduction zone that broke was not the part that had built up the most stress, according to a ground-motion study of northern Chile's seismic gap by Marianne Métois, a geophysicist at the National Institute of Geophysics and Volcanology in Rome, and her colleagues (M. Métois et al. *Geophys. J. Int.* 194, 1283–1294; 2013). For some reason, the Pisagua quake released stress in areas that were not the most wound up. "A lot of energy remains to be released in north Chile," Métois says.

When the next one comes, seismologists plan to be ready. IPOC has added instruments to capture aftershocks from the 1 April quake and whatever might happen next. Dozens of new seismometers and global-positioning stations have been deployed by teams from Chile, Germany and France, says Sergio Barrientos, director of the National Seismological Centre at the University of Chile in Santiago.

For Sobiesiak, every little bit of data helps. Before the 1 April quake, she thought that the northern Chile seismic gap would rupture either to the north or to the south of the Pisagua area, but not right through it. Now she has some fresh thinking to do. "Each of these efforts really does bring us a step forward," she says.

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

Deaf people get gene tweak to restore natural hearing

People who have lost their hearing will be injected with a harmless virus carrying a gene that should trigger the regrowth of their ears' sensory receptors

23 April 2014 by Helen Thomson

IN TWO months' time, a group of profoundly deaf people could be able to hear again, thanks to the world's first gene therapy trial for deafness.

The volunteers, who lost their hearing through damage or disease, will get an injection of a harmless virus containing a gene that should trigger the regrowth of the sensory receptors in the ear.

The idea is that the method will return a more natural sense of hearing than other technologies can provide.

Hearing aids merely amplify sounds, while cochlear implants transform sound waves into electrical waves that the brain interprets, but they don't pick up all of the natural frequencies. This means people can find it difficult to distinguish many of the nuances in voices and music.

"The holy grail is to give people natural hearing back," says Hinrich Staecker at the University of Kansas Medical Center, who is leading the trial. "That's what we hope to do – we are essentially repairing the ear rather than artificially imitating what it does."

There are still many things we don't know about how the ear works. This is because the delicate machinery of the inner ear is enclosed in the hardest bone in the body, making it difficult to isolate without causing damage. What we do know is that sound waves are funnelled into the ear, making the ear drum vibrate. These vibrations are transferred to the cochlea in the inner ear via three tiny bones. Thousands of sensory receptors line a part of the cochlea called the organ of Corti, as rows of inner and outer hair cells. Sound waves, amplified by the outer hair cells (shown above right), vibrate the inner hair cells, opening ion channels on their surface that let neurotransmitters flow in. This triggers electrical activity in the cochlear neurons, passing the information to the brain so it can be processed.

Both inner and outer hair cells can be damaged by loud noises, drugs such as some antibiotics and disease, and don't regrow. A possible fix arose in 2003, when researchers discovered that certain genes can transform the cells supporting the hair cells into both types of hair cell.

To see whether one of these genes, called *Atoh1*, could be used to improve hearing, last year Staecker and colleagues inserted it into a harmless virus and injected that into the cochlea of mice that had had almost all of their hair cells destroyed. Two months later, the rodents' hearing had improved by about 20 decibels. "This is about the same difference between hearing with your hands over your ears, and what you hear ordinarily," says Lloyd Klickstein, head of translational medicine at Novartis, the Swiss drug company collaborating on the trial.

Staecker's team have now got the go-ahead to do the same in people. In the next month, they will begin searching for about 45 volunteers who have severe hearing loss, most likely caused by the side effects of drugs. This group will have lost a large number of hair cells, but will still have supporting structures, such as neurons, present in the inner ear. "The biggest risk is that we interfere with residual hearing, so we're starting with people who have lost almost all hearing already," says Klickstein.

People between the ages of 18 and 70 will be eligible for the trial. Those who are born deaf won't be because they often don't have the structures needed to support hair cells. Staecker estimates that the approach could help 1 to 2 per cent of all people with hearing loss, up to 7 million people in the US.

Sticking plasters

The trial will start at the University of Kansas Medical School before being widened to other institutions. As with the mice, the team will inject the viral gene package directly into the volunteers' cochlea by peeling back their ear drum and passing a needle through a tiny hole made by a laser (see diagram). The *Atoh1* gene should reach the supporting cells, instructing them to divide and form new hair cells. Results are expected between two weeks and two months later.

"Today's medical treatments are largely limited to hearing aids and cochlear implants, which are essentially just sticking plasters," says Ralph Holme, head of biomedical research at UK charity Action on Hearing Loss. "This is why the planned trial is extremely encouraging and offers hope to the millions affected by hearing loss that a cure is possible."

Jeffrey Holt at Harvard Medical School, who isn't involved in the trial, calls it ground-breaking and says he is cautiously optimistic about the work. "Hopes are high that the trial will yield positive results without introducing unnecessary complications."

The only expected side effect is a brief period of dizziness or nausea, a common occurrence after ear surgery. In pre-clinical tests, Novartis researchers looked to see if the virus spread to any other tissues, but found it was restricted to the site of injection. It has also been designed to have limited potential to recombine with the volunteer's DNA so it is unlikely to cause problems elsewhere.

Many other species, such as fish and birds, can regenerate the hair cells in their inner ear over time and create new auditory circuits, says Klickstein. "We're just trying to tweak the mammalian system a little bit to do what a lot of other species do naturally".

http://www.eurekalert.org/pub_releases/2014-04/uol-tfd042414.php#rssowlmlink

Treatment for deadly yeast disease reduced to 3 days

Initial treatment for a brain infection caused by fungus could now be treated in three days, rather than two weeks, due to study by University of Liverpool scientists.

Cryptococcus – a form of yeast - infections are often fatal but are relatively neglected in medical research. They are found in many parts of the world, including Africa, Australasia and South East Asia and mainly affect people with weakened immune systems. This infection kills up to 700,000 people a year.

The University research team has tested the effects of the most commonly used drug on Cryptococcus infections of the brain and discovered that although the recommendation for treatment is currently two weeks, the drug has been shown by the new studies to be effective at clearing the fungus within three days.

Professor of Therapeutics and Infectious Diseases, William Hope said: "This infection kills up to 700,000 people a year and is mainly fatal in areas with poor resources. In many parts of the world it is simply infeasible to administer intravenous drugs for two weeks."

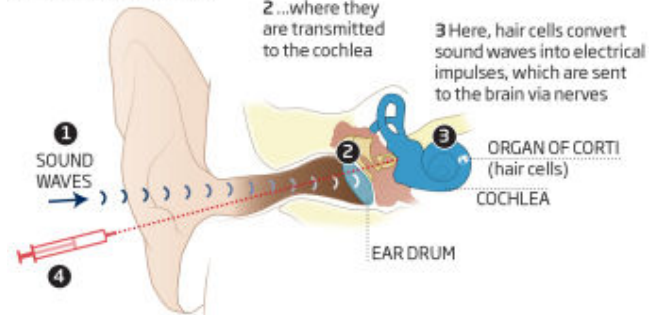
Good vibrations

Hair cells in the ear convert sound vibrations to electrical impulses, allowing us to hear...

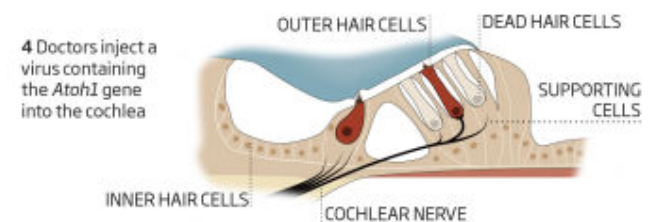
1 Sound waves are directed to the ear drum...

2 ...where they are transmitted to the cochlea

3 Here, hair cells convert sound waves into electrical impulses, which are sent to the brain via nerves



...but loud noise, drugs or age can damage these hair cells, leading to deafness. To counteract this...



5 The *Atoh1* gene converts supporting cells into new hair cells, replacing the dead cells

The scientists in the Institute of Translational Medicine examined the effects of amphotericin B deoxycholate (dAmB) over both three and 14 day treatments and found that the effect was the same after three days as it was after two weeks.

The results in animal trials was compared with humans using a range of mathematical modelling techniques, to produce findings which suggest that the three day regime will be equally as effective in people.

The researchers believe that this opens up significant possibilities for treatment in areas where there is a scarcity of medically trained staff, who often have to ration the drugs they administer to patients.

The infection often takes hold in people with AIDS as a result of their immune systems being compromised, and areas with high rates of AIDS are also usually those without resources.

Professor Hope added: "A lot of the treatment administered with a variety of drugs is assumed and generalised. This is one example of how experimental medicine can help accelerate changes to improve outcomes for patients." The next stage of the research will be to test it in clinical trials in humans. The findings were published in the journal mBio.

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Taking a walk may lead to more creativity than sitting, study finds

Free-flowing thought more likely while walking indoors or outdoors, research reveals

WASHINGTON - When the task at hand requires some imagination, taking a walk may lead to more creative thinking than sitting, according to research published by the American Psychological Association.

"Many people anecdotally claim they do their best thinking when walking," said Marily Oppezzo, PhD, of Santa Clara University. "With this study, we finally may be taking a step or two toward discovering why."

While at Stanford University's Graduate School of Education, Oppezzo and colleague Daniel L. Schwartz, PhD, conducted studies involving 176 people, mostly college students. They found that those who walked instead of sitting or being pushed in a wheelchair consistently gave more creative responses on tests commonly used to measure creative thinking, such as thinking of alternate uses for common objects and coming up with original analogies to capture complex ideas. When asked to solve problems with a single answer, however, the walkers fell slightly behind those who responded while sitting, according to the study published in APA's Journal of Experimental Psychology: Learning, Memory and Cognition.

While previous research has shown that regular aerobic exercise may protect cognitive abilities, these researchers examined whether simply walking could temporarily improve some types of thinking, such as free-flowing thought compared to focused concentration. "Asking someone to take a 30-minute run to improve creativity at work would be an unpopular prescription for many people," Schwartz said. "We wanted to see if a simple walk might lead to more free-flowing thoughts and more creativity."

Of the students tested for creativity while walking, 100 percent came up with more creative ideas in one experiment, while 95 percent, 88 percent and 81 percent of the walker groups in the other experiments had more creative responses compared with when they were sitting. If a response was unique among all responses from the group, it was considered novel. Researchers also gauged a participant's total number of responses and whether a response was feasible and appropriate to the constraints of the task. For example, "Putting lighter fluid in soup is novel, but it is not very appropriate," Oppezzo said.

In one experiment with 48 participants, each student sat alone in a small room at a desk facing a blank wall. When a researcher named an object, the student came up with alternative ways to use the object. For example, for the word "button," a person might say "as a doorknob on a dollhouse." The students heard two sets of three words and had four minutes per set to come up with as many responses as possible. To see how walking might affect more restricted thinking, the researchers also had the students complete a word association task with 15 three-word groups, such as "cottage-Swiss-cake," for which the correct answer is "cheese." Participants repeated both tasks with different sets of words first while sitting and then while walking at a comfortable pace on a treadmill facing a blank wall in the same room.

With a different group of 48 students, some sat for two different sets of the tests, some walked during two sets of the test and some walked and then sat for the tests. "This confirmed that the effect of walking during the second test set was not due to practice," Oppezzo said. "Participants came up with fewer novel ideas when they sat for the second test set after walking during the first. However, they did perform better than the participants who sat for both sets of tests, so there was a residual effect of walking on creativity when people sat down afterward. Walking before a meeting that requires innovation may still be nearly as useful as walking during the meeting."

Students who walked in another experiment doubled their number of novel responses compared with when they were sitting. The 40 students in this experiment were divided into three groups: One sat for two sets of tests but

moved to separate rooms for each set; another sat and then walked on a treadmill; and one group walked outdoors along a predetermined path.

To see if walking was the source of creative inspiration rather than being outdoors, another experiment with 40 participants compared responses of students walking outside or inside on a treadmill with the responses of students being pushed in a wheelchair outside and sitting inside. Again, the students who walked, whether indoors or outside, came up with more creative responses than those either sitting inside or being pushed in a wheelchair outdoors. "While being outdoors has many cognitive benefits, walking appears to have a very specific benefit of improving creativity," said Oppezzo.

More research will be necessary to explain how walking improves creativity, the authors said. They speculated that future studies would likely determine a complex pathway that extends from the physical act of walking to physiological changes to the cognitive control of imagination.

"Incorporating physical activity into our lives is not only beneficial for our hearts but our brains as well. This research suggests an easy and productive way to weave it into certain work activities," Oppezzo said.

Funding for the study was provided by the Knut and Alice Wallenberg Foundation, the Gordon and Betty Moore Foundation and a Stanford Graduate School of Education Dissertation Support Grant.

Article: "Give Your Ideas Some Legs: The Positive Effect of Walking on Creative Thinking," Marily Oppezzo, PhD, Santa Clara University, and Daniel L. Schwartz, PhD, Stanford University, Journal of Experimental Psychology: Learning, Memory and Cognition, published online April 2014.

Full text of the article is available from the APA Public Affairs Office and at <http://www.apa.org/pubs/journals/releases/xlm-a0036577.pdf>.

http://www.eurekalert.org/pub_releases/2014-04/mgh-uof042214.php#rssowlmlink

Use of frozen material for fecal transplant successfully treats C. difficile infection

Mass. General study identifies more acceptable way to administer treatment for dangerous recurrent infection

A pilot study by Massachusetts General Hospital (MGH) investigators may lead to greater availability and acceptability of an unusual treatment for a serious medical problem – use of fecal material from healthy donors to treat recurrent diarrhea caused by the *Clostridium difficile* (*C. difficile*) bacteria. In their paper being published online in the journal *Clinical Infectious Diseases*, the researchers report that use of prescreened frozen fecal material from donors unrelated to patients was as successful in curing recurrent *C. difficile* infection as was the use of fresh material reported in previous studies of what is called Fecal Microbiota Transplant (FMT).

"We found that delivery of a frozen, stored inoculum through a nasogastric tube is safe, acceptable to patients and as successful as delivery by colonoscopy – which requires a preparatory 'clean out,' sedation or anesthesia, and is quite costly," says Elizabeth Hohmann, MD, of the MGH Infectious Diseases Division, senior author of the report. "Without this treatment option, patients with recurrent *C. difficile* may have chronic diarrhea – limiting their quality of life and their ability to maintain weight – and need to live on chronic antibiotic treatment, which is both expensive and can have other side effects."

C. difficile infection has become an increasingly serious problem, causing around 250,000 infections requiring hospitalization and 14,000 deaths each year in the U.S. Hohmann notes that from two to five patients test positive for the infection at MGH every day. In patients with recurrent or treatment-resistant infection, long-term treatment with vancomycin or other antibiotics has had limited success, with symptoms recurring up to 30 percent of the time. In fact, antibiotic treatment has the potential of making matters worse, as it kills off the beneficial normal intestinal microbes that can keep pathologic species like *C. difficile* in check.

FMT probably treats *C. difficile* by restoring the normal balance of intestinal microbes. Previous animal and human FMT studies using fresh fecal material have had success rates of around 90 percent, but the MGH researchers note that recruiting and screening potential donors can be time-consuming and costly. Banking a supply of frozen, prescreened donor stool could significantly increase the availability of FMT, and the current study was designed to test the feasibility and effectiveness of such an approach, along with comparing two routes for delivery of the donor material.

Stool samples were donated by exceptionally healthy adults who received comprehensive screening for infectious diseases. Donors also were asked to refrain from eating any common allergens, such as nuts or eggs, in the days before donation. The donated fecal material was filtered, diluted, screened and frozen; stored for at least four weeks to allow retesting donors for any hidden infections; and prior to administration, thawed and kept refrigerated.

The study enrolled 20 patients – three of whom were children – who either had three or more episodes of mild to moderate *C. difficile* infection for which antibiotic treatment failed or had two episodes serious enough to

require hospitalization. Participants were randomly divided into two groups – 10 who received donor material by standard colonoscopy and 10 who received it though a nasogastric tube (NGT) passed into the stomach. A single administration was successful in curing 14 of the 20 participants – 8 in the colonoscopy group and 6 in the NGT group, a difference not considered significant in such a small study.

Among those whose infections did not resolve, a single participant declined additional treatment. The other 5 received a second administration, which cured the infection in 4, for an overall success rate of 90 percent, similar to that of the previous studies. Participants who received the second infusion were allowed to choose the route of administration, and all chose to receive it via NGT.

Subsequently the researchers discovered that the participant who declined a second infusion was self-administering fecal enemas, using unprocessed material from his roommate, a practice Hohmann notes could be hazardous. "We certainly don't recommend 'home brew' FMT, since it's very important to screen donors properly. In addition, while some people may be comfortable using stool from a spouse or other intimate partner, many older patients might not have such a donor who is healthy enough to donate safely."

The research team also reports treating an additional 11 patients with frozen donor samples via NGT, achieving a 91 percent success rate, and they currently are investigating what may be an even more acceptable means of administration – via a capsule that would remain undigested until it reaches the small intestine.

"It's been very gratifying to be able to help these patients, some of whom have been sick for a year or two," Hohmann explains. "They have told us this has been life changing for them and that they have gotten themselves back to normal. There aren't many things in medicine that have a success rate of more than 90 percent. Insurers may not want to pay for this, but it is very effective, makes patients better quite quickly and saves money overall. While it may never become a first-line treatment, we are starting to consider using it more and more often," she adds.

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Take notes by hand for better long-term comprehension

Dust off those Bic ballpoints and college-ruled notebooks - research shows that taking notes by hand is better than taking notes on a laptop for remembering conceptual information over the long term.

The findings are published in Psychological Science, a journal of the Association for Psychological Science. Walk into any university lecture hall and you're likely to see row upon row of students sitting behind glowing laptop screens. Laptops in class have been controversial, due mostly to the many opportunities for distraction that they provide (online shopping, browsing Reddit, or playing solitaire, just to name a few). But few studies have examined how effective laptops are for the students who diligently take notes.

"Our new findings suggest that even when laptops are used as intended - and not for buying things on Amazon during class - they may still be harming academic performance," says psychological scientist Pam Mueller of Princeton University, lead author of the study.

This is a photo of a student taking notes by hand. Mueller was prompted to investigate the question after her own experience of switching from laptop to pen and paper as a graduate teaching assistant:

"I felt like I'd gotten so much more out of the lecture that day," says Mueller, who was working with psychology researcher Daniel Oppenheimer at the time. "Danny said that he'd had a related experience in a faculty meeting: He was taking notes on his computer, and looked up and realized that he had no idea what the person was actually talking about."

Mueller and Oppenheimer, who is now at the UCLA Anderson School of Management, conducted a series of studies to investigate whether their intuitions about laptop and longhand note-taking were true. In the first study, 65 college students watched one of five TED Talks covering topics that were interesting but not common knowledge. The students, who watched the talks in small groups, were either given laptops (disconnected from Internet) or notebooks, and were told to use whatever strategy they normally used to take notes.

The students then completed three distractor tasks, including a taxing working memory task. A full 30 minutes later, they had to answer factual-recall questions (e.g., "Approximately how many years ago did the Indus civilization exist?") and conceptual-application questions (e.g., "How do Japan and Sweden differ in their approaches to equality within their societies?") based on the lecture they had watched.

The results revealed that while the two types of note-takers performed equally well on questions that involved recalling facts, laptop note-takers performed significantly worse on the conceptual questions. The notes from laptop users contained more words and more verbatim overlap with the lecture, compared to the notes that were written by hand. Overall, students who took more notes performed better, but so did those who had less verbatim overlap, suggesting that the benefit of having more content is canceled out by "mindless transcription."

"It may be that longhand note takers engage in more processing than laptop note takers, thus selecting more important information to include in their notes, which enables them to study this content more efficiently," the researchers write.

Surprisingly, the researchers saw similar results even when they explicitly instructed the students to avoid taking verbatim notes, suggesting that the urge to do so when typing is hard to overcome.

The researchers also found that longhand note takers still beat laptop note takers on recall one week later when participants were given a chance to review their notes before taking the recall test. Once again, the amount of verbatim overlap was associated with worse performance on conceptual items.

"I don't anticipate that we'll get a mass of people switching back to notebooks," says Mueller, "but there are several new stylus technologies out there, and those may be the way to go to have an electronic record of one's notes, while also having the benefit of being forced to process information as it comes in, rather than mindlessly transcribing it." "Ultimately, the take-home message is that people should be more aware of how they are choosing to take notes, both in terms of the medium and the strategy," Mueller concludes.

All data and materials have been made publicly available via Open Science Framework and can be accessed at <http://osf.io/crsiz>. The complete Open Practices Disclosure for this article can be found at <http://pss.sagepub.com/content/by/supplemental-data>.

This article has received badges for Open Data and Open Materials. More information about the Open Practices badges can be found at <https://osf.io/tvyxz/wiki/view/> and <http://pss.sagepub.com/content/25/1/3.full>.

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Low-dose natural antimicrobial exacerbates chronic lung infection in cystic fibrosis

Antimicrobial peptide produced by human immune cells can promote mutations in the bacterium that make it more lethal

Respiratory failure caused by chronic lung infection with *Pseudomonas aeruginosa* bacteria is a common cause of death in patients with cystic fibrosis (CF), a genetic disease that is common in individuals of European descent. A study published on April 24th in *PLOS Pathogens* demonstrates that an antimicrobial peptide produced by human immune cells can promote mutations in the bacterium that make it more lethal.

Daniel Wozniak, from The Ohio State University Wexner Medical Center, USA, and colleagues studied a process called "mucoid conversion", which involves mutations in *Pseudomonas* that produce a sticky sugar coating of the bacteria which makes them more resistant to various treatments. The process is fairly well understood, and involves mutation of a particular *Pseudomonas* gene called *mucA*. Searching for factors of the human host that facilitate *mucA* mutation, the scientists found that specific immune system cells called polymorphonucleocytes (or neutrophils), which are present in large numbers in lung cells of patients with CF, can trigger *Pseudomonas* mucoid conversion, and that a specific antimicrobial factor produced by these cells called LL-37 plays a key role.

At high doses, LL-37 can kill bacteria by poking large holes into their cell walls. However, at lower concentrations (which seem to mimic the situation in the lungs of CF patients), the scientists found that some LL-37 molecules can enter the bacterial cells without killing them. Once inside, LL-37 appears to be able to directly interact with and alter the bacterial DNA, leading to mutation of the *mucA* gene. The resulting mucoid conversion makes the sugar-coated bacteria then resistant to higher doses of LL-37, including doses that would readily kill the "naked" *Pseudomonas* bacteria prior to mucoid conversion. The scientists went on to show that LL-37 can induce mutations besides those in *mucA* in both *Pseudomonas* and *E. coli*, showing that its function as a mutagen is neither restricted to a particular gene nor a particular pathogen.

Taken together, the results demonstrate that an antimicrobial substance can, at low dose, function as a mutagen that makes bacteria more dangerous. Given that antimicrobial peptides similar to LL-37 are being discussed as promising leads for the development of new antibiotics, the scientists say their data "reinforce how important it is to consider the impact of current and novel treatments and the host immune response on evolution of microbial communities during chronic infections."

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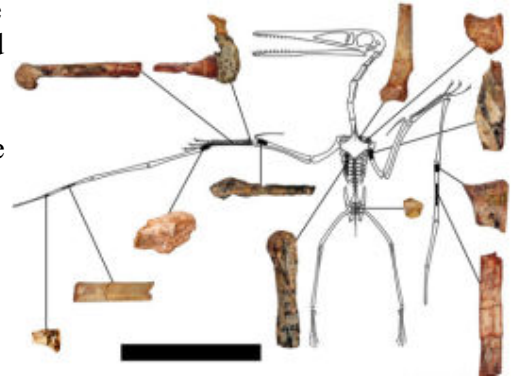
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Oldest pterodactyloid species discovered, named by international team of researchers

Study rewrites chapter in understanding of prehistoric world, evolution of great flying beasts

WASHINGTON - An international research team, including a George Washington University (GW) professor, has discovered and named the earliest and most primitive pterodactyloid - a group of flying reptiles that would go on to become the largest known flying creatures to have ever existed - and established they flew above the earth some 163 million years ago, longer than previously known. Working from a fossil discovered in northwest China, the project - led by University of South Florida (USF) paleontologist Brian Andres, James Clark of the GW Columbian College of Arts and Sciences and Xu Xing of the Chinese Academy of Sciences - named the new pterosaur species *Kryptodrakon progenitor*.



A diagram shows the fragmentary remains of Kryptodrakon progenitor found in the famed "dinosaur death pits" area of the Shishugou Formation in northwest China. Researchers focused on one of the palm bones, which is longer than its more primitive relatives and shows that it is the earliest known pterodactyloid pterosaur. The skeletal outline is Pterodactylus antiquus reprinted with permission from Peter Wellnhofer. Scale bar is 50 mm. Credit: Illustration by

Brian Andres

Through scientific analysis the team established it as the first pterosaur to bear the characteristics of the Pterodactyloidea, which would become the dominant winged creatures of the prehistoric world. Their research will be published online Thursday in the journal *Current Biology*.

"This finding represents the earliest and most primitive pterodactyloid pterosaur, a flying reptile in a highly specialized group that includes the largest flying organisms," says Chris Liu, program director in the National Science Foundation's Division of Earth Sciences. "The research has extended the fossil record of pterodactyloids by at least five million years to the Middle-Upper Jurassic boundary about 163 million years ago."

Kryptodrakon progenitor lived around the time of the Middle-Upper Jurassic boundary. Through studying the fossil fragments, researchers also determined that the pterodactyloids originated, lived, and evolved in terrestrial environments - rather than marine environments where other specimens have been found. The fossil is of a small pterodactyloid with a wingspan estimate of about 4.5 feet. Pterodactyloids - who went on to evolve into giant creatures, some as big as small planes - went extinct with the dinosaurs, about 66 million years ago. Pterosaurs are considered close relatives to the dinosaurs, but are not dinosaurs themselves. The discovery provides new information on the evolution of pterodactyloids, Dr. Andres said. This area was likely a flood plain at the time the pterosaur lived, Dr. Andres said. As the pterosaurs evolved, their wings changed from being narrow, which are more useful for marine environments, to being more broad near the origin of the pterodactyloids - helpful in navigating land environments.

"He (*Kryptodrakon progenitor*) fills in a very important gap in the history of pterosaurs," Dr. Andres said. "With him, they could walk and fly in whole new ways."

The fossil that became the centerpiece of the research was discovered in 2001 by Chris Sloan, formerly of National Geographic and now president of Science Visualization. It was found in a mudstone of the Shishugou Formation of northwest China on an expedition led by Drs. Xu and Clark when Dr. Andres was a graduate student with Dr. Clark at GW. The desolate and harsh environment has become known to scientists worldwide as having "dinosaur death pits" for the quicksand in the area that trapped an extraordinary range of prehistoric creatures, stacking them on top of each other, including one of the oldest tyrannosaurs, *Guanlong*.

Kryptodrakon progenitor was found 35 meters below an ash bed that has been dated back to more than 161 million years.

The specimen is housed at the Institute of Vertebrate Paleontology and Paleoanthropology, Beijing, China. The name *Kryptodrakon progenitor* comes from *Krypto* (hidden) and *drakon* (serpent), referring to "Crouching Tiger, Hidden Dragon" filmed near where the species was discovered, and *progenitor* (ancestral or first-born), referring to its status as the earliest pterodactyloid, Dr. Andres said.

"*Kryptodrakon* is the second pterosaur species we've discovered in the Shishugou Formation and deepens our understanding of this unusually diverse Jurassic ecosystem," said Dr. Clark, GW's Ronald B. Weintraub Professor of Biology. "It is rare for small, delicate fossils to be preserved in Jurassic terrestrial deposits, and the Shishugou fauna is giving us a glimpse of what was living alongside the behemoths like *Mamenchisaurus*."

The scientists write that the pterosaurs were a diverse group of Mesozoic flying reptiles that underwent a body plan reorganization, adaptive radiation, and replacement of earlier forms midway through their long history, resulting in the origin of the Pterodactyloidea, a highly-specialized group of pterosaurs of which *Kryptodrakon* is the earliest and most primitive species.

This new take on the ecological history of pterosaurs is supported by a significant correlation found between wing shape and environment in pterosaurs and modern flying vertebrates, like bats and birds, the researchers said. Pterosaurs, however, are not the ancestors of birds - those are the dinosaurs - and scientists still believe that pterosaurs did not evolve into birds or other modern animals humans would know.

The fieldwork was supported by the National Natural Science Foundation of China, the National Science Foundation Division of Earth Sciences of the USA, the Chinese Academy of Sciences, the National Geographic Society, the Jurassic Foundation, the Hilmar Sallee bequest, and the George Washington University. Study of the specimen was supported by the Chinese Academy of Sciences, the National Science Foundation Division of Earth Sciences and the National Natural Science Foundation of China.

http://www.eurekalert.org/pub_releases/2014-04/kcl-slg042414.php#rssowlmlink

Skin layer grown from human stem cells could replace animals in drug and cosmetics testing

First lab-grown epidermis with a functional permeability barrier akin to real skin

An international team led by King's College London and the San Francisco Veteran Affairs Medical Center (SFVAMC) has developed the first lab-grown epidermis – the outermost skin layer - with a functional permeability barrier akin to real skin. The new epidermis, grown from human pluripotent stem cells, offers a cost-effective alternative lab model for testing drugs and cosmetics, and could also help to develop new therapies for rare and common skin disorders.

The epidermis, the outermost layer of human skin, forms a protective interface between the body and its external environment, preventing water from escaping and microbes and toxins from entering. Tissue engineers have been unable to grow epidermis with the functional barrier needed for drug testing, and have been further limited in producing an in vitro (lab) model for large-scale drug screening by the number of cells that can be grown from a single skin biopsy sample.

The new study, published in the journal *Stem Cell Reports*, describes the use of human induced pluripotent stem cells (iPSC) to produce an unlimited supply of pure keratinocytes – the predominant cell type in the outermost layer of skin - that closely match keratinocytes generated from human embryonic stem cells (hESC) and primary keratinocytes from skin biopsies. These keratinocytes were then used to manufacture 3D epidermal equivalents in a high-to-low humidity environment to build a functional permeability barrier, which is essential in protecting the body from losing moisture, and preventing the entry of chemicals, toxins and microbes.

A comparison of epidermal equivalents generated from iPSC, hESC and primary human keratinocytes (skin cells) from skin biopsies showed no significant difference in their structural or functional properties compared with the outermost layer of normal human skin.

Dr Theodora Mauro, leader of the SFVAMC team, says: "The ability to obtain an unlimited number of genetically identical units can be used to study a range of conditions where the skin's barrier is defective due to mutations in genes involved in skin barrier formation, such as ichthyosis (dry, flaky skin) or atopic dermatitis. We can use this model to study how the skin barrier develops normally, how the barrier is impaired in different diseases and how we can stimulate its repair and recovery."

Dr Dusko Ilic, leader of the team at King's College London, says: "Our new method can be used to grow much greater quantities of lab-grown human epidermal equivalents, and thus could be scaled up for commercial testing of drugs and cosmetics. Human epidermal equivalents representing different types of skin could also be grown, depending on the source of the stem cells used, and could thus be tailored to study a range of skin conditions and sensitivities in different populations."

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Oxygen diminishes the heart's ability to regenerate, researchers discover

Scientific research at UT Southwestern Medical Center previously discovered that the newborn animal heart can heal itself completely, whereas the adult heart lacks this ability.

DALLAS – New research by the same team today has revealed why the heart loses its incredible regenerative capability in adulthood, and the answer is quite simple – oxygen.

Yes, oxygen. It is well-known that a major function of the heart is to circulate oxygen-rich blood throughout the body. But at the same time, oxygen is a highly reactive, nonmetallic element and oxidizing agent that readily forms toxic substances with many other compounds. This latter property has now been found to underlie the loss of regenerative capacity in the adult heart.

This groundbreaking new finding, published in today's issue of *Cell*, finds that the oxygen-rich postnatal environment results in cell cycle arrest of cardiomyocytes, or heart cells.

"Knowing the key mechanism that turns the heart's regenerative capacity off in newborns tells us how we might discover methods to reawaken that capacity in the adult mammalian heart," said Dr. Hesham Sadek, Assistant Professor of Internal Medicine at UT Southwestern and senior author of the study.

Due to the oxygen-rich atmosphere experienced immediately after birth, heart cells build up mitochondria – the powerhouse of the cell – which results in increased oxidization. The mass production of oxygen radicals by mitochondria damages DNA and, ultimately, causes cell cycle arrest.

"We have uncovered a previously unrecognized protective mechanism that mediates cardiomyocyte cell cycle arrest and that arises as a consequence of oxygen-dependent aerobic metabolism," said Dr. Sadek.

Physiologically speaking, Dr. Sadek said, mammals likely had to make the choice early on between being energy efficient or retaining the heart's ability to regenerate. "The choice was clear," said Dr. Sadek. "More than any organ in the body, the heart needs to be energy efficient in order to pump blood throughout life."

Heart muscle contains the highest amount of mitochondria in the body and consumes 30 percent of the body's total oxygen in a resting state alone. Unfortunately, the energy that comes from massive oxygen consumption comes with a price in the form of oxidation of DNA that makes the heart cells unable to divide and regenerate.

Dr. Sadek, along with co-first authors Dr. Bao "Robyn" Puente, postdoctoral trainee in Pediatrics, and Dr. Wataru Kimura, visiting senior researcher in Internal Medicine, found that if they subjected mice to a low-oxygen atmosphere, the cardiomyocytes divided longer than normal. The opposite was true when mice were born in a higher-oxygenated atmosphere. In that case, the cardiomyocytes stopped dividing earlier than normal. This study comes on the heels of findings published in the Feb. 25, 2011, edition of *Science*, in which Dr. Sadek found that if a portion of a mouse heart was removed during the first week after birth, that portion grew back wholly and correctly. In contrast, an adult heart was irreversibly damaged by removal of even a small amount of tissue.

Because the adult mammal's heart is not able to regenerate following injury, this represents a major barrier in cardiovascular medicine. Having a promising new understanding of what arrests cardiomyocyte cell cycle could be an important component of cardiomyocyte proliferation-based therapeutic approaches.

Funding sources for this research include NASA, the European Research Council, the British Heart Foundation, the Fondation Leducq, the American Heart Association, the Foundation for Heart Failure Research, New York, and the National Institutes of Health.

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'Horsing around' reduces stress hormones in youth

Saliva tells a tale of lower stress hormones

PULLMAN, Wash. – New research from Washington State University reveals how youth who work with horses experience a substantial reduction in stress – and the evidence lies in kids' saliva. The results are published in the *American Psychological Association's Human-Animal Interaction Bulletin* this month.

Pendry-80 "We were coming at this from a prevention perspective," said Patricia Pendry, a developmental psychologist at WSU who studies how stress "gets under the skin" and the effects of prevention programs on human development. "We are especially interested in optimizing healthy stress hormone production in young adolescents, because we know from other research that healthy stress hormone patterns may protect against the development of physical and mental health problems."

NIH grant to apply hard science

Her work is the first evidence-based research within the field of human-equine interaction to measure a change in participants' levels of the stress hormone cortisol. "The beauty of studying stress hormones is that they can be sampled quite noninvasively and conveniently by sampling saliva in naturalistic settings as individuals go about their regular day," Pendry said.

While human-animal interaction programs with horses, dogs, cats and other companion animals have been credited with improving social competence, self-esteem and behavior in children, scientifically valid research to support these claims – and an understanding of the underlying mechanism for why people report a positive experience in these programs – has been limited.

Three years ago, the National Institutes of Health began asking researchers to tackle big questions about the effects of human-animal interaction on child development. With the support of a \$100,000 NIH grant, Pendry led a research project to engage students in grades 5-8 in a 12-week equine facilitated learning program in Pullman, Wash. She approached the coordinator of PATH (Palouse Area Therapeutic Horsemanship) at the WSU College of Veterinary Medicine, which had been offering a therapeutic riding program for over 30 years.

Pendry has been riding and working with horses since she was a child and reacquainted herself with therapeutic horsemanship when she began to look for her next research project at WSU.

Higher hormone levels pose potential risk

She said stress hormone functioning is a result of how we perceive stress as well as how we cope with it. Stress is not just what you experience, she said, but it's how you interpret the size of the stressor. A child in front of a large, unfamiliar horse may experience more stress than when he or she encounters a smaller, more familiar animal.

Working with PATH director Sue Jacobson and Phyllis Erdman from the WSU College of Education, Pendry designed and implemented an after-school program serving 130 typically developing children over a two-year period that bused students from school to the barn for 12 weeks. Children were randomly assigned to participate in the program or be waitlisted. Based on natural horsemanship techniques, the program provided 90 minutes weekly to learn about horse behavior, care, grooming, handling, riding and interaction. Participants provided six samples of saliva over a two-day period both before and after the 12-week program. Pendry compared the levels and patterns of stress hormone functioning by measuring cortisol. The results were exciting, she said. "We found that children who had participated in the 12-week program had significantly lower stress hormone levels throughout the day and in the afternoon, compared to children in the waitlisted group," she said. "We get excited about that because we know that higher base levels of cortisol – particularly in the afternoon – are considered a potential risk factor for the development of psychopathology."

Evidence to support human-animal work

Pendry said the experimental design underlying the study gives more scientific credit to the claims of therapeutic horsemanship professionals, parents and children who have reported a positive impact from these types of programs. In addition, she hopes the results will lead to development of alternative after-school programs. While the research focused on prevention, Pendry said she believes it could provide a starting point to look at the impact on children of high levels of stress and physical or mental health issues.

"Partly because of NIH's effort to bring hard science to the field of human-animal interaction, program implementers now have scientific evidence to support what they are doing," she said.

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Increasing consumption of coffee is associated with reduced risk of type 2 diabetes

Drinking one and half more cups per day over a four-year period reduces the risk of type 2 diabetes by 11%

New research published in *Diabetologia* (the journal of the European Association for the Study of Diabetes) shows that increasing coffee consumption by on average one and half cups per day (approx 360ml) over a four-year period reduces the risk of type 2 diabetes by 11%. The research is led by Dr Frank Hu and Dr Shilpa Bhupathiraju, Department of Nutrition, Harvard School of Public Health, Harvard University, Boston, MA, USA, and colleagues.

Coffee and tea consumption has been associated with a lower type 2 diabetes risk but little is known about how changes in coffee and tea consumption influence subsequent type 2 diabetes risk. The authors examined the associations between 4-year changes in coffee and tea consumption and risk of type 2 diabetes in the subsequent 4 years.

The authors used observational data from three large prospective, US-based studies in their analysis: the Nurses' Health Study (NHS) (female nurses aged 30-55 years, 1986-2006), the NHS II (younger female nurses aged 25-42 years 1991-2007), and the Health Professionals Follow-up Study (HPFS) (male professionals 40-75 years, 1986-2006). Detailed information on diet, lifestyle, medical conditions, and other chronic diseases was collected every 2 to 4 years for over 20 years.

The availability of these repeated measures and the long-duration of follow-up allowed the authors to evaluate 4 year changes in coffee and tea intake in relation to risk of type 2 diabetes in the following 4 years. They also examined whether the association with diabetes incidence differed between changes in caffeinated and decaffeinated coffee. Diet was assessed every 4 years using a validated food frequency questionnaire. Self-reported incident type 2 diabetes cases were validated by supplementary questionnaires. The final analysis included 48,464 women in NHS, 47,510 women in the NHS II, and 27,759 men in HPFS.

The authors documented 7,269 incident type 2 diabetes cases, and found that participants who increased their coffee consumption by more than 1 cup/day (median change=1.69 cups/day) over a 4-year period had a 11% lower risk of type 2 diabetes in the subsequent 4-years compared to those who made no changes in consumption. Participants who decreased their coffee intake by 1 cup a day or more (median change=-2 cups/day) had a 17% higher risk for type 2 diabetes. Changes in tea consumption were not associated with type 2 diabetes risk.

Those with highest coffee consumption and who maintained that consumption - referred to as "high-stable consumers" since they consumed 3 cups or more per day - had the lowest risk of type 2 diabetes, 37% lower than the "low-stable consumers" who consumed 1 cup or less per day.

The authors say that the higher risk of type 2 diabetes associated with decreasing coffee intake may represent a true change in risk, or may potentially be due to reverse causation whereby those with medical conditions associated with risk for type 2 diabetes (such as high blood pressure, elevated cholesterol, cardiovascular disease, cancer) may reduce their coffee consumption after diagnosis. However, even when cases of cardiovascular disease or cancer were excluded during follow-up, the results were very similar.

While baseline decaffeinated coffee consumption was associated with a lower type 2 diabetes risk, the changes in decaffeinated coffee consumption did not change this risk. Regarding tea consumption, the authors say: "we found no evidence of an association between 4-year increases in tea consumption and subsequent risk of type 2 diabetes. This finding may have potentially been due to the relatively low number of participants who made significant changes to their tea consumption over a 4-year period thereby limiting statistical power to detect true associations. The overall low levels of tea consumption in this group may also be responsible for these findings."

The authors say: "In these 3 large prospective cohorts with more than 1.6 million person-years of follow-up, we observed that increasing coffee, but not tea, intake over a 4-year period was associated with a lower type 2 diabetes risk in the next 4 years. Decreasing coffee intake was associated with a higher type 2 diabetes risk. These changes in risk were observed for caffeinated, but not decaffeinated coffee, and were independent of initial coffee consumption and 4-year changes in other dietary and lifestyle factors."

They add: "Changes in coffee consumption habits appear to affect diabetes risk in a relatively short amount of time. Our findings confirm those of prospective studies that higher coffee consumption is associated with a lower type 2 diabetes risk and provide novel evidence that changes in coffee consumption habits are related to diabetes risk."

<http://spectrum.ieee.org/aerospace/satellites/japans-plan-for-centimeter-resolution-gps>

Japan's Plan for Centimeter-Resolution GPS

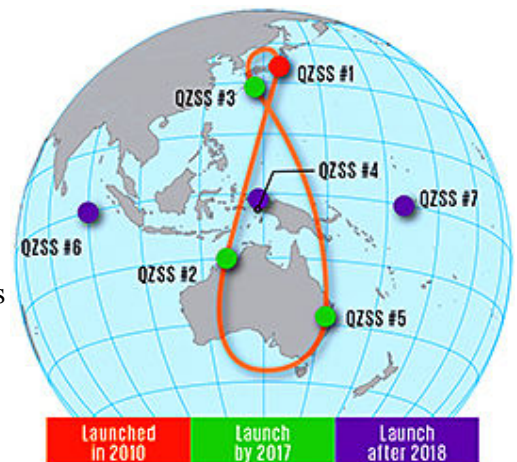
A \$1.2 billion system of satellites and ground stations would give unprecedented accuracy

By John Boyd

A stranger to Tokyo could easily get lost in its urban canyons. And GPS navigation, stymied by low resolution and a blocked view of the sky, might not be much help. But that won't be the case after 2018. Engineers at Tokyo-based Mitsubishi Electric Corp. report that they're on track to start up the first commercial, nationwide, centimeter-scale satellite positioning technology. As well as spot-on navigation, the technology will also usher in a variety of innovative new applications, its proponents say.

Named Quazi-Zenith Satellite System (QZSS), it is designed to augment Japan's use of the U.S.-operated Global Positioning System (GPS) satellite service. By precisely correcting GPS signal errors, QZSS can provide more accurate and reliable positioning, navigation, and timing services.

Today's GPS receivers track the distance to four or more GPS satellites to calculate the receiver's position. But because of the various errors inherent in the GPS system, location can be off by several meters. In using the data from QZSS to correct the measured distance from each satellite, the accuracy of the calculated position is narrowed down to the centimeter scale.



Pacific Constellation: Four QZSS satellites will orbit in such a way that at least one is always directly over Japan. Three reserves will hang at the equator. Illustration: Erik Vrielink

"GPS positioning can be off by as much as 10 meters due to various kinds of errors," says Yuki Sato, a research engineer in Mitsubishi Electric's Advanced Technology R&D Center, the prime contractor for the space portion of the project. "And in Japan, with all its mountains and skyscrapers blocking out GPS signals, positioning is not possible in some city and country locations," he adds.

The Japan Aerospace Exploration Agency (JAXA) got the project under way with the launch of QZS-1 in September 2010. Three additional satellites are slated to be in place by the end of 2017, with a further three launches expected sometime later to form a constellation of seven satellites - enough for sustainable operation and some redundancy. The government has budgeted about US \$500 million for the three new satellites, which are to be supplied by Mitsubishi. It also apportioned an additional \$1.2 billion for the ground component of the

project, which is made up of 1200 precisely surveyed reference stations. That part's being developed and operated by Quazi-Zenith Satellite System Services, a private company established for this purpose.

The four satellites will follow an orbit that, from the perspective of a person in Japan, traces an asymmetrical figure eight in the sky. While the orbit extends as far south as Australia at its widest arc, it is designed to narrow its path over Japan so that at least one satellite is always in view high in the sky - hence the name quasi-zenith. This will enable users in even the shadowed urban canyons of Tokyo to receive the system's error-correcting signals.

"Errors can be caused, for example, by the satellite's atomic clock, orbital shift, and by Earth's atmosphere, especially the ionosphere, which can bend the signal, reducing its speed," says Sato.

To correct the errors, a master control center compares the satellite's signals received by the reference stations with the distance between the stations and the satellite's predicted location. These corrected components are compressed from an overall 2-megabit-per-second data rate to 2 kilobits per second and transmitted to the satellite, which then broadcasts them to users' receivers.

"This is all done in real time, so compression is really important," says Ryoichiro Yasumitsu, a deputy chief manager in Mitsubishi's Space Systems Division. "It would take too long to transmit the original data."

Compression also means a practical-size antenna can be employed in the user's receiver. In QZS-1 trial tests, Yasumitsu notes that the average accuracy is about 1.3 centimeters horizontally and 2.9 cm vertically.

This centimeter-scale precision promises to usher in a number of creative, or at least greatly improved, applications beyond car and personal navigation. Besides pointing out obvious uses like mapping and land surveying, Sam Pullen, a senior research engineer in the department of aeronautics and astronautics at Stanford, says precision farming and autonomous tractor operations will be big applications. "Unmanned aerial vehicles and autonomous vehicles in general," he adds, "will also find centimeter-level positioning valuable in maintaining and assuring separation from other vehicles and fixed obstacles."

In addition, the Japanese government plans to use the service to broadcast short warning messages in times of disaster, when ground-based communication systems may be damaged. As instructed by the government, the control center will transmit a brief warning message to the QZSS satellite, which will then broadcast it to users on the same frequency.

Given the range of promised applications and relatively low cost of the Japanese system compared with the €5 billion (\$6.9 billion) budgeted for the EU's Galileo, for instance, other nations will be watching and waiting to see if QZSS achieves its goals.

<http://nyti.ms/1IT57LU>

Why Chocolate Is Good for Us

In recent years, large-scale epidemiological studies have found that people whose diets include dark chocolate have a lower risk of heart disease than those whose diets do not.

By GRETCHEN REYNOLDS

Other research has shown that chocolate includes flavonols, natural substances that can reduce the risk of disease. But it hasn't been clear how these flavonols could be affecting the human body, especially the heart. New findings from Virginia Tech and Louisiana State University, however, suggest an odd explanation for chocolate's goodness: It improves health largely by being indigestible.

Researchers at Louisiana State reached this conclusion after simulating the human digestive system in glass vessels. One represented the stomach and the small intestine, with their digestive enzymes, and a second reproduced a large-intestine-like environment, with gut microbes from human volunteers. The scientists then added cocoa powder to the stomach vessel.

The "stomach" and "small intestine" broke down and absorbed some of the cocoa. But while many of the flavonols previously identified in chocolate were digested in this way, there was still plenty of undigested cocoa matter. Gut bacteria in the simulated colon then broke that down further into metabolites, small enough to be absorbed into the bloodstream and known to reduce cardiac inflammation. Finally, the last undigested cocoa matter, now mostly fiber, began to ferment, releasing substances that improve cholesterol levels. And there was another health-giving twist to this entire process: The gut microbes that digested the cocoa were desirable probiotics like lactobacillus. Their numbers appeared to increase after the introduction of the cocoa, while less-salutary microbes like staphylococcus declined in number.

These findings are broadly consistent with those from Virginia Tech, published in March in The Journal of Agricultural and Food Chemistry. Researchers there began by feeding healthy lab mice a high-fat diet. Some of the mice were also given unsweetened cocoa extract; others were fed various types of flavonols extracted from the cocoa. After 12 weeks, most of the mice had grown fat and unwell, characterized by insulin resistance, high

blood sugar and incipient diabetes. A few, however, had not gained weight. These animals had ingested one of the flavonol groups whose chemical structure seems to be too large to be absorbed by the small intestine. What the results suggest, says Andrew Neilson, an assistant professor at Virginia Tech and the senior author of the mouse study, is that "there is something going on with cocoa in the colon," but what that means for chocolate lovers is not clear. Future experiments, he hopes, will tease out why one flavonol group impeded weight gain and the others did not. Do not hold your breath for a cocoa-based diet pill anytime soon, though. Cocoa's biochemical impacts are "extremely complex," he says.

Sadly, Dr. Neilson also points out that cocoa is not a chocolate bar, something whose added ingredients and processing reduce the number and type of flavonols, increase calories (cocoa itself has very few) and possibly change the response of gut bacteria to the cocoa. "The evidence does not show that you can eat a chocolate bar every day and expect to improve your health," he says. A few tablespoons of unsweetened cocoa powder sprinkled onto oatmeal or a handful of cocoa nibs - bits of the cacao bean, available at natural-food stores - would be better, he says less than sweetly.

http://www.eurekalert.org/pub_releases/2014-04/njh-im042514.php#rsslmlink

'Beneficial inflammation' may promote healing in pulmonary fibrosis

Inflammation has long been considered an integral part of the biological process that leads to deadly scarring in idiopathic pulmonary fibrosis.

New research at National Jewish Health, however, suggests that a little inflammation may also be crucial to the healing and repair processes in the lungs. Elizabeth Redente, PhD, assistant professor of cell biology at National Jewish Health, and her colleagues report in the April 2014 issue of the American Journal of Respiratory Cell and Molecular Biology that the pro-inflammatory cytokine TNF- α can speed recovery of injured lungs and accelerate the resolution of established fibrosis in a mouse model.

"The role of inflammation in the development of scarring has been hotly debated in recent years," said Dr. Redente. "Our findings show for the first time that TNF- α actually promotes inflammation during the resolution of established scarring. A little inflammation may actually be a good thing in the right place and time."

Idiopathic pulmonary fibrosis is a relentless, progressive scarring of the lungs for which there is no approved medical therapy. The disease has no known cause and patients generally die within three years of diagnosis. Approximately 40,000 Americans die of idiopathic pulmonary fibrosis every year.

Inflammation was long believed to be a precursor and cause of scarring in the lungs. However, anti-inflammatory treatments have shown no positive effect on the progress of the disease. In recent years, some researchers have thought that inflammation may be part of the healing process as well as the scarring of the lungs.

Dr. Redente and her colleagues gave mice TNF- α after their lungs had been injured and developed scar tissue. While these mice do normally heal from the lung injury, the researchers found that the TNF- α accelerated the recovery process. It reduced levels of collagen, the main component of scar tissue, and improved the flexibility of lung tissue well before the natural healing process would have begun. The researchers also found that knockout mice lacking the gene for TNF- α failed to heal as wild type mice eventually do.

The researchers believe that TNF- α acts by inducing white blood cells known as macrophages to change from ones that promote fibrosis to ones that promote inflammation instead. TNF- α may also promote the death of some of the pro-fibrotic macrophages.

"Physicians would welcome any therapy that could just slow down or stop the scarring process in the lungs," said David Riches, PhD, professor and head of the program in cell biology at National Jewish Health, and senior author on the study. "Our findings suggest that TNF- α not only slows the fibrotic process, but actually reverses established scarring in the lungs." The researchers are now investigating the role of TNF- α in various process that actually remove scar tissue including the removal of collagen-producing cells, the degradation and removal of collagen and restoration of healthy lung cells.

http://www.eurekalert.org/pub_releases/2014-04/ps-sid042514.php#rsslmlink

Star is discovered to be a close neighbor of the Sun and the coldest of its kind

Frosty star only 7.2 light years away

A "brown dwarf" star that appears to be the coldest of its kind - as frosty as Earth's North Pole - has been discovered by a Penn State University astronomer using NASA's Wide-field Infrared Survey Explorer (WISE) and Spitzer Space Telescopes. Images from the space telescopes also pinpointed the object's distance at 7.2 light-years away, making it the fourth closest system to our Sun.

"It is very exciting to discover a new neighbor of our solar system that is so close," said Kevin Luhman, an associate professor of astronomy and astrophysics at Penn State and a researcher in the Penn State Center for

Exoplanets and Habitable Worlds. "In addition, its extreme temperature should tell us a lot about the atmospheres of planets, which often have similarly cold temperatures."

Brown dwarfs start their lives like stars, as collapsing balls of gas, but they lack the mass to burn nuclear fuel and radiate starlight. The newfound coldest brown dwarf, named WISE J085510.83-071442.5, has a chilly temperature between minus 54 and 9 degrees Fahrenheit (minus 48 to minus 13 degrees Celsius). Previous record holders for coldest brown dwarfs, also found by WISE and Spitzer, were about room temperature. Although it is very close to our solar system, WISE J085510.83-071442.5 is not an appealing destination for human space travel in the distant future. "Any planets that might orbit it would be much too cold to support life as we know it" Luhman said.

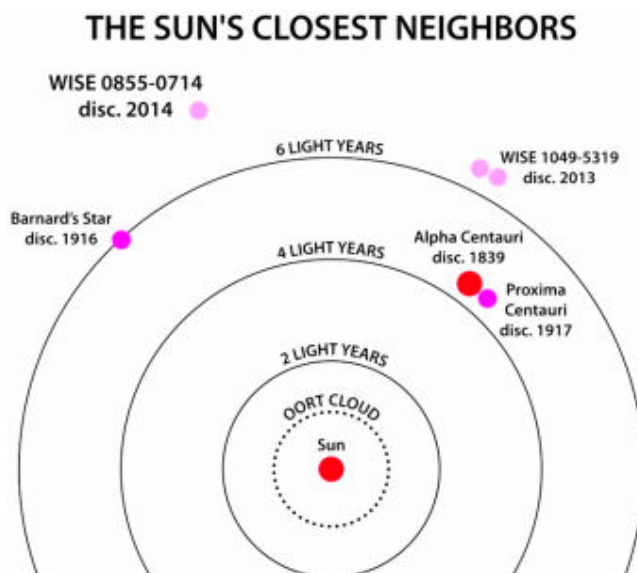
"This object appeared to move really fast in the WISE data," said Luhman. "That told us it was something special." The closer a body, the more it appears to move in images taken months apart. Airplanes are a good example of this effect: a closer, low-flying plane will appear to fly overhead more rapidly than a high-flying one.

WISE was able to spot the rare object because it surveyed the entire sky twice in infrared light, observing some areas up to three times. Cool objects like brown dwarfs can be invisible when viewed by visible-light telescopes, but their thermal glow - even if feeble - stands out in infrared light.

After noticing the fast motion of WISE J085510.83-071442.5 in March, 2013, Luhman spent time analyzing additional images taken with Spitzer and the Gemini South telescope on Cerro Pachon in Chile. Spitzer's infrared observations helped to determine the frosty temperature of the brown dwarf.

WISE J085510.83-071442.5 is estimated to be 3 to 10 times the mass of Jupiter. With such a low mass, it could be a gas giant similar to Jupiter that was ejected from its star system. But scientists estimate it is probably a brown dwarf rather than a planet since brown dwarfs are known to be fairly common. If so, it is one of the least massive brown dwarfs known.

This diagram illustrates the locations of the star systems that are closest to the Sun. The year when each star was discovered to be a neighbor of the Sun is indicated. The brown dwarf WISE J085510.83-071442.5 is the fourth nearest system to the Sun. Janella Williams, Penn State University



Combined detections from WISE and Spitzer, taken from different positions around the Sun, enabled the measurement of its distance through the parallax effect. This is the same principle that explains why your finger, when held out right in front of you, appears to jump from side to side when you alternate left-eye and right-eye views.

In March of 2013, Luhman's analysis of the images from WISE uncovered a pair of much warmer brown dwarfs at a distance of 6.5 light years, making that system the third closest to the Sun. His search for rapidly moving bodies also demonstrated that the outer solar system probably does not contain a large, undiscovered planet, which has been referred to as "Planet X" or "Nemesis."

"It is remarkable that even after many decades of studying the sky, we still do not have a complete inventory of the Sun's nearest neighbors," said Michael Werner, the project scientist for Spitzer at NASA's Jet Propulsion Laboratory (JPL), which manages and operates Spitzer. "This exciting new result demonstrates the power of exploring the universe using new tools, such as the infrared eyes of WISE and Spitzer." An animation and high-resolution images are online at science.psu.edu/news-and-events/2014-news/Luhman4-2014

http://www.eurekalert.org/pub_releases/2014-04/embo-rao042314.php#rssowlmlink

Reconstructed ancient ocean reveals secrets about the origin of life

Researchers from the University of Cambridge have published details about how the first organisms on Earth could have become metabolically active.

HEIDELBERG - The results, which are reported in the journal *Molecular Systems Biology*, permit scientists to speculate how primitive cells learned to synthesize their organic components – the molecules that form RNA, lipids and amino acids. The findings also suggest an order for the sequence of events that led to the origin of life. A reconstruction of Earth's earliest ocean in the laboratory revealed the spontaneous occurrence of the chemical reactions used by modern cells to synthesize many of the crucial organic molecules of metabolism.

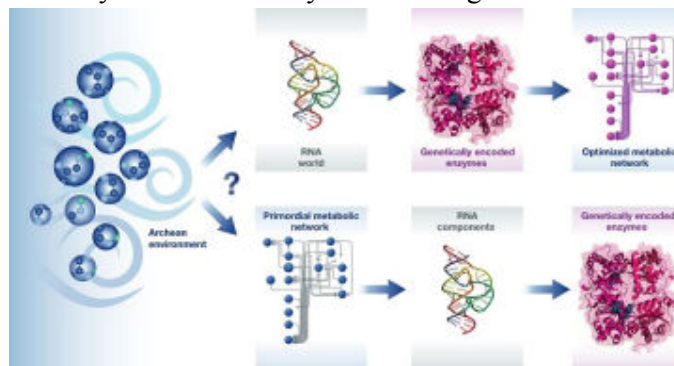
Previously, it was assumed that these reactions were carried out in modern cells by metabolic enzymes, highly complex molecular machines that came into existence during the evolution of modern organisms.

Almost 4 billion years ago life on Earth began in iron-rich oceans that dominated the surface of the planet. An open question for scientists is when and how cellular metabolism, the network of chemical reactions necessary to produce nucleic acids, amino acids and lipids, the building blocks of life, appeared on the scene.

The observed chemical reactions occurred in the absence of enzymes but were made possible by the chemical molecules found in the Archean sea. Finding a series of reactions that resembles the "core of cellular metabolism" suggests that metabolism predates the origin of life. This implies that, at least initially, metabolism may not have been shaped by evolution but by molecules like RNA formed through the chemical conditions that prevailed in the earliest oceans.

"Our results demonstrate that the conditions and molecules found in the Earth's ancient oceans assisted and accelerated the interconversion of metabolites that in modern organisms make up glycolysis and the pentose-phosphate pathways, two of the essential and most centrally placed reaction cascades of metabolism," says Dr. Markus Ralser, Group Leader at the Department of Biochemistry at the University of Cambridge and the

National Institute for Medical Research. "In our reconstructed version of the ancient Archean ocean, these metabolic reactions were particularly sensitive to the presence of ferrous iron that helped catalyze many of the chemical reactions that we observed." From the analysis of early oceanic sediments, geoscientists such as Alexandra V. Turchyn from the Department of Earth Sciences at the University of Cambridge, one of the co-authors of the study, concluded that soluble forms of iron were one of the most frequently found molecules in the prebiotic oceans.



A reconstruction of Earth's earliest ocean in the laboratory revealed the spontaneous occurrence of the chemical reactions used by modern cells to synthesize many of the crucial organic molecules of metabolism (bottom pathway).

Whether and how the first enzymes adopted the metal-catalyzed reactions described by the scientists remain to be established. Image: Ralser et al.

The scientists reconstructed the conditions of this prebiotic sea based on the composition of various early sediments described in the scientific literature. The different metabolites were incubated at high temperatures (50-90oC) similar to what might be expected close to a hydrothermal vent of an oceanic volcano, a temperature that would not support the activity of conventional protein enzymes. The chemical products were separated and analyzed by liquid chromatography tandem mass spectrometry.

Some of the observed reactions could also take place in water but were accelerated by the presence of metals that served as catalysts. "In the presence of iron and other compounds found in the oceanic sediments, 29 metabolic-like chemical reactions were observed, including those that produce some of the essential chemicals of metabolism, for example precursors of the building blocks of proteins or RNA," says Ralser. "These results indicate that the basic architecture of the modern metabolic network could have originated from the chemical and physical constraints that existed on the prebiotic Earth."

The detection of one of the metabolites, ribose 5-phosphate, in the reaction mixtures is particularly noteworthy. Its availability means that RNA precursors could in theory give rise to RNA molecules that encode information, catalyze chemical reactions and replicate. Whether and how the first enzymes adopted the metal-catalyzed reactions described by the scientists remain to be established.

Non-enzymatic glycolysis and pentose phosphate pathway-like reactions in a plausible Archean ocean Markus A. Keller, Alexandra V. Turchyn, Markus Ralser doi: 10.1002/msb.20145228 <http://msb.embopress.org/cgi/doi/10.1002/msb.20145228>

News and Views by Pier Luigi Luisi: doi: 10.1002/msb.20145351 <http://msb.embopress.org/cgi/doi/10.1002/msb.20145351>

<http://www.bbc.com/news/science-environment-27158883#rssowlmlink>

Agreement reached on deep sea mining

Plans to open the world's first mine in the deep ocean have moved significantly closer to becoming reality.

A Canadian mining company has finalised an agreement with Papua New Guinea to start digging up an area of seabed. The controversial project aims to extract ores of copper, gold and other valuable metals from a depth of 1,500m. However, environmental campaigners say mining the ocean floor will prove devastating, causing lasting damage to marine life.

The company, Nautilus Minerals, has been eyeing the seabed minerals off Papua New Guinea (PNG) since the 1990s but then became locked in a lengthy dispute with the PNG government over the terms of the operation.

Under the agreement just reached, PNG will take a 15% stake in the mine by contributing \$120m towards the costs of the operation.

Mike Johnston, chief executive of Nautilus Minerals, told BBC News: "It's taken a long time but everybody is very happy." "There's always been a lot of support for this project and it's very appealing that it will generate a significant amount of revenue in a region that wouldn't ordinarily expect that to happen."

The mine will target an area of hydrothermal vents where superheated, highly acidic water emerges from the seabed, where it encounters far colder and more alkaline seawater, forcing it to deposit high concentrations of minerals. The result is that the seabed is formed of ores that are far richer in gold and copper than ores found on land. Mr Johnston said that a temperature probe left in place for 18 months was found to have "high grade copper all over it".

For decades, the idea of mining these deposits - and mineral-rich nodules on the seabed - was dismissed as unfeasible because of the engineering challenge and high cost. But the boom in offshore oil and gas operations in recent years has seen the development of a host of advanced deep sea technologies at a time when intense demand for valuable metals has pushed up global prices.

The mine, known as Solwara-1, will be excavated by a fleet of robotic machines steered from a ship at the surface. The construction of the largest machine, a Bulk Cutter weighing 310 tonnes, has just been completed by an underwater specialist manufacturer, Soil Machine Dynamics (SMD), based in Newcastle, UK. The plan is to break up the top layer of the seabed so that the ore can be pumped up as a slurry. The agreement with PNG now clears the way for Nautilus to order a specialist vessel to manage the operation. Mining itself could start within five years.

Environmental campaigners have long argued that seabed mining will be hugely destructive and that the precise effects remain unknown. Richard Page, oceans campaigner for Greenpeace, said: "The emerging threat of seabed mining is an urgent wake-up call for the need to protect the oceans. "The deep ocean is not yet mapped or explored and so the potential loss of fauna and biospheres from mining is not yet understood. "Only 3% of the oceans and only 1% of international waters are protected, which makes them some of the most vulnerable places on earth - what we desperately need is a global network of ocean sanctuaries."

According to Nautilus, the mine will have a minimal environmental footprint, covering the equivalent of about 10 football fields and focusing on an area which is likely to be rapidly re-colonised by marine life.

Mr Johnston said: "It's a resilient system and studies show that life will recover in 5-10 years. An active venting site 1km to the southeast has the same bugs and snails and the current will carry the bugs and snails to the mine site. We expect it to recover quite quickly."

But this will be the first attempt to extract ore from the ocean floor, so the operation - and the company's assurances about the impacts - will be watched closely. So far, 19 licences to search for seabed minerals have been awarded by the International Seabed Authority, the UN body policing this emerging industry.

The International Seabed Authority (ISA), which has welcomed the Nautilus Minerals agreement with Papua New Guinea, is currently drawing up guidelines for the environmental management of future seabed mining. Michael Lodge of the ISA told the BBC: "This is a very exciting opportunity and we are looking forward to learning from the tests of the new machine, which is a world first and should give us some valuable insights into technical feasibility and environmental impact."

<http://phys.org/news/2014-04-coated-droplets-hint-formation-early.html#rsslmlink>

Coated droplets hint at formation of early cells

Researchers at the University of Bristol have designed a chemical system that brings together alternative ideas on how primitive cells were formed on the early Earth to produce a new model of protocell organization.

Phys.org - The most fundamental requirement for the emergence of cells on the early Earth is the existence of a closed compartment, but how this came about remains a mystery. The work is described in an article published this week in Nature Chemistry.

Two alternative theories based on the self-assembly of fatty acid membrane-bounded water droplets (vesicles) or the spontaneous phase separation of membrane-free liquid droplets (coacervates) are being tested experimentally, but neither model is fully satisfactory.

Professor Stephen Mann and Dr Dora Tang, with colleagues in the new Bristol Centre for Protolife Research in the School of Chemistry and collaborators at Imperial College London, have now addressed this problem by designing and constructing a new type of protocell that integrates aspects of both hypotheses to produce a hybrid model of prebiotic organization.

The team first prepared membrane-free droplets containing high concentrations of biomolecules such as adenosine triphosphate (ATP), ribonucleic acid (RNA) and a short or long polymer of the natural amino acid lysine, and then added low amounts of a fatty acid.

The concentration of the fatty acid was too low for the molecules to self-organize into vesicles, and instead they became attached to the surface of the droplets to produce a continuous organic membrane. In this way, the researchers were able to produce protocells that were both membrane-bounded and chemically enriched.

Professor Stephen Mann said: "This work could open up a new horizon in protocell research as it offers an integrated approach to the problem of how the first cells were formed and organized.

"Our new hybrid model can be easily developed towards more complex systems, and designed and tested for new types of functions. For example, we hope to use the new design principle to study the membrane-mediated regulation of biological reactions inside coacervate droplets."

More information: "Fatty acid membrane assembly on coacervate microdroplets as a step towards a hybrid protocell model." T-Y. Dora Tang, et al. Nature Chemistry (2014) DOI: 10.1038/nchem.1921.

<http://phys.org/news/2014-04-carbon-reactions-basalt-carbonate-minerals.html#rssowlmlink>

Researchers find carbon reactions with basalt can form carbonate minerals faster than thought

pumping CO₂ into underground basalt formations resulted in 80 % of the carbon being sequestered into carbonate materials within one year

Phys.org - A pair of researchers, one with the Institute of Earth Sciences at the University of Iceland, the other with University College in London, has found that mixing carbon dioxide with water and pumping it into underground basalt formations in Iceland has resulted in 80 percent of the carbon being sequestered into carbonate materials within one year's time. In their paper published in the journal *Science*, Sigurdur Gislason and Eric Oelkers suggest their method of carbon sequestering may prove a feasible approach to carbon capture and storage (CCS).

As the planet continues to warm due to greenhouse gases (mainly CO₂) captured in the atmosphere, scientists focus on two main approaches to solving the problem: stopping (or at least slowing) the addition of new gasses into the atmosphere, or devising techniques to remove the gasses already there. In this new effort, the researchers are focused on the latter approach.

Most of the press dedicated to global warming to date has been focused on ways to reduce greenhouse gas emissions. Sadly, that approach hasn't had the desired impact. Because of that governments and organizations are increasingly turning to CCS technology. Just this past week the U.N. issued a climate report which highlighted the necessity of putting more effort into removing gasses to slow the massive costs of the expected average rise in global temperatures in the near future.

The problem with pulling carbon out of the air is where to put it - pushing it into the ground is both expensive and risky - geologic activity, such as earthquakes could cause fissures allowing the gas to seep back out into the atmosphere. This is where the researchers in Iceland come in - they've been dissolving carbon dioxide into water (from a geothermal plant) and pumping the mixture into basalt formations (that came about due to volcanic activity) underground. Over time, the carbon reacts with calcium, magnesium and iron in the basalt and forms carbonate minerals such as limestone. Scientists have known about this process for some time, but until now, didn't realize it could happen so quickly. The researchers report that approximately 80 percent of the carbon became embedded in the minerals over the span of just one year. The down side is that it takes a lot of water - up to twenty times as much as the carbon dioxide. Another problem could be pulling the carbon dioxide out of the air, and perhaps having to transport it to a sequestration site. There is also the difficulty of finding the right kind of basalt - it has to be porous.

Regardless of the problems, it appears likely that the cost of storing carbon dioxide in such fashion (or others like it) will likely become relatively smaller as the costs of dealing with rising temperatures and sea levels increases, which hopefully, will cause more such efforts to come about.

More information: Carbon Storage in Basalt, Science 25 April 2014: Vol. 344 no. 6182 pp. 373-374. DOI: 10.1126/science.1250828

Abstract

All the carbon in the atmosphere, living creatures, and dissolved in the oceans is derived from rocks and will eventually end up in rocks, the largest carbon reservoir on Earth. The carbon moves from one reservoir to another in what is called the carbon cycle. Humans have accelerated this cycle by mining and burning fossil fuel since the beginning of the industrial revolution, causing rising atmospheric carbon dioxide (CO₂) concentrations that are the main cause of global warming. One option for mitigating high levels of global warming is to capture CO₂ and safely store it for thousands of years or longer in subsurface rocks. By accelerating carbonate mineral formation in these rocks, it is possible to

rebalance the global carbon cycle, providing a long-term carbon storage solution. However, this approach is both technically challenging and economically expensive.

<http://nyti.ms/1rAe1kF>

Treating Appendicitis Without Surgery

For many years, immediate surgery has been considered the only proper treatment for appendicitis in children.

By NICHOLAS BAKALAR

Now a small study suggests that in some cases, antibiotics alone may be better.

The study, [published online in The Journal of the American College of Surgeons](#), involved 77 uncomplicated cases of acute appendicitis that met specific criteria. Patients were 7 to 17 years old; they had had pain for 48 hours or less; their white blood cell counts were only moderately elevated (less than 18,000); CT or ultrasound scans confirmed their appendix had not ruptured; and they had no impacted feces.

Thirty of the patients opted not to have immediate surgery and were treated with a minimum of 24 hours of intravenous antibiotics, followed by about a week of oral antibiotics. Any child who did not get better within 24 hours of antibiotics underwent surgery.

Of the 30, two needed surgery within 24 hours, and a third underwent surgery a day after discharge because of insufficient improvement, but none suffered complications. The other 27 nonsurgical patients missed fewer days of school and resumed normal activities sooner than those who had had appendectomies.

“It’s so dogmatic to operate for appendicitis that it requires a huge paradigm shift,” said the senior author, Dr. Katherine J. Deans, an assistant professor of surgery at Nationwide Children’s Hospital. “But there are choices. It may be safe to wait.”