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Link found between cell death and inflammatory disease

A team of Melbourne researchers has shown a recently discovered type of cell death called necroptosis could be the underlying cause of inflammatory disease.

The research team discovered that a previously identified molecule involved in necroptosis, called RIPK1, was essential for survival by preventing uncontrolled inflammation. This finding could lead to future treatments for inflammatory diseases including Crohn's disease, rheumatoid arthritis and psoriasis.

The researchers, from the Walter and Eliza Hall Institute, also discovered that the 'survival' molecule RIPK1 acts as the 'gatekeeper' between cell life and death. In a paper published in the journal Cell, they reveal RIPK1 is essential for a cell's decision to live or die, and in choosing how to die.

Institute researchers Associate Professor John Silke, Dr Motti Gerlic and Dr Ben Croker led the project, working with PhD students Mr James Rickard, Ms Joanne O'Donnell and Mr Joseph Evans. Associate Professor Silke said the team had shown for the first time that RIPK1 (receptor interacting protein kinase 1) was a master controller of cell life and death.

"We showed that, in the body, RIPK1 is not only essential for initiating necroptosis, but also for inhibiting necroptosis and the runaway inflammation that can cause severe tissue damage," Associate Professor Silke said. "We also found that it played a role in another type of programmed cell death called apoptosis. Our research highlighted that RIPK1 is the gatekeeper that controls whether a cell lives or dies, and the decision it makes on how to die."

Necroptosis is a type of 'controlled' death that instructs a cell to die while stimulating an inflammatory reaction to let the immune system know something has gone wrong. However when this cell death pathway begins to spiral out of control, it can lead to inflammatory disease. Necroptosis has also been implicated in neurodegenerative disease, brain injuries caused by blood loss, and some viral infections.

Dr Gerlic said their study provided the first evidence that RIPK1 was essential for inhibiting necroptosis.

"This research puts a new dogma on the table about RIPK1 and its role in controlling or inhibiting necroptosis," Dr Gerlic said. "It is also the first time that we have shown necroptosis and the molecules involved actually induce inflammatory disease, suggesting that targeting this pathway could be useful for treating human conditions such as psoriasis, rheumatoid arthritis and Crohn's disease."

Associate Professor Silke said necroptosis was a newly discovered type of cell death that had only really been studied in the past five years. "When our time comes to die, we don't have a choice," he said.

"However cells make this choice all the time – not only whether they die, but also how they die. They can choose to die quietly, or they can make a fuss. Necroptosis is their way of letting everyone else know that they are dying and help is needed usually when something has gone wrong such as a viral infection."

Dr Gerlic said the research team had also shown RIPK1 played other important roles in the body. "As part of the research we found that RIPK1 was essential for keeping blood stem cells alive after bone marrow transplant," he said. "This finding is particularly important when considering treatments that target RIPK1, as it could have unwanted side-effects for other cells in the body. Therefore it is important to ensure any potential drugs are properly investigated for any off-target effects."

Associate Professor Silke said the institute was already capitalising on its expertise in necroptotic cell death with a drug discovery program to identify small molecules that could target molecules downstream of RIPK1 in the necroptotic pathway, such as MLKL (mixed lineage kinase domain-like).

The research was supported by the Australian National Health and Medical Research Council, Thomas William Francis & Violet Coles Trust and the Victorian Government. Mr Rickard and Ms O'Donnell are enrolled as PhD students through The University of Melbourne, and Mr Evans is enrolled through La Trobe University.

http://www.medscape.com/viewarticle/824971?src=rss#rssowlmlink

Is Atrial Fibrillation Necessary? The Most Important Study Presented at the Heart Rhythm Society 2014 Scientific Sessions

Most diseases have a turning point, a time when things begin to change.

John Mandrola

What follows is a report on what I believe may be (pardon the big word) an inflection point in the way we think about the most common heart-rhythm disorder. **Dr Rajeev Pathak**, an electrophysiology fellow in the laboratory of **Prof Prashanthan Sanders** in Adelaide, Australia, gave the presentation. It happened late in the afternoon, in a small room, nestled into a back corner of the massive convention hall. Even though this paper won the prestigious **Eric Prystowsky** award for outstanding clinical science, there were no press releases, no simultaneous publications, and nearly no attendees in the small room. Session chair **Dr Francis Marchlinski** (University of Pennsylvania, Philadelphia) remarked that it "was too bad more people weren't here to hear this."

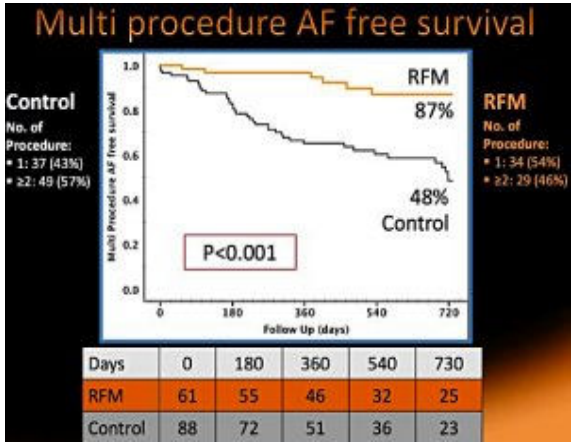
Here's my recap of the **Aggressive Risk Factor Reduction Study-Implications for Ablation Outcomes** (ARREST-AF) trial[1]:

Background: Previous work from the Adelaide researchers has demonstrated the causative role of typical cardiovascular risk factors (obesity, high blood pressure, diabetes, smoking, alcohol, sleep apnea, etc) in promoting the substrate for atrial fibrillation. Last year at the **Heart Rhythm Society 2013 Scientific Sessions**, this group presented data showing that weight loss (in obese sheep) resulted in favorable structural and electrical properties of the atria[2]. Most notably, there was a reduction in interstitial fibrosis.

They then demonstrated similar findings in humans. In this study [3], which was published in the *Journal of the American Medical Association*, they selected overweight AF patients on the waiting list for ablation and randomized them to either a physician-led lifestyle-intervention group or standard care. Both groups lost weight and improved on measures of overall health, but those in the aggressive-intervention group improved much more. Just like the sheep, humans who lost weight enjoyed shrinking LA volumes and striking drops in AF burden, with 30% of patients avoiding AF ablation altogether.

This work set the stage for ARREST-AF. Dr Sanders told me they figured if risk-factor modification worked before ablation, it would likely work after. The hypothesis, therefore, was that late recurrence of AF after ablation is due to progression of the underlying substrate, and aggressive risk-factor intervention would improve ablation outcomes.

Methods: Patients (n=165) were selected for the study after their first AF ablation if they had a body-mass index (BMI) >27 and one risk factor, such as hypertension, diabetes, sleep apnea, or abnormal lipids. All patients were offered aggressive risk-factor management in a physician-led clinic. The active-treatment group included 61 patients who accepted, while the 88 patients who refused made up the control group. The two groups were followed for two years, and the primary outcome measure was recurrence of AF.



RFM=Risk-factor-modification group

Patients in the active-treatment group underwent intense lifestyle modification, which included active weight-management strategies and medical treatment of hyperlipidemia, glucose intolerance, high blood pressure, and sleep apnea. Tobacco and alcohol use were aggressively targeted. These primary therapies were accomplished in a separate clinic from electrophysiology. Dr Sanders emphasized that the Adelaide brand of risk-factor modification is unique and robust.

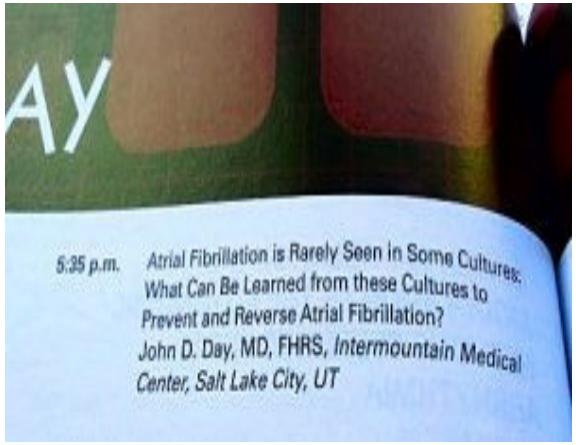
Results: The impact on risk factors was striking. Patients in the risk-factor-modification arm lost weight. Glycemic control improved, blood pressure dropped, and the percent of patients with nocturnal hypoxic episodes decreased.

Structural changes of the heart also were significant. Left atrial volume and LV diastolic volume decreased. Using standard questionnaires, measures of AF symptom burden and global well-being also improved.

AF-free survival after a single ablation procedure was 62% for patients in risk-factor-modification group and 26% for the control arm. After multiple ablations, AF-free survival increased to 87% in the risk-factor-modification group vs 48% in the control arm. Said another way, Adelaide-style risk-factor management increased the success rate of AF ablation fivefold.

Conclusion: Risk-factor management improves outcomes after AF ablation and should be considered crucial when choosing a rhythm-control strategy.

Comments:



I'm going to do something unusual. Rather than offer opinion, I'll present words from **Dr John Day** (Intermountain Health, Salt Lake City UT), who is president-elect of the **Heart Rhythm Society** and program director of this meeting. During a session entitled "How to prevent and reverse AF," Dr Day gave one of the most unusual talks I have ever heard at a medical meeting. He started with a personal confession:

"Until a few years ago, my life was about ablating AF, thousands of ablations, three per day. In the process of this, I didn't give a whole lot of thought as to how the patient got AF or what was happening to my life."

I was now hooked, utterly mesmerized. I thought to myself: is this really happening, or am I jetlagged?

Next, as he showed images of his diet at the time - doughnuts, pizza, and soda - he told the audience:

"At age 44, my health had hit rock bottom. I was overweight. I had developed high blood pressure, high cholesterol, palpitations, insomnia, and even an autoimmune disease. And I was taking five medications. Something had to change."

Stay with me. It gets better.

He described trying the usual diets and solutions, even the "gluten-free thing." Not much happened. Then he got interested in the famous book *The China Study* .

"I became fascinated with some of these rural Chinese villages where people lived long lives, free of heart disease and cancer. I speak Chinese, and we visited these places multiple times.

What I learned has taken my life in a whole new direction.

My entire perspective of AF has changed from one of ablation to one of . . . does AF even need to happen?"

Let me remind you that Dr Day is about to lead the world's most influential electrophysiology society.

Then he showed an incredibly professional four-minute video of a Chinese village. (He's writing a book, and this is likely the trailer.) Alongside rolling streams were smiling 100-year-old Chinese women. A calm female voice narrates . . .

"They have such a sense of peace about them."

Then this, in Dr Day's voice:

"Whether you are 40, or 50, or 60, or 70, it's never too late to make changes."

The video stops, but Dr Day continues:

"I began to slow down. I started looking at the big picture, eating real food, sleeping. My extra weight came off without trying; my cholesterol fell nearly 100 points; my BP dropped 30 to 40 points and my CRP went below 1.

"I now take no medications. I feel good."

And for the win:

"This has changed my approach when I meet with patients. No longer is atrial fibrillation something that we just ablate."

In an interview with me the next day, Dr Day said he thinks (in most cases) AF may be unnecessary.

Enough said. **JMM**

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2. Mahajan R, Brooks AG, Shipp N, et al. AF and obesity: Impact of weight reduction on the atrial substrate. Heart Rhythm 2013; May 9, 2013; Denver, CO. Abstract YIA-01.

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http://bit.ly/1qFD3BW

Having a sense of purpose may add years to your life

Feeling that you have a sense of purpose in life may help you live longer, no matter what your age, according to research published in Psychological Science, a journal of the Association for Psychological Science.

The research has clear implications for promoting positive aging and adult development, says lead researcher Patrick Hill of Carleton University in Canada: "Our findings point to the fact that finding a direction for life, and setting overarching goals for what you want to achieve can help you actually live longer, regardless of when you find your purpose," says Hill. "So the earlier someone comes to a direction for life, the earlier these protective effects may be able to occur."

Previous studies have suggested that finding a purpose in life lowers risk of mortality above and beyond other factors that are known to predict longevity. But, Hill points out, almost no research examined whether the benefits of purpose vary over time, such as across different developmental periods or after important life transitions.

Hill and colleague Nicholas Turiano of the University of Rochester Medical Center decided to explore this question, taking advantage of the nationally representative data available from the Midlife in the United States (MIDUS) study.

The researchers looked at data from over 6000 participants, focusing on their self-reported purpose in life (e.g., "Some people wander aimlessly through life, but I am not one of them") and other psychosocial variables that gauged their positive relations with others and their experience of positive and negative emotions.

Over the 14-year follow-up period represented in the MIDUS data, 569 of the participants had died (about 9% of the sample). Those who had died had reported lower purpose in life and fewer positive relations than did survivors.

Greater purpose in life consistently predicted lower mortality risk across the lifespan, showing the same benefit for younger, middle-aged, and older participants across the follow-up period.

This consistency came as a surprise to the researchers:

"There are a lot of reasons to believe that being purposeful might help protect older adults more so than younger ones," says Hill. "For instance, adults might need a sense of direction more, after they have left the workplace and lost that source for organizing their daily events. In addition, older adults are more likely to face mortality risks than younger adults."

"To show that purpose predicts longer lives for younger and older adults alike is pretty interesting, and underscores the power of the construct," he explains.

Purpose had similar benefits for adults regardless of retirement status, a known mortality risk factor. And the longevity benefits of purpose in life held even after other indicators of psychological well-being, such as positive relations and positive emotions, were taken into account.

"These findings suggest that there's something unique about finding a purpose that seems to be leading to greater longevity," says Hill.

The researchers are currently investigating whether having a purpose might lead people to adopt healthier lifestyles, thereby boosting longevity.

Hill and Turiano are also interested in examining whether their findings hold for outcomes other than mortality.

"In so doing, we can better understand the value of finding a purpose throughout the lifespan, and whether it provides different benefits for different people," Hill concludes.

All data and materials have been made publicly available via the Interuniversity Consortium for Political and Social Research and can be accessed at the following URLs: http://doi.org/10.3886/ICPSR04652.v6 and http://midus.colectica.org/. 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.

Preparation of the manuscript was supported through funding from the National Institute of Mental Health (Grant T32-MH018911-23), and the data collection was supported by Grant P01-AG020166 from the National Institute on Aging.

http://bit.ly/RUK7eH

Alcohol and drugs: Not just for modern man

New article uncovers the 'anthropology of intoxication' in prehistoric European societies

Unlike modern Man, the prehistoric people of Europe did not use mind-altering substances simply for their hedonistic pleasure. The use of alcohol and plant drugs – such as opium poppies and hallucinogenic mushrooms – was highly regulated and went hand-in-hand with the belief system and sacred burial rituals of many preindustrial societies. Elisa Guerra-Doce of the Universidad de Valladolid in Spain contends that their use was an integral part of prehistoric beliefs, and that these substances were believed to aid in communication with the spiritual world. Guerra-Doce's research appears in Springer's Journal of Archaeological Method and Theory.

Despite the fact that the consumption of these substances is as ancient as human society itself, it is only fairly recently that researchers have started to look into the historical and cultural contexts in which mind-altering products were used in Europe. To add to the body of literature about the anthropology of intoxication in prehistoric European societies, Guerra-Doce systematically documented the cultural significance of consuming inebriating substances in these cultures.

In the research, four different types of archaeological documents were examined: the macrofossil remains of the leaves, fruits or seeds of psychoactive plants; residues suggestive of alcoholic beverages; psychoactive alkaloids found in archaeological artifacts and skeletal remains from prehistoric times; and artistic depictions of mood-altering plant species and drinking scenes. These remnants include bits of the opium poppy in the teeth of a male adult in a Neolithic site in Spain, charred Cannabis seeds in bowls found in Romania, traces of barley beer on several ceramic vessels recovered in Iberia, and abstract designs in the Italian Alps that depict the ritual use of hallucinogenic mushrooms.

Because Guerra-Doce mainly found traces of sensory-altering products in tombs and ceremonial places, she believes such substances are strongly linked to ritual usage. They were consumed in order to alter the usual state of consciousness, or even to achieve a trance state. The details of the rituals are still unclear, but the hypothesis is that the substances were either used in the course of mortuary rites, to provide sustenance for the deceased in their journey into the afterlife, or as a kind of tribute to the underworld deities.

She adds that the right to use such substances may have been highly regulated given that they were a means to connect with the spirit world, and therefore played a sacred role among prehistoric European societies.

"Far from being consumed for hedonistic purposes, drug plants and alcoholic drinks had a sacred role among prehistoric societies," says Guerra-Doce. "It is not surprising that most of the evidence derives from both elite burials and restricted ceremonial sites, suggesting the possibility that the consumption of mind-altering products was socially controlled in prehistoric Europe."

Reference: Guerra-Doce, E. (2014). The Origins of Inebriation: Archaeological Evidence of the Consumption of Fermented Beverages and Drugs in Prehistoric Eurasia. Journal of Archaeological Method and Theory. DOI 10.1007/s10816-014-9205-z.

http://bit.ly/1jxPgio

Against the current with lava flows

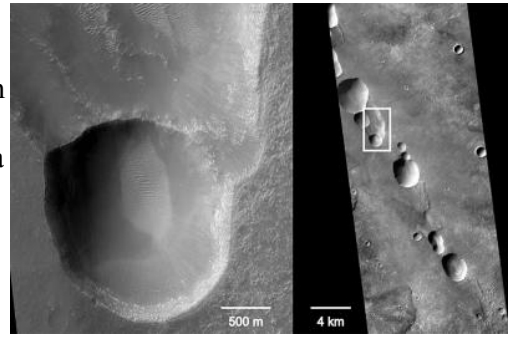
Lava formed massive canyons on Mars

An Italian astronomer in the 19th century first described them as 'canali' – on Mars' equatorial region, a conspicuous net-like system of deep gorges known as the Noctis Labyrinthus is clearly visible. The gorge system, in turn, leads into another massive canyon, the Valles Marineris, which is 4,000 km long, 200 km wide and 7 km deep. Both of these together would span the US completely from east to west.

As these gorges, when observed from orbit, resemble terrestrial canyons formed by water, most researchers assumed that immense flows of water must have carved the Noctis Labyrinthus and the Valles Marineris into the surface of Mars. Another possibility was that tectonic activity had created the largest rift valley on a planet in our solar system.

Lava flows caused the gorges

These assumptions were far from the mark, says Giovanni Leone, a specialist in planetary volcanism in the research group of ETH professor Paul Tackley. Only lava flows would have had the force and mass required to carve these gigantic gorges into the surface of Mars. The study was recently published in the Journal of Volcanology and Geothermal Research.



A pit chain marks a subterranean lava tunnel. Its roof collapsed partially. **Mars Image Explorer / asu.edu**

In recent years, Leone has examined intensively the structure of these canyons and their outlets into the Ares Vallis and the Chryse Planitia, a massive plain on Mars' low northern latitude. He examined thousands of high-resolution surface images taken by numerous Mars probes, including the latest from the Mars Reconnaissance Orbiter, and which are available on the image databases of the US Geological Survey.

No discernible evidence of erosion by water

His conclusion is unequivocal: "Everything that I observed on those images were structures of lava flows as we know them on Earth," he emphasises. "The typical indicators of erosion by water were not visible on any of them." Leone therefore does not completely rules out water as final formative force. Evidence of water, such as salt deposits in locations where water evaporated from the ground or signs of erosion on the alluvial fans of the landslides, are scarce but still existing. "One must therefore ask oneself seriously how Valles Marineris could have been created by water if one can not find any massive and widespread evidence of it." The Italian volcanologist similarly could find no explanation as to where the massive amounts of water that would be required to form such canyons might have originated.

Source region of lava flows identified

The explanatory model presented by Leone in his study illustrates the formation history from the source to the outlet of the gorge system. He identifies the volcanic region of Tharsis as the source region of the lava flows and from there initial lava tubes stretched to the edge of the Noctis Labyrinthus. When the pressure from an eruption subsided, some of the tube ceilings collapsed, leading to the formation of a chain of almost circular holes, the 'pit chains'.

When lava flowed again through the tubes, the ceilings collapsed entirely, forming deep V-shaped troughs. Due to the melting of ground and rim material, and through mechanical erosion, the mass of lava carved an ever-deeper and broader bed to form canyons. The destabilised rims then slipped and subsequent lava flows carried away the debris from the landslides or covered it. "The more lava that flowed, the wider the canyon became," says Leone.

Leone supported his explanatory model with height measurements from various Mars probes. The valleys of the Noctis Labyrinthus manifest the typical V-shape of 'young' lava valleys where the tube ceilings have completely collapsed. The upper rims of these valleys, however, have the same height. If tectonic forces had been at work, they would not be on the same level, he says.

The notion of water as the formative force, in turn, is undermined by the fact that it would have taken tens of millions of cubic kilometres of water to carve such deep gorges and canyons. Practically all the atmospheric water of all the ages of Mars should have been concentrated only on Labyrinthus Noctis. Moreover, the atmosphere on Mars is too thin and the temperatures too cold. Water that came to the surface wouldn't stay liquid, he notes: "How could a river of sufficient force and size even form?"

Life less likely

Leone's study could have far-reaching consequences. "If we suppose that lava formed the Noctis Labyrinthus and the Valles Marineris, then there has always been much less water on Mars than the research community has believed to date," he says. Mars received very little rain in the past and it would not have been sufficient to erode such deep and large gorges. He adds that the shallow ocean north of the equator was probably much smaller than imagined – or hoped for; it would have existed only around the North Pole. The likelihood that life existed, or indeed still exists, on Mars is accordingly much lower.

Leone can imagine that the lava tubes still in existence are possible habitats for living organisms, as they would offer protection from the powerful UV rays that pummel the Martian surface. He therefore proposes a Mars mission to explore the lava tubes. He considers it feasible to send a rover through a hole in the ceiling of a tube and search for evidence of life. "Suitable locations could be determined using my data," he says.

Swimming against the current

With his study, the Italian is swimming against the current and perhaps dismantling a dogma in the process. Most studies of the past 20 years have been concerned with the question of water on Mars and how it could have formed the canyons.

Back in 1977, a researcher first posited the idea that the Valles Marineris may have been formed by lava, but the idea failed to gain traction. Leone says this was due to the tunnel vision that the red planet engenders and the prevailing mainstream research. The same story has been told for decades, with research targeted to that end, without achieving a breakthrough. Leone believes that in any case science would only benefit in considering other approaches. "I expect a spirited debate," he says. "But my evidence is strong."

Further reading

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http://phys.org/news/2014-05-students-artificial-kidney-d.html#rssowlmlink

Students design artificial kidney with 3-D printing

Students design artificial kidney with 3-D printing

Students have recently taken the application of three-dimensional printing into the medical field to create body parts

Phys.org -Three-dimensional printing has garnered coverage in the popular press for its application in the custom manufacturing of tools and mechanical parts. But six School of Engineering seniors have recently taken the application of the technology into the medical field, using 3-D printing to create body parts.

Under the direction of Anson Ma, assistant professor in the Department of Chemical and Biomolecular Engineering and the Institute of Materials Science, two three-person teams of chemical engineering students were tasked with creating an artificial kidney for their Senior Design Project using 3-D printing technology. 3-D printing is an additive manufacturing method capable of creating complex parts that are otherwise impossible or extremely difficult to produce.

The students participating were: Derek Chhiv, Meaghan Sullivan, Danny Ung, Benjamin Coscia, Guleid Awale, and Ali Rogers. They are one of the first classes of students to partner with a commercial 3-D printing company, ACT Group, to create a prototype.

The challenge the teams set out to tackle is rooted in a very real problem.

The United States Renal Data System reports that, as recently as 2009, End-Stage Renal Disease (ESRD) resulted in over 90,000 deaths. Options for treatment of renal disease are essentially limited to either an organ transplant or dialysis.

However, there is a limited supply of transplantable kidneys, with demand far outstripping the supply; and dialysis is expensive and is only a temporary solution. According to data from the National Kidney Foundation, there are currently nearly 100,000 people awaiting kidney transplants in the United States, yet only 14,000 kidney transplants took place in the country this year. An additional 2,500 new patients are added to the kidney waiting list each month.

Faced with these challenges, the two UConn teams set out on a year-long effort to design and develop a prototype of a cost-effective, functional artificial kidney using chemical engineering principles and 3-D printing technology.

"The objective of the design project is to get these students to combine the latest technology and their chemical engineering knowledge, learned over their four years at UConn, to solve a technical problem where we can make a difference," notes Ma. "Can they push the technology further?"

Guleid Awale, one of the seniors, said the two design teams each took a slightly different approach to the problem. "While the other team utilized techniques such as electrodialysis and forward osmosis in their prototype, our group opted for mainly hollow fiber membrane technology commonly found in traditional hemodialysis treatments."

Benjamin Coscia '14 (ENG) explains the hollow fiber membrane technology: "Because 3D printing resolutions are not currently low enough to print a structure which will actually filter blood, the file is of only the shell of the kidney. Hollow fiber membranes will be installed on the inside to do the filtration function. The kidney will then be sealed together using the threads and sealing o-rings. A fluid called dialysate will be circulated on the outside of the membranes, inside of the shell, which will cause flux of components from the blood. A waste stream maintains the person's ability to urinate. The outside of the shell can be used as a substrate for growth of biological material for ease of integration into the body."

After undertaking the research and development of the design, the teams designed the prototype using AutoCAD software. Then each team collaborated with UConn technology partner ACT Group of Cromwell, Conn. to select the appropriate polymers, as well as the right printer to use in printing the particular prototype design.

The two teams presented their projects on May 2 at the School of Engineering Senior Design Demonstration Day.

"The biggest challenge in approaching the project was applying the engineering knowledge we've gained during our undergraduate years to a more complex biological application," Awale notes. "This forced us to come out of our comfort zone and rely on our problem-solving skills in order to come up with viable solutions."

http://bit.ly/1vexzOt

Origin of Mysterious Jellyfish Lightning 'Sprites' Revealed

Red electrical flashes that mysteriously hover above some thunderstorms have long puzzled scientists, but now, new research reveals how these alienlike atmospheric sprites form.

May 12, 2014 11:43 AM ET // by Tanya Lewis, LiveScience

Red sprite over Canadian County, Oklahoma, on August 6, 2013. **Jason Ahrns**

Sprites form at irregularities in the plasma, or charged particles of gas, in the ionosphere, the layer just above the dense lower atmosphere, about 37 to 56 miles (60 to 90 kilometers) above the Earth's surface, a study found.

Since disturbances in the ionosphere can affect radio communication, sprites could be useful for sensing such disturbances remotely, researchers say.

"We would like to know how sprites are initiated and how they develop," Victor Pasko, an electrical engineer at Penn State and author of the study published May 7 in the journal Nature Communications, said in a statement.

Sprites are large electrical discharges that occur above thunderstorms. They resemble reddish-orange jellyfish with bluish tentacles streaming down.

But while sprites require thunderstorms, not all thunderstorms produce sprites. Recent studies suggested that ionosphere irregularities were required for these ghostly flashes to occur, but evidence for them was lacking.

In the study, Pasko and his colleagues studied high-speed video of sprites, and developed a model for how the strange lightning evolves and disappears. They used the model to try to recreate sprite-forming conditions.

Analysis of the videos showed that streamers snake downward from the sprites much more quickly than they spread horizontally, suggesting plasma irregularities were driving the streamer spread.

To study sprite dynamics, the team used a two-dimensional mathematical model of the movement of charged particles in the sprite. They used the model to recreate how sprites are formed, using it to see how the streamers originated and how large the plasma irregularities were.

Several sources could be causing these irregularities in the plasma. The existence of a previous sprite is the most obvious, but there were none that occurred in the region studied that occurred close enough in time - unless the irregularities last much longer than scientists suspect.

Alternatively, meteors could cause irregularities as they move through the upper regions of the ionosphere, before burning up in the lower atmosphere due to friction.

The high-speed videos and models could be useful to do remote sensing of the ionosphere, to understand how natural phenomena impact long-range radio communication, the researchers said.

http://bit.ly/1lHYnS0

Dino Death Watch: Microbe Fossil Matter Reveals Post-Asteroid Cold Snap

The first-ever fossil proof of dramatic global cooling after the cosmic impact that ended the Age of Dinosaurs has been discovered.

By Charles Q. Choi, Live Science Contributor | May 12, 2014 03:00pm ET

The darkness and cold from the dust and ash thrown up by the giant collision was likely the main driver of the resulting mass die-off, known as the K-T extinction, scientists say. This extinction at the end of the Cretaceous period finished the reign of the dinosaurs.

The only dinosaurian survivors were the birds; other reptiles such as turtles and crocodiles survived as well, although these are not descended from dinosaurs.

The prime suspect behind this disaster is a cosmic impact from an asteroid or comet. Scientists have found evidence of this collision near the town of Chicxulub (CHEEK-sheh-loob) in Mexico in the form of a giant crater more than 110 miles (180 kilometers) wide.

The explosion that carved out this crater, likely caused by an object about 6 miles (10 km) across, would have released as much energy as 100 trillion tons of TNT, more than a billion times more than the atom bombs that destroyed Hiroshima and Nagasaki combined.

"When such an asteroid hits the Earth, the results are devastating," said lead study author Johan Vellekoop, a PhD candidate in paleoclimatology at Utrecht University in the Netherlands.

"The impact itself releases an enormous amount of energy, so much that in the first hours after the impact, the air is heated up, igniting global wildfires."

Speculative cooling

In principle, such impacts also loft dust and soot into the atmosphere, "blocking incoming sunlight," Vellekoop said.

"The sun is both our source of light as well as our main source of heat - hence, when sunlight can no longer reach the surface of the Earth, this surface rapidly cools down, creating a so-called 'impact winter,' a period of darkness and cold lasting for decades."

Prior studies hint that the impact winter reduced the amount of sunlight reaching Earth's surface by as much as 80 percent, cooling the land from tropical warmth to below freezing. This darkness and cold would have killed off plants and caused a global collapse of terrestrial and marine food webs.

"Ultimately, more than 50 percent of all plants and animals on Earth died out because of this," Vellekoop said.

However, until now, scientists had lacked fossil evidence of this impact winter, because this severe cold spell might have only lasted months to decades, too short a time period to be captured in a fossil record stretching across millions of years.

In addition, many of the algae that produce the chalky fossils scientists use to estimate ancient ocean surface temperatures went extinct during the end-Cretaceous mass extinction.

"Our study is the first to show that this period of darkness and cold indeed took place," Vellekoop told Live Science.

Microfossils

Vellekoop and his colleagues focused their research on rocks exposed along the Brazos River between Waco and Hearne, Texas. These rocks originated from sediments deposited on the floor of a sea that existed in the area during and after the end of the Cretaceous.

The scientists analyzed organic compounds from microbes known as Thaumarchaeota, which adjust the composition of fat molecules in their membranes as sea surface temperatures change.

The researchers investigated organic compounds from Thaumarchaeota in Bravos River sediments of the same age as the Chicxulub impact.

These sediments held coarse layers of broken shells - possibly traces of a post-impact tsunami - and anomalously high concentrations of iridium, a metal rare on Earth's surface but more common in space rocks

The findings suggest ocean temperatures fell dramatically after the impact, cooling from about 86 degrees F (30 degrees C) to about 73 degrees F (23 degrees C).

"Working on an event 66 million years ago, it is incredible that we could resolve sea water temperature changes [to] within decades," Vellekoop said.

The most important implication of these findings "is that they demonstrate how devastating large meteorite impacts can be," Vellekoop added.

"Our study confirms that such impacts can cause a so-called 'impact winter,' a global darkness lasting for years."

The researchers now aim to verify these results at other sites. The scientists detailed their findings online May 12 in the journal Proceedings of the National Academy of Sciences.

http://phys.org/news/2014-05-killer-robots.html#rssowlmlink

UN talks take aim at 'killer robots' (Update)

Armies of Terminator-like warriors fan out across the battlefield, destroying everything in their path, as swarms of fellow robots rain fire from the skies.

That dark vision could all too easily shift from science fiction to fact unless such weapons are banned before they leap from the drawing board to the arsenal, campaigners warn.

On Tuesday, governments began the first-ever talks exclusively on so-called "lethal autonomous weapons systems" - opponents prefer the label "killer robots".

"All too often international law only responds to atrocities and suffering once it has happened," said Michael Moeller, head of the UN Conference on Disarmament.

"You have the opportunity to take pre-emptive action and ensure that the ultimate decision to end life remains firmly under human control," he told the meeting in Geneva.

That was echoed by the International Committee of the Red Cross, guardian of the Geneva Conventions on warfare. "There is a sense of deep discomfort with the idea of allowing machines to make life-and-death decisions on the battlefield with little or no human involvement," said Kathleen Lawand, head of its arms unit.

The four-day meeting aims to pave the way for more in-depth talks in November.

"The only answer is a pre-emptive ban," said Human Rights Watch arms expert Steve Goose.

UN-brokered talks have done that before: blinding laser weapons were banned in 1998, before they ever hit the battlefield. Automated weapons are already deployed worldwide. The best-known are drones, unmanned aircraft whose human controllers push the trigger from a distant base. Controversy rages, especially over the civilian collateral damage caused when the United States strikes alleged Islamist militants.

Perhaps closest to the Terminator of Arnold Schwarzenegger's action films is a Samsung sentry robot used in South Korea, able to spot unusual activity, quiz intruders and, when authorised by a controller, shoot them. Other countries in the research vanguard include Britain, Israel, China, Russia and Taiwan.

As revolutionary as gunpowder

But it is the next step, the power to kill without a human handler, that rattles opponents the most. Experts predict that military research could produce such machines within 20 years. "Lethal autonomous weapons systems are rightly described as the next revolution in military technology, on par with the introduction of gunpowder and nuclear weapons," said Pakistan's UN ambassador Zamir Akram, warning that they would threaten world peace and security.

German ambassador Michael Biontino said human control was the bedrock of international law. "Even in times of war, human beings cannot be made simple objects of machine action," he said.

The goal, diplomats said, is not to ban the technology outright. "We need to keep in mind that these are dual technologies and could have numerous civilian, peaceful and legitimate uses. This must not be about restricting research in this field," said French ambassador Jean-Hugues Simon-Michel, chairman of the talks.

Robots can potentially be used in firefighting and bomb disposal, while robot vacuum cleaners and lawnmowers are already common. "We believe that such technology is not only useful, but also contributes to a safe and sound life for us all," said Japan's ambassador Toshio Sano.

Campaigner Noel Sharkey, emeritus professor of robotics and artificial intelligence at Britain's University of Sheffield, said autonomy itself is not the problem. "There is just one thing that we don't want, and that's what we call the kill function," he said.

One aim is to start sketching out the definition of a robot weapon. US delegate Stephen Townley said the Terminator image was misleading. "That is a far cry from what we should be focusing on, which is the likely trajectory of technological development, not images from popular culture," he said. "The United States believes it is premature to determine where these discussions might or should lead," he added.

In 2012, Washington imposed a 10-year human control requirement on automated weapons, welcomed by campaigners even though they said it should go further.

Supporters of automated weapons say they have life-saving potential in warfare, for example being able to get closer than troops to assess a threat properly, without letting emotion cloud decision-making. But that is precisely what worries critics.

"If we don't inject a moral and ethical discussion into this, we won't control warfare," said Jody Williams, who won the 1997 Nobel Peace Prize for her campaign for a treaty banning landmines.

http://www.bbc.com/news/science-environment-27374482##rssowlmlink

Deep-sea 'graveyard' reveals fate of dead ocean giants

The chance discovery of a deep-sea "graveyard" is helping scientists to shed light on the fate of dead ocean giants, scientists report.

Rebecca Morelle By Rebecca Morelle Science correspondent, BBC News

Footage recorded by the oil and gas industry shows the carcasses of four large marine creatures in a small patch of sea floor off the coast of Angola.

Around the dead whale shark and three deceased rays, scavengers flocked to the food bonanza.

The findings are published in the journal Plos One.

Lead author Dr Nick Higgs, from the University of Plymouth's Marine Institute, said: "There's been lots of research on whale-falls, but we've never really found any of these other large marine animals on the sea bed."

Whale carcasses are home to complex ecosystems, first attracting scavengers such as sharks, then smaller opportunists such as crabs and shrimp-like creatures called amphipods. Osedax - or "zombie worms" - feed on the animal's bones, while specialist bacteria break down fats.

But with this latest footage, scientists have been able to see how the feeding frenzy that takes place around other big animal carcasses compares.

The video was recorded by remotely operated vehicles (ROVs), which were surveying the seafloor around Angola for industrial exploration.

The dead creatures were found between 2008 and 2010 on a one-square-kilometre patch of the sea floor and had been dead for an estimated one or two months.

The researchers mainly found scavenging fish - up to 50 around each carcass.

"We found three to four different types - but what really dominated were eel pouts. These normally sit around the carcass and wait for smaller scavengers - amphipods - to come along, and they will eat them," said Dr Higgs.

"There were lots of these fish sitting around the carcasses - they seemed to be guarding it."

But the team did not find other animals, such as the bone-eating worms, lurking around the dead whale shark and rays.

"Absence of evidence isn't evidence of absence... but the ecosystem does seem different to whale falls," said Dr Higgs.

The team was not sure why, given how rare sightings like this are, that four dead animals were all spotted in a small area.

Dr Higgs said: "There are lots of these animals living in the surface waters, and through natural mortality, you will have an increased abundance of dead animals on the seabed.

The reason we found them could be because of this industrial survey work - there are very few places surveyed as intensively as these areas."

The researchers estimated that the carcasses of large animals could provide about 4% of the total food that arrives on the sea floor in this area.

"These large carcass falls can be quite common and support quite a few fish in terms of the amount of food coming down there - there may be easily enough to support fish populations."

http://bit.ly/1IpyBjS

Richest marine reptile fossil bed along Africa's South Atlantic coast is dated at 71.5 mya

A new study uses carbon isotope dating to determine the first precise age for this bed, and ties the western coast of Africa to 30 million years of global geologic records

Paleontologists at Southern Methodist University have measured the carbon isotopes in marine fossils to precisely date for the first time 30 million years of sediments along Africa's South Atlantic shoreline.

The researchers matched the pattern of ratios of carbon-13 and carbon-12 isotopes in marine fossils from Africa's South Atlantic shoreline to known patterns of carbon ratios in fossils found elsewhere in the world. From that they determined the age of the coastal sediments at a fossil locality near the southern Angolan village of Bentiaba, said paleontologist Christopher Strganac, lead author on the study.

The analysis focused on a sequence of shoreline sediments totaling 140 meters thick. Their age spans a timeline of nearly 30 million years, from 95 million years ago to 68 million years ago. That period was about 40 million years after Africa and South America split, allowing the South Atlantic Ocean to slowly emerge.

The analysis revealed that the richest marine reptile fossil bed on Africa's South Atlantic dated to 71.5 million years ago, he said. This new date at the Bentiaba locality is more than 2 million years older than the estimated date of about 69 million years previously assigned to those marine beds by earlier researchers.

Africa's South Atlantic coast is remarkable in plate tectonics as the place where part of the prehistoric supercontinent Gondwana split 130 million years ago into what we now call Africa and South America.

"The precise age for these rocks allows better understanding of the ancient life and environments at Bentiaba by placing them accurately within the history of the ancient South Atlantic," said Strganac, a doctoral student in SMU's Roy M. Huffington Department of Earth Sciences. "It's a benchmark now from the Southern Hemisphere with which we can better understand ancient life at that time."

The precise dating was made possible by new scientific dating techniques. The age of the rocks hadn't previously been assessed because Africa's South Atlantic shore - noted for its puzzle-like fit with South America - has few localities with well-exposed rocks of this age. Also, it has been essentially unexplored by scientific expeditions since the 1960s largely because war and unrest prevented exploration in the previous century.

The new measurements stem from the work of Projecto PaleoAngola, an international team of scientists who in recent years have explored Angola and discovered an abundance of fossils. Their discoveries include the bones of dinosaurs, whales, mosasaurs and other ancient life from what is the richest marine reptile fossil bed along the South Atlantic coast.

Strganac and his co-authors report their findings in the Journal of African Earth Sciences. The article, "Carbon isotope stratigraphy, magnetostratigraphy, and 40Ar/39AR age of the Cretaceous South Atlantic coast, Namibe Basin, Angola," is available online through open access at http://bit.ly/1v4r8xi.

"This improvement in understanding the ages of the rocks along the shore is a great first step in trying to understand the climatic and evolutionary events that accompanied the growth of this ocean," said vertebrate paleontologist Louis L. Jacobs, also a co-author on the study and co-leader of Projecto PaleoAngola. Jacobs describes Angola as "an untapped frontier" for fossil hunters.

Aids in new knowledge of climate, temperature and vegetation

Scientists have recognized since the 1960s that ancient supercontinents split apart and their remnants drifted to the current positions of today's continents over the course of millions of years. One of the results was the creation of vast new oceans. Little is known of the vertebrate life that lived during that time along the eastern and western margins of the emerging South Atlantic Ocean.

Fossils being discovered now by Projecto PaleoAngola hold the key to understanding the South Atlantic Ocean's ancient past. Analysis of the fossils sheds light on the paleoenvironment, including changes in climate, temperature, vegetation and ecology.

The geologic time period covered by the 30-million-year sequence represents the Late Cretaceous. Studies have shown it was a period of dramatic change in climate, beginning with one of the warmest periods on Earth, then starting to transition to cooler climates, Strganac said.

Determining carbon ratios allowed comparison with global geologic events

To discover the age of the sediments, Strganac tested 55 fossil shells of ancient oysters and clams from 40 different rock layers on the coast. Testing determined the ratio of stable carbon isotopes, carbon-13 and carbon-12, in each shell. Because these isotopes do not decay with time, the relative abundance of each relates to the ocean when the shells formed. These isotope ratios can be compiled as a sequence with the rock layers, producing a pattern of carbon isotope change in the ancient oceans through millions of years. To accurately date the rocks, Strganac matched the pattern in isotope ratios in the shell record at Angola with the pattern known from ancient geologic events that occurred elsewhere in the world.

Specifically, the red rift-valley layers at Bentiaba were deposited as Africa and South America began to split. Also observed in the layers are a reversal in the Earth's magnetic polarity at 71.4 million to 71.64 million years to delimit the age of

marine fossils; rocks deposited in the South Atlantic Ocean 93.9 million years ago during an oceanic anoxic event; and rocks south of Bentiaba that bracket the mass extinction of dinosaurs at 66 million years.

Besides comparing the stable carbon isotopes, other measuring techniques included: magnetostratigraphy, which measures the ancient polarity of the Earth's magnetic field when various sedimentary layers were deposited; and argon-argon radiometric dating of a volcanic basalt layer at the site, which measures the radioactive decay of potassium to argon and dates the cooling of the volcanic lava to 85 million years ago.

"Adding a new ocean to the globe, in this case the South Atlantic, has many long-lasting effects," said SMU's Jacobs. "One obvious example is the formation of energy resources found along the coasts of Brazil and Angola."

Strganac briefly describes the research on youtube at http://youtu.be/ii25ufRCLAk, with a scientific figure of matching carbon ratio patterns at http://bit.ly/1mvfisd.

http://ind.pn/1k8hbKj

Exclusive: Found after 500 years, the wreck of Christopher Columbus's flagship the Santa Maria

Shipwreck found off coast of Haiti thought to be one of the most significant underwater discoveries in history

David Keys Archaeology correspondent

More than five centuries after Christopher Columbus's flagship, the Santa Maria, was wrecked in the Caribbean, archaeological investigators think they may have discovered the vessel's long-lost remains – lying at the bottom of the sea off the north coast of Haiti. It's likely to be one of the world's most important underwater archaeological discoveries.

"All the geographical, underwater topography and archaeological evidence strongly suggests that this wreck is Columbus' famous flagship, the Santa Maria," said the leader of a recent reconnaissance expedition to the site, one of America's top underwater archaeological investigators, Barry Clifford.

"The Haitian government has been extremely helpful – and we now need to continue working with them to carry out a detailed archaeological excavation of the wreck," he said.

So far, Mr Clifford's team has carried out purely non-invasive survey work at the site – measuring and photographing it.

Tentatively identifying the wreck as the Santa Maria has been made possible by quite separate discoveries made by other archaeologists in 2003 suggesting the probable location of Columbus' fort relatively nearby. Armed with this new information about the location of the fort, Clifford was able to use data in Christopher Columbus' diary to work out where the wreck should be.

An expedition, mounted by his team a decade ago, had already found and photographed the wreck – but had not, at that stage, realized its probable identity.

It's a current re-examination of underwater photographs from that initial survey (carried out back in 2003), combined with data from recent reconnaissance dives on the site (carried out by Clifford's team earlier this month), that have allowed Clifford to tentatively identify the wreck as that of the Santa Maria.

The evidence so far is substantial. It is the right location in terms of how Christopher Columbus, writing in his diary, described the wreck in relation to his fort.

The site is also an exact match in terms of historical knowledge about the underwater topography associated with the loss of the Santa Maria. The local currents are also consistent with what is known historically about the way the vessel drifted immediately prior to its demise.

The footprint of the wreck, represented by the pile of ship's ballast, is also exactly what one would expect from a vessel the size of the Santa Maria.

Using marine magnetometers, side-scan sonar equipment and divers, Mr. Clifford's team has, over several years, investigated more than 400 seabed anomalies off the north coast of Haiti and has narrowed the search for the Santa Maria down to the tiny area where the wreck, which the team thinks may well be Columbus' lost vessel, has been found.

The underwater remains of what is thought to be Columbus's flagship The underwater remains of what is thought to be Columbus's flagship (Brandon Clifford) A re-examination of the photographic evidence taken during the 2003 initial survey of the site by Mr. Clifford and his son Brandon has also provided evidence which is consistent with the vessel being from Columbus' era - including a probable early cannon of exactly the type known to have been on-board the Santa Maria.

When Clifford and his team returned to the site earlier this month, their intention was to definitively identify the cannon and other surface artefacts that had been photographed back in 2003. But tragically all the key visible diagnostic objects including the cannon had been looted by illicit raiders.

"We've informed the Haitian government of our discovery – and we are looking forward to working with them and other Haitian colleagues to ensure that the site is fully protected and preserved. It will be a wonderful opportunity to work with the Haitian authorities to preserve the evidence and artefacts of the ship that changed the world," said Mr. Clifford.

"I am confident that a full excavation of the wreck will yield the first ever detailed marine archaeological evidence of Columbus' discovery of America." Christopher Columbus Christopher Columbus (Alamy)

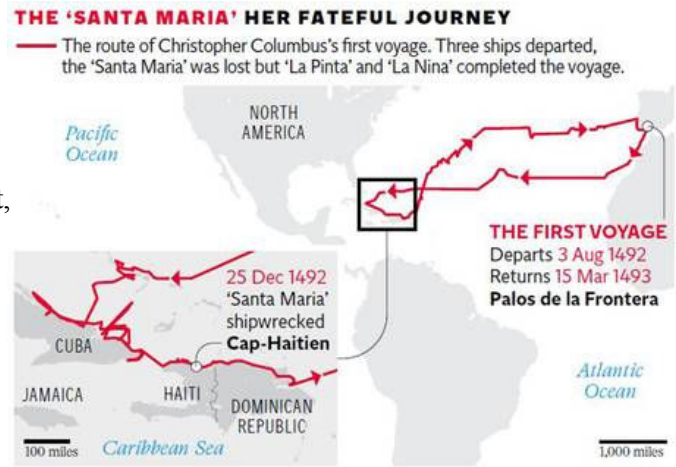
"Ideally, if excavations go well and depending on the state of preservation of any buried timber, it may ultimately be possible to lift any surviving remains of the vessel, fully conserve them and then put them on permanent public exhibition in a museum in Haiti.

"I believe that, treated in this way, the wreck has the potential to play a major role in helping to further develop Haiti's tourism industry in the future," he said.

Mr Clifford, who discussed the wreck site with the President of Haiti, Michel Martelly last year, is one of the world's most experienced explorers of underwater archaeological sites. He has carried out survey work on dozens of historic wrecks in different parts of the world over the past four decades – and was the discoverer and excavator of the world's first fully verified pirate shipwreck, the Whydah, back in 1984, and more recently discovered Captain Kidd's flagship off Madagascar.

The Santa Maria was built at some stage in the second half of the 15 century in northern Spain's Basque Country. In 1492, Columbus hired the ship and sailed in it from southern Spain's Atlantic coast via the Canary Islands in search of a new western route to Asia.

After 37 days, Columbus reached the Bahamas – but, just over ten weeks later, his flagship, the Santa Maria, with Columbus on board, drifted at night onto a reef off the northern coast of Haiti and had to be abandoned. Then, in a native village nearby, Columbus began building his first fort – and, a week later, leaving many of his men behind in the fort, he used his two remaining vessels to sail back to Spain in order to report his discovery of what he perceived as a new westerly route to Asia to his royal patrons - King Ferdinand and Queen Isabella of Spain.



(Source: Keith Pickering)

A leading American maritime archaeologist, Professor Charles Beeker of Indiana University, who accompanied Mr Clifford's recent reconnaissance expedition to Haiti and who also carried out an underwater visual assessment of the site, says that it "warrants a detailed scientific investigation to obtain diagnostic artefacts".

"There is some very compelling evidence from the 2003 photographs of the site and from the recent reconnaissance dives that this wreck may well be the Santa Maria,"

"But an excavation will be necessary in order to find more evidence and confirm that," said Professor Beeker who is Director of the University of Indiana's Office of Underwater Science.

The investigation into the wreck is being supported by the American TV network, the History channel, which has secured the exclusive rights to produce a major television programme on the subject.

http://phys.org/news/2014-05-proof-oxygen-element-earth-core.html#rssowlmlink

Researchers offer 'proof' that oxygen is the only light element in the Earth's core

Planetary scientists use seismic data, lab experiment results and theoretical calculations to offer proof that oxygen is present in the Earth's outer core.

Phys.org - A trio of planetary scientists from France, Switzerland and the U.K. has used seismic data, lab experiment results and theoretical calculations as a means to offer proof that oxygen is present in the Earth's outer core. In their paper published in Proceedings of the National Academy of Sciences, the team describes how they used experimentation in the lab to exclude all other light elements existing in the outer core, leaving oxygen as the sole remainder.

Scientists have believed that the Earth's core is made up mainly of iron - subsequent analysis of seismic data readings after earthquakes, volcano eruptions, etc. along with measurements of the Earth's moment of inertia, and the composition of meteorites, has led most to agree that mixed in with the iron is a small amount of nickel. But as the core meets with the mantle, other elements creep in, some of which scientists have suspected are light elements, such as carbon, silicon, sulfur and oxygen. Seismic data alone has not been able to reveal which of them might be present, though many have suspected that the most likely is oxygen.

To "prove" which element is present, the researchers simulated conditions in the Earth's core (adding heat and pressure to a piece of iron and nickel) in their lab and then added suspected light elements. One by one they eliminated (using density functional theory) all the light elements they tested until settling on oxygen as the sole survivor. Their calculations suggest it makes up 3.7 percent of the outer core. Their testing also indicated that the outer core is also 1.9 percent silicon and that there is no carbon or sulfur.

The researchers acknowledge that their ideas regarding oxygen in the core are not new, and instead suggest their work serves as more of a proof of what has been previously suspected. What they've done, they say, is constrain the number of

possible elements and the likely conditions under which the Earth's core was and is different from the mantle.

Oxygen as an ingredient in the core would suggest a warmer early Earth than has been previously theorized, the team notes, one with an oxygen rich magma ocean. More work will have to be done, though, as not all scientists will agree with the results, especially the lack of sulfur, an element present in most meteorites and suspected to make up a sizable portion of Mar's core.

More information: A seismologically consistent compositional model of Earth's core, James Badro, et al PNAS, DOI: 10.1073/pnas.1316708111

Abstract

Earth's core is less dense than iron, and therefore it must contain "light elements," such as S, Si, O, or C. We use ab initio molecular dynamics to calculate the density and bulk sound velocity in liquid metal alloys at the pressure and temperature conditions of Earth's outer core. We compare the velocity and density for any composition in the (Fe–Ni, C, O, Si, S) system to radial seismological models and find a range of compositional models that fit the seismological data. We find no oxygen-free composition that fits the seismological data, and therefore our results indicate that oxygen is always required in the outer core. An oxygen-rich core is a strong indication of high-pressure and high-temperature conditions of core differentiation in a deep magma ocean with an FeO concentration (oxygen fugacity) higher than that of the present-day mantle.

http://bit.ly/1sAoueL

Ancient giant sperm discovered at Riversleigh World Heritage Fossil Site

Preserved giant sperm from tiny shrimps that lived at least 17 million years ago have been discovered at the Riversleigh World Heritage Fossil Site by a team including UNSW Australia researchers.

The giant sperm are thought to have been longer than the male's entire body, but are tightly coiled up inside the sexual organs of the fossilised freshwater crustaceans, which are known as ostracods. "These are the oldest fossilised sperm ever found in the geological record," says Professor Mike Archer, of the UNSW School of Biological, Earth and Environmental Sciences, who has been excavating at Riversleigh for more than 35 years.

"The Riversleigh fossil deposits in remote northwestern Queensland have been the site of the discovery of many extraordinary prehistoric Australian animals, such as giant, toothed platypuses and flesh-eating kangaroos. So we have become used to delightfully unexpected surprises in what turns up there.

"But the discovery of fossil sperm, complete with sperm nuclei, was totally unexpected. It now makes us wonder what other types of extraordinary preservation await discovery in these deposits."

The study is published in the journal Proceedings of the Royal Society B.

A UNSW research team led by Professor Archer, Associate Professor Suzanne Hand and Henk Godthelp collected the fossil ostracods from Bitesantennary Site at Riversleigh in 1988. They were sent to John Neil, a specialist ostracod researcher at La Trobe University, who realised they contained fossilised soft tissues.

He drew this to the attention of European specialists, including the lead author on the paper, Dr Renate Matzke-Karasz, from Ludwig Maximilian University of Munich, Germany, who examined the specimens with Dr Paul Tafforeau at the European Synchrotron Radiation Facility in Grenoble, France.

The microscopic study revealed the fossils contain the preserved internal organs of the ostracods, including their sexual organs. Within these are the almost perfectly preserved giant sperm cells, and within them, the nuclei that once contained the animals' chromosomes and DNA.

Also preserved are the Zenker organs – chitinous-muscular pumps used to transfer the giant sperm to the female. The researchers estimate the fossil sperm are about 1.3 millimetres long, about the same length or slightly longer than the ostracod itself.

"About 17 million years ago, Bitesantennary Site was a cave in the middle of a vast biologically diverse rainforest. Tiny ostracods thrived in a pool of water in the cave that was continually enriched by the droppings of thousands of bats," says Professor Archer.

UNSW's Associate Professor Suzanne Hand, who is a specialist in extinct bats and their ecological role in Riversleigh's ancient environments, says the bats could have played a role in the extraordinary preservation of the ostracod sperm cells.

The steady rain of poo from thousands of bats in the cave would have led to high levels of phosphorous in the water, which could have aided mineralisation of the soft tissues.

"This amazing discovery at Riversleigh is echoed by a few examples of soft-tissue preservation in fossil bat-rich deposits in France. So the key to eternal preservation of soft tissues may indeed be some magic ingredient in bat droppings," says Associate Professor Hand.

Previous discoveries of extraordinary preservation at Riversleigh include insects with internal muscles that have been preserved because bacteria became fossilised as they attempted to consume the soft tissues of these creatures.

Perfectly preserved cells of leaves have been found, as well as the preserved soft tissue of eyeballs in the eye sockets of some of the extinct marsupials.

Research at Riversleigh is supported by the Australian Research Council, UNSW CREATE Fund, Queensland Museum, Queensland Parks and Wildlife Service, Environment Australia, Xstrata, Mount Isa City Council, Outback at Isa and the Waanyi people of northwestern Queensland.

http://www.eurekalert.org/pub_releases/2014-05/si-nsc051314.php#rssowlmlink

New stem cell research points to early indicators of schizophrenia

Salk scientists show fundamental differences in early neurons from patients with schizophrenia, supporting the theory that risk for the disease may begin in the womb

LA JOLLA - Using new stem cell technology, scientists at the Salk Institute have shown that neurons generated from the skin cells of people with schizophrenia behave strangely in early developmental stages, providing a hint as to ways to detect and potentially treat the disease early.

The findings of the study, published online in April's Molecular Psychiatry, support the theory that the neurological dysfunction that eventually causes schizophrenia may begin in the brains of babies still in the womb.

"This study aims to investigate the earliest detectable changes in the brain that lead to schizophrenia," says Fred H. Gage, Salk professor of genetics. "We were surprised at how early in the developmental process that defects in neural function could be detected."

Currently, over 1.1 percent of the world's population has schizophrenia, with an estimated three million cases in the United States alone. The economic cost is high: in 2002, Americans spent nearly $63 billion on treatment and managing disability. The emotional cost is higher still: 10 percent of those with schizophrenia are driven to commit suicide by the burden of coping with the disease.

Although schizophrenia is a devastating disease, scientists still know very little about its underlying causes, and it is still unknown which cells in the brain are affected and how. Previously, scientists had only been able to study schizophrenia by examining the brains of patients after death, but age, stress, medication or drug abuse had often altered or damaged the brains of these patients, making it difficult to pinpoint the disease's origins.

The Salk scientists were able to avoid this hurdle by using stem cell technologies. They took skin cells from patients, coaxed the cells to revert back to an earlier stem cell form and then prompted them to grow into very early-stage neurons (dubbed neural progenitor cells or NPCs). These NPCs are similar to the cells in the brain of a developing fetus.

The researchers generated NPCs from the skin cells of four patients with schizophrenia and six people without the disease. They tested the cells in two types of assays: in one test, they looked at how far the cells moved and interacted with particular surfaces; in the other test, they looked at stress in the cells by imaging mitochondria, which are tiny organelles that generate energy for the cells.

On both tests, the Salk team found that NPCs from people with schizophrenia differed in significant ways from those taken from unaffected people.

In particular, cells predisposed to schizophrenia showed unusual activity in two major classes of proteins: those involved in adhesion and connectivity, and those involved in oxidative stress. Neural cells from patients with schizophrenia tended to have aberrant migration (which may result in the poor connectivity seen later in the brain) and increased levels of oxidative stress (which can lead to cell death).

These findings are consistent with a prevailing theory that events occurring during pregnancy can contribute to schizophrenia, even though the disease doesn't manifest until early adulthood. Past studies suggest that mothers who experience infection, malnutrition or extreme stress during pregnancy are at a higher risk of having children with schizophrenia. The reason for this is unknown, but both genetic and environmental factors likely play a role.

"The study hints that there may be opportunities to create diagnostic tests for schizophrenia at an early stage," says Gage, who holds the Vi and John Adler Chair for Research on Age-Related Neurodegenerative Disease.

Kristen Brennand, the first author of the paper and assistant professor at Icahn School of Medicine at Mount Sinai, said the researchers were surprised that the skin-derived neurons remained in such an early stage of development. "We realized they weren't mature neurons but only as old as neurons in the first trimester," Brennand says. "So we weren't studying schizophrenia but the things that go wrong a long time before patients actually get sick."

Interestingly, the study also found that antipsychotic medication such as clozapine and loxapine did not improve migration in NPCs (in particular, loxapine actually worsened migration in these cells).

"That was an experiment that gave the opposite results from what we were expecting," says Brennand. "Though in hindsight, using drugs that treat symptoms might not be helpful in trying to prevent the disease."

The next steps to this work will be to increase the sample size to a broader range of patients and to look at hundreds or thousands of patient samples, says Brennand.

Contributors to this work include Yongsung Kim, Ngoc Tran, Anthony Simone, Hyung Joon Kim, and Ian Ladran at the Salk Institute; Jeffrey Savas and John Yates at the Scripps Research Institute; Kazue Hashimoto-Torii and Pasko Rakic at Yale University; Kristin Beaumont and Milan Mrksich at Northwestern University; Aaron Topol, Mohammed Abdelrahim, Bridget Matikainen-Ankne, Gang Fang and Bin Zhang at Icahn School of Medicine at Mount Sinai; and Shih-hui Chao at Arizona State University Tempe.

The Gage Laboratory is partially funded by the California Institute of Regenerative Medicine (CIRM), the G Harold & Leila Y Mathers Foundation, the JPB Foundation, the Leona M and Harry B Helmsley Charitable Trust, Annette Merle-Smith, and Robert and Mary Jane Engman. The Brennand Laboratory is partially funded by NARSAD, NIMH and the New York Stem Cell Foundation.

http://bit.ly/1jO35xU

Get it over with: People choose more difficult tasks to get jobs done more quickly

Putting off tasks until later, or procrastination, is a common phenomenon – but new research suggests that "pre-crastination," hurrying to complete a task as soon as possible, may also be common.

The research, published in Psychological Science, a journal of the Association for Psychological Science, suggests that people often opt to begin a task as soon as possible just to get it off their plate, even if they have to expend more physical effort to do so.

"Most of us feel stressed about all the things we need to do – we have to-do lists, not just on slips of paper we carry with us or on our iPhones, but also in our heads," says psychological scientist and study author David Rosenbaum of Pennsylvania State University. "Our findings suggest that the desire to relieve the stress of maintaining that information in working memory can cause us to over-exert ourselves physically or take extra risks."

Rosenbaum and colleagues Lanyung Gong and Cory Adam Potts were conducting research to explore the trade-off between the weight of a load and how far people would carry it. In testing their experimental setup, the researchers stumbled on a surprising finding: Participants often chose the action that took more physical effort, choosing the near bucket even though that meant they would have to carry it further. Intrigued by the counterintuitive finding, they decided to investigate the phenomenon further.

The researchers conducted a total of 9 experiments, each of which had the same general setup: College student participants stood at one end of an alley, along which two plastic beach buckets were stationed. The students were instructed to walk down the alley without stopping and to pick up one of the two buckets and drop it off at the endpoint.

The researchers varied the positions of the two buckets relative to the starting point and the students were asked to do whatever seemed easier: Pick up and carry the left bucket with the left hand or pick up and carry the right bucket with the right hand.

In the first three experiments, participants showed an overwhelming tendency to choose whichever bucket had the shorter approach distance, which translated to the longer carrying distance in these experiments.

The researchers were able to rule out various potential explanations, including problems with hand-foot coordination and differences in attention, in subsequent experiments.

When the students were asked to explain why they chose the bucket they did, they often said that they "wanted to get the task done as soon as they could."

"Our findings indicate that while our participants did care about physical effort, they also cared a lot about mental effort," says Rosenbaum. "They wanted to complete one of the subordinate tasks they had to do, picking up the bucket, in order to finish the entire task of getting the bucket to the drop-off site."

Picking up a bucket may seem like a trivial task, but Rosenbaum speculates that it still stood out on participants' mental to-do lists:

"By picking up the near bucket, they could check that task off their mental to-do lists more quickly than if they picked up the far bucket," he explains. "Their desire to lighten their mental load was so strong that they were willing to expend quite a bit of extra physical effort to do so."

The findings raise several additional questions that Rosenbaum and colleagues hope to investigate, such as: What's the relationship between procrastination and pre-crastination?

"Almost all the people we tested pre-crastinated," Rosenbaum points out, "so procrastinating and pre-crastinating may be turn out to be two different things."

The researchers also want to examine whether physical ability limitations might play a role in the effect:

"If it's a big deal for someone to carry a load a long distance, then he or she may be more judicious in their decision-making," Rosenbaum explains. "Elderly or frail people may therefore have better memory management abilities than more able-bodied individuals."

This research was supported in part by a John Simon Guggenheim Memorial Foundation Fellowship to D.A. Rosenbaum and an Oak Ridge Institue for Science and Education Fellowship to L. Gong.

http://www.medscape.com/viewarticle/825053?src=rss#1

Top 100 Most Prescribed, Top Selling Drugs

Megan Brooks

The hypothyroid medication levothyroxine (*Synthroid*, AbbVie) continues to be the nation's most prescribed drug, and the antipsychotic aripiprazole (*Abilify*, Otsuka Pharmaceutical) continues to have the highest sales, at nearly $6.9 billion, according to the latest data from research firm IMS Health.

The data reflect a rolling 12 months of history (April 2013 - March 2014) on the top 100 drugs by total sales and total prescriptions in the United States.

Following levothyroxine (with just more than 23 million prescriptions) as most prescribed drug in the United States were the cholesterol-lowering drug rosuvastatin (*Crestor*, AstraZeneca), at about 22.9 million; the proton pump inhibitor esomeprazole (*Nexium*, AstraZeneca), at roughly 19.3 million; the asthma

medication albuterol (*Ventolin HFA*, GlaxoSmithKline), at about 17.5 million; and the chronic obstructive pulmonary disease medication fluticasone/salmeterol (*Advair Diskus*, GlaxoSmithKline), at more than 15.5 million.

Rounding out the top 10 most prescribed drugs for the period were the antidepressant duloxetine (*Cymbalta*, Eli Lilly), the antihypertensive valsartan (*Diovan*, Novartis), the attention deficit drug lisdexamfetamine dimesylate (*Vyvanse*, Shire), insulin glargine injection (*Lantus Solostar*, sanofi-aventis), and the antiepileptic pregabalin (*Lyrica*, Pfizer).

After aripiprazole, the next best selling drugs for the period April 2013 through March 2014 were esomeprazole magnesium (*Nexium*, AstraZeneca) at nearly $6.3 billion, and the arthritis drug adalimumab (*Humira*, AbbVie), at $5.9 billion.

Rounding out the top 10 in sales were Crestor ($5.5 billion), Advair Diskus ($5.1 billion), the arthritis drugs etanercept (*Enbrel*, Amgen; almost $4.9 billion) and infliximab (*Remicade*, Centocor; $4.2 billion), Cymbalta ($4.1 billion), the multiple sclerosis drug glatiramer acetate (*Copaxone*, Teva Pharm; almost $3.7 billion), and the neutropenia drug pegfilgrastim (*Neulasta*, Amgen; $3.6 billion).

http://bit.ly/1oX0jXD

Sentient robots? Not possible if you do the maths

So long, robot pals – and robot overlords. Sentient machinesMovie Camera may never exist, according to a variation on a leading mathematical model of how our brains create consciousness.

17:43 13 May 2014 by Anil Ananthaswamy

Over the past decade, Giulio Tononi at the University of Wisconsin-Madison and his colleagues have developed a mathematical framework for consciousness that has become one of the most influential theories in the field. According to their model, the ability to integrate information is a key property of consciousness. They argue that in conscious minds, integrated information cannot be reduced into smaller components. For instance, when a human perceives a red triangle, the brain cannot register the object as a colourless triangle plus a shapeless patch of red.

But there is a catch, argues Phil Maguire at the National University of Ireland in Maynooth. He points to a computational device called the XOR logic gate, which involves two inputs, A and B. The output of the gate is "0" if A and B are the same and "1" if A and B are different. In this scenario, it is impossible to predict the output based on A or B alone – you need both.

Memory edit

Crucially, this type of integration requires loss of information, says Maguire: "You have put in two bits, and you get one out. If the brain integrated information in this fashion, it would have to be continuously haemorrhaging information."

Maguire and his colleagues say the brain is unlikely to do this, because repeated retrieval of memories would eventually destroy them. Instead, they define integration in terms of how difficult information is to edit.

Consider an album of digital photographs. The pictures are compiled but not integrated, so deleting or modifying individual images is easy. But when we create memories, we integrate those snapshots of information into our bank of earlier memories. This makes it extremely difficult to selectively edit out one scene from the "album" in our brain.

Based on this definition, Maguire and his team have shown mathematically that computers can't handle any process that integrates information completely. If you accept that consciousness is based on total integration, then computers can't be conscious.

Open minds

"It means that you would not be able to achieve the same results in finite time, using finite memory, using a physical machine," says Maguire. "It doesn't necessarily mean that there is some magic going on in the brain that involves some forces that can't be explained physically. It is just so complex that it's beyond our abilities to reverse it and decompose it."

Disappointed? Take comfort – we may not get Rosie the robot maid, but equally we won't have to worry about the world-conquering AgentsMovie Camera of The Matrix.

Neuroscientist Anil Seth at the University of Sussex, UK, applauds the team for exploring consciousness mathematically. But he is not convinced that brains do not lose information. "Brains are open systems with a continual turnover of physical and informational components," he says. "Not many neuroscientists would claim that conscious contents require lossless memory."

Maguire acknowledges that their proof would not hold up if information integration in the brain is reversible. "Maybe, if you had a very clever algorithm, you could still break down peoples' memories and edit them."

Journal reference: arxiv.org/abs/1405.0126v1

http://www.bbc.com/news/health-27398730##rssowlmlink

Chronotherapy: The science of timing drugs to our Body Clock

Being in tune with your natural Body Clock is about a lot more than knowing whether your are a "lark" or an "owl".

As the BBC's Day of the Body Clock has shown, it can also have a profound effect on our health. Doctors are becoming increasingly interested in the science of chronotherapy - aligning medical treatment to our circadian rhythms.

Cancer and rheumatoid arthritis are two disease areas where chronotherapy is showing promise.

Chemotherapy

Every three weeks Philippe Maillol makes the 500 mile round trip from his home in Limoges to Paris for cancer treatment. He was diagnosed with pancreatic cancer in August 2013 and began standard chemotherapy in Limoges with the drugs infused during the day. But the side effects were hard to bear.

"I was completely exhausted," said Philippe. "When I got home from my local hospital I couldn't even speak, let alone eat. I suffered extreme nausea which lasted for days."

Six months ago Philippe switched to treatment at the Paul Brousse hospital in Villejuif in southern Paris. Now his drug infusions are spaced during the day, with two happening overnight while he sleeps.

"The impact on my body is much gentler" he said. "So much so that I don't need to take the anti-nausea drugs which themselves carried their own side-effects."

He treatment is being led by Professor Francis Levi, one of the pioneers of chronotherapy.

He said: "We have clocks within our cells that govern the metabolism of drugs. So some drugs are best given at night and others during the day. "We have found chronotherapy is reducing the toxicity of treatments and improving the quality of life of patients, by respecting the circadian rhythms of the patients.

Prof Levi is taking up a post at Warwick Medical School later this year.

He plans to continue his research into cancer chronotherapy and will treat patients at University Hospital Birmingham.

Rheumatoid arthritis

The University of Manchester is conducting a small chronotherapy trial for rheumatoid arthritis. The inflammatory condition causes pain and swelling in the joints.

Ten patients are having their sleep/wake cycle and movements monitored for a week, culminating with a 24-hour stay at Manchester Royal Infirmary.

During this visit, their blood and saliva are analysed to examine immune cells.

Krystal Fayle, 27, is one of those on the trial. She said: "I wake up in pain every day and it often hurts to walk. "I don't really go out much anymore because I can't stand for long because my joints are swollen."

Patients with rheumatoid arthritis commonly find their symptoms are worse in the morning. But now doctors realise this is not simply because joints stiffen up through lack of use overnight.

"Rheumatoid arthritis is driven by cells in the immune system called T lymphocytes" said David Ray, Prof of Medicine at University of Manchester.

"These cells each have their own clock, and their inflammatory response varies depending on the time of day. "Even when we remove them from the body and look at them in a dish they still keep a day/night rhythm."

Some of the drug treatments for rheumatoid arthritis are relatively toxic and carry a significant risk of side effects.

The trial is trying to determine the best time to deliver drugs so that they dampen the immune system only when needed.

Prof Ray said: "The processes that drive the disease are only active for part of 24 cycle - so if get our potent drug in at the right time we can avoid exposing patients to toxic drugs throughout the day."

Krystal Fayle suffered liver damage from one drug and hair loss from another. So she is hoping that the trial may identify a better treatment. She said: "To have a drug that worked for me would be absolutely brilliant, and make life much easier."

The trial is still recruiting but should be completed later this year.

Timing medical treatment to fit our natural biological rhythms is still unusual.

Further patient trials of chronotherapy are needed for what remains an area at the fringe of medicine. But it is a concept that is gaining ground as more doctors realise the importance of our body clock.

http://bit.ly/1n4eDfB

Twisted brain lobes could make depression more likely

There's a new twist in mental health. People with depression seem three times as likely as those without it to have two brain lobes curled around each other.

18:55 13 May 2014 by Nathan Collins

The brains of people with depression can be physically different from other brains – they are often smaller, for example – but exactly why that is so remains unclear.

In humans, some studies point to changes in the size of the hippocampi, structures near the back of the brain thought to support memory formation.

"There are so many studies that show a smaller hippocampus in almost every psychiatric disorder," says Jerome Maller, a neuroscientist at the Monash Alfred Psychiatry Research Centre in Melbourne, Australia, who led the latest work looking at brain lobes. "But very few can actually show or hypothesize why that is."

Mind-bending research

Maller thinks he has stumbled on an explanation. He had been using a brain stimulation technique known as transcranial magnetic stimulation as a therapy for antidepressant-resistant depression.

This involved using fMRI scans to create detailed maps of the brain to determine which parts to stimulate. While pouring over hundreds of those maps, Maller noticed that many of them showed signs of occipital bending. This is where

occipital lobes – which are important for vision – at the back of the brain's left and right hemispheres twist around each other.

So he and his colleagues scanned 51 people with and 48 without major depressive disorder. They found that about 35 per cent of those with depression and 12.5 per cent of the others showed signs of occipital bending. The difference was even greater in women: 46 per cent of women with depression had occipital bending compared with just 6 per cent of those without depression.

Reduced activity

Gerard Bruder, a clinical psychiatrist at Columbia University in New York City, says the anatomical findings may relate to findings by his team and others which show reduced electrical activity in the occipital brain regions of patients with major depressive disorder, although the mechanism at work is still unclear.

Maller thinks the brain twisting could be the result of abnormally developed ventricles, channels that carry cerebrospinal fluid through the brain.

The twisted occipital lobes could in turn be putting pressure on the hippocampus, he says, preventing it from growing properly and ultimately upping the chances of someone developing depression.

Journal reference: Brain, DOI 10.1093/brain/awu072

http://www.wired.com/2014/05/fantastically-wrong-jackalope/#rssowlmlink

Fantastically Wrong: The Disturbing Reality That Spawned the Mythical Jackalope

As it turns out, the jackalope isn't purely a work of fiction

By Matt Simon

Having grown up in the '90s in the suburbs of San Francisco, my first encounter with the wily jackalope was not in the wild. It was on the show America's Funniest People, in which a recurring skit starred a hilariously unrealistic rabbit puppet with the horns of an antelope and the habits of a sociopath.

The horned rabbit (Lepus cornutus) appears in 1650's Historiae Naturalis de Quadrupetibus Libri, meaning The History Book of Natural Quadrangles. Look at me now, Latin teacher from college who gave me bad grades. **Source: Biodiversity Heritage Library**

Fantastically Wrong

It's OK to be wrong, even fantastically so, because when it comes to understanding our world, mistakes mean progress. From folklore to pure science, these are humankind's most bizarre theories.

That puppet made a big impression on me. For the uninitiated, the show's jackalope stories revolved around the creature assaulting humans–whether they deserved it or not–typically jabbing them in the bum with its horns. This was not, however, the first time the jackalope has been sighted in the United States. The critter has long been a fixture in American folklore. But as it turns out, the jackalope isn't purely a work of fiction.

Back in the 1800s in the wilds of Wyoming, when cowboys sang to their cattle on dark nights before thunderstorms, they heard their tunes repeated back to them. Not by the cattle–that would just be silly–but by some jackalope off in the brush. That bit about the nighttime before thunderstorms wasn't for dramatic effect, by the way. This was the only time the jackalope would call out.

The first "confirmed" jackalope specimen was secured by one Douglas Herrick, who in 1932 found a dead one sprawled in his shop in Douglas, Wyoming. If you want to get technical, though, it was an ordinary dead rabbit next to some deer horns on the floor. But Herrick mounted the rabbit, horns and all, thus begetting a slew of taxidermic jackalopes in bars all across the West.

Next to bigfoot, it is now perhaps the most iconic American creature of legend. But this is far from a mythical critter of American invention. A horned hare appears in an early-17th century work of natural history, and in another in the mid-1700s–not to mention that a rabbit with a single unicorn-like horn showed up in a Persian geographic dictionary 500 years earlier. Americans may have given the jackalope a persona, but could it be that the creature has indeed hopped the world over?

Yes, but those are no horns. They're tumors.

In the 1930s, an American scientist procured the horns of such a critter for testing, as Carl Zimmer recounts in his book A Planet of Viruses. The scientist had a hunch that a virus was causing these bizarre growths, so he ground up the horns and made a solution, then filtered it so only viruses could get through. He then applied the theoretically virus-packed liquid to the heads of otherwise healthy rabbits, and sure enough they grew horns as well.

He had discovered the cancer-causing Shope papillomavirus, a strain related to the human papillomavirus, or HPV. Whereas HPV corrupts cells in the human cervix to build cancerous tumors, in rabbits the papillomavirus manifests as hard, keratinized horns. When observers in antiquity saw horned rabbits, they were in fact seeing the ravages of carcimonas brought on by viral infections. These growths are isolated on the critter's head and face, though not necessarily to the top of the skull. Afflicted rabbits can in fact grow them around their mouths and starve to death, unable to feed.

Such papillomaviruses are found throughout the animal kingdom, from birds to reptiles to mammals. But how could this virus jump between totally unrelated

species? Well, it almost never does. And the answer to why these viruses are so widespread is actually far more interesting than if they could indeed just move from species to species willy-nilly.

It's theorized that papillomaviruses are so common because they first took up residence in a common ancestor of birds and mammals and reptiles some 300 million years ago, then followed each subsequent branching of the tree of life, evolving separately in each species. And as, say, mammals like rabbits eventually evolved skin, their virus coevolved to exploit that tissue.

An unfortunate bunny infected with the Shope papillomavirus. **Image: Wikimedia**

And so it is that the mythical jackalope is far from just silly myth-making (and profitability for imaginative taxidermists across the American West, not to mention the producers of America's Funniest People). It's a great lesson in evolutionary biology.

So the next time you're in a watering hole out West and see a jackalope on the wall, buy it a stiff drink. It's seen better days. Specifically, if you find yourself in San Francisco's jackalope-infested bar Dalva, drop me a line and you can buy me one too. Or, like, three or four. Whatever works for your budget.

Zimmer, C. (2011) A Planet of Viruses. University of Chicago Press

http://bit.ly/1hTp1TP

High-speed solar winds increase lightning strikes on Earth

Scientists have discovered new evidence to suggest that lightning on Earth is triggered not only by cosmic rays from space, but also by energetic particles from the Sun.

University of Reading researchers found a link between increased thunderstorm activity on Earth and streams of high-energy particles accelerated by the solar wind, offering compelling evidence that particles from space help trigger lightning bolts.

Publishing their study today, 15 May 2014, in IOP Publishing's journal Environmental Research Letters, researchers from Reading's Department of Meteorology found a substantial and significant increase in lightning rates across Europe for up to 40 days after the arrival of high-speed solar winds, which can travel at more than a million miles per hour, into the Earth's atmosphere.

A summary of the findings can be found in the associated Video Abstract: https://www.youtube.com/watch?v=v-r-3qhed1s&feature=youtu.be

Although the exact mechanism that causes these changes remains unknown, the researchers propose that the electrical properties of the air are somehow altered as the incoming charged particles from the solar wind collide with the atmosphere.

The results could prove useful for weather forecasters, since these solar wind streams rotate with the Sun, sweeping past the Earth at regular intervals, accelerating particles into Earth's atmosphere. As these streams can be tracked by spacecraft, this offers the potential for predicting the severity of hazardous weather events many weeks in advance.

Lead author of the study, Dr Chris Scott, said: "Our main result is that we have found evidence that high-speed solar wind streams can increase lightning rates. This may be an actual increase in lightning or an increase in the magnitude of lightning, lifting it above the detection threshold of measurement instruments.

"Cosmic rays, tiny particles from across the Universe accelerated to close to the speed of light by exploding stars, have been thought to play a part in thundery weather down on Earth, but our work provides new evidence that similar, if lower energy, particles created by our own Sun also affect lightning.

"As the Sun rotates every 27 days these high-speed streams of particles wash past our planet with predictable regularity. Such information could prove useful when producing long-range weather forecasts."

Professor Giles Harrison, head of Reading's Department of Meteorology and co-author of the ERL article, said: "In increasing our understanding of weather on Earth we are learning more about its important links with space weather. Bringing the topics of Earth Weather and Space Weather ever closer requires more collaborations between atmospheric and space scientists, in which the University of Reading is already leading the way."

To arrive at their results, the researchers analysed data on the strikes of lightning over the UK between 2000 and 2005, which was obtained from the UK Met Office's lightning detection system. They restricted their data to any event that occurred within a radius of 500 km from central England.

The record of lightning strikes was compared with data from Nasa's Advanced Composition Explorer (ACE) spacecraft, which lies between the Sun and the Earth and measures the characteristics of solar winds.

After the arrival of a solar wind at the Earth, the researchers showed there was an average of 422 lightning strikes across the UK in the following 40 days, compared to an average of 321 lightning strikes in the 40 days prior the arrival of the solar wind. The rate of lightning strikes peaked between 12 and 18 days after the arrival of the solar wind.

The solar wind consists of a constant stream of energetic particles - mainly electrons and protons - that are propelled from the Sun's atmosphere at around a

million miles per hour. The streams of particles can vary in density, temperature and speed and sweep past Earth every 27 days or so, in line with the time it takes the Sun to make one complete rotation relative to the Earth.

The Earth's magnetic field provides a sturdy defence against the solar wind, deflecting the energetic particles around the planet; however, if a fast solar stream catches up with a slow solar stream, it generates an enhancement in both the material and the associated magnetic field.

In these instances, the energetic particles can have sufficient energies to penetrate down into the cloud-forming regions of the Earth's atmosphere and subsequently affect the weather that we experience.

"We propose that these particles, while not having sufficient energies to reach the ground and be detected there, nevertheless electrify the atmosphere as they collide with it, altering the electrical properties of the air and thus influencing the rate or intensity at which lightning occurs," said Dr Scott.

The increase in the rate of lightning after the arrival of solar winds was corroborated by a significant increase in the days in which thunder was heard, which were recorded at UK Met Office stations around the UK.

From Thursday 15 May, this paper can be downloaded from http://iopscience.iop.org/1748-9326/9/5/055004/article

http://www.eurekalert.org/pub_releases/2014-05/uow-sst050914.php

Study shows tropical cyclone intensity shifting poleward

Cyclones shifting from the tropics toward the poles at rates of about 33 to 39 miles per decade

MADISON, Wis. - The latitude at which tropical cyclones reach their greatest intensity is gradually shifting from the tropics toward the poles at rates of about 33 to 39 miles per decade, according to a study published today (May 14, 2014) in the journal Nature.

The new study was led by Jim Kossin, a National Oceanic and Atmospheric Administration (NOAA) National Climatic Data Center scientist stationed at the University of Wisconsin-Madison's Cooperative Institute for Meteorological Satellite Studies. The research documents a poleward migration of storm intensity in both the Northern and Southern Hemispheres through an analysis of 30 years of global historical tropical cyclone data. The term "tropical cyclone" describes a broad category of storms that includes hurricanes and typhoons, large and damaging storms that draw their energy from warm ocean waters.

The findings are important, says Kossin, because they suggest that some areas, including densely populated coastal cities, could experience changes in risk due to large storms and associated floods and storm surges. Regions closer to the equator, he notes, could experience a reduced risk, and places more distant from the equator could experience an increased risk. The trend observed by Kossin and his colleagues is particularly important given the devastating loss of life and property that can follow in the wake of a tropical cyclone.

Conversely, equatorial regions where people depend on tropical cyclone rainfall to replenish sources of fresh water may experience water shortages.

According to Kossin, there isn't a global trend in the frequency of tropical cyclones for the 30-year study period. However, the data record shows a distinct poleward trend in the observed latitude where storms are the most intense. While estimates of storm intensity vary in the data, the latitude at which tropical cyclones reach their maximum intensity, Kossin explains, is a more reliable assessment of changes in the way tropical cyclones behave.

"We've identified changes in the environment in which the deep tropics have become more hostile to the formation and intensification of tropical cyclones and the higher latitudes have become less hostile," Kossin explains. "This seems to be driving the poleward migration" of storm intensity.

From a global climate perspective, Kossin says, "the more compelling aspect is that the rate of migration fits very well into independent estimates of the observed expansion of the tropics." That phenomenon has been widely studied by other scientists and is attributed, in part, to increasing greenhouse gases, stratospheric ozone depletion, and particulate pollution, all by-products of human activity.

Whether the observed movement of tropical cyclone maximum intensity toward the poles is a result of the expansion of the tropics and its links to human activity requires more and longer-term investigation, says Kossin. Both phenomena, however, exhibit very similar behavior over the past 30 years, lending credence to the idea that the two are linked.

Co-authors on the Nature paper are Kerry A. Emanuel, Program in Atmospheres, Oceans and Climate at the Massachusetts Institute of Technology, and Gabriel A. Vecchi, NOAA Geophysical Fluid Dynamics Laboratory, Princeton, New Jersey.

http://www.eurekalert.org/pub_releases/2014-05/uops-cah051314.php

Can anti-depressants help prevent Alzheimer's disease?

Penn researcher studies effects of common anti-depressant on brain peptide thought to be responsible for the development of Alzheimer's

PHILADELPHIA – A University of Pennsylvania researcher has discovered that the common selective serotonin reuptake inhibitor (SSRI) citalopram arrested the growth of amyloid beta, a peptide in the brain that clusters in plaques that are thought to trigger the development of Alzheimer's disease (AD). Penn, in collaboration with investigators at Washington University, tested the drug's effects on the brain interstitial fluid (ISF) in plaque-bearing mice and the cerebrospinal

fluid (CSF) of healthy human subjects to draw its conclusions, which are detailed in the new issue of Science Translational Medicine.

Alzheimer's disease is the sixth leading cause of death the United States, affecting five million patients, with the numbers expected to leap to approximately 16 million patients in the coming decades, unless preventive measures are developed.

"Our previous studies have shown an association between anti-depressants and the reduction in amyloid burden in the brain," says the paper's lead author, Yvette Sheline, MD, professor of Psychiatry, Radiology and Neurology and director of the Center for Neuromodulation in Depression and Stress, at Penn's Perelman School of Medicine. "Those studies examined a retrospective correlation between the duration of anti-depressant use and amyloid burden shown in PET scans in the brains of elderly volunteers. With this new study we took our research a step further and tested the prospective effect of the SSRI citalopram on the CSF amyloid levels in younger, healthy subjects." Sheline performed the research while at Washington University.

She again found that citalopram, which is approved by the FDA in 1998 for the treatment of depression, had significant effects.

The brain interstitial fluid (ISF) of transgenic plaque-bearing mice following exposure to citalopram showed that the level of amyloid-beta in the ISF decreased in a dose-dependent manner by as much as 25 percent compared to baseline numbers. In addition, the researchers found that two months of citalopram exposure in plaque-bearing mice resulted in no new plaque development, and no growth of existing plaques compared with a marked increase in plaque growth and development in the control group of mice, who were exposed to sugar water. However, citalopram had little effect on the regression of already existing amyloid plaques.

In a parallel study, 23 healthy human subjects, age 18 to 50 without medical disease and with no previous history of anti-depressant treatment, were administered 60 mg citalopram, roughly equivalent to the dose used in mice.

The double-blind study showed that citalopram was associated with a 38 percent lower A-beta concentration over the 37-hour testing period versus placebo, and showed a reduction in newly-produced A-beta in the citalopram-treated group versus the control group.

SSRIs are thought to produce their antidepressant effect by blocking the reuptake of the neurotransmitter serotonin into the presynaptic terminals of the neurons, increasing the availability of serotonin and reducing A-beta production. Serotonin receptor levels are reduced in brains of patients with AD. In contrast, this newly described effect on the reduction of amyloid protein concentration most likely occurs by a different pathway.

The development of safe and effective therapeutic approaches that can reduce CSF A-beta production even modestly may prevent a cascade of neuronal damage, which would have an important impact on preventing or slowing progression to symptomatic AD.

"While these results are an excellent start at lowering A-beta production, we are a long way from making a statement regarding the ability of SSRIs to prevent the cognitive decline associated with AD," Sheline says. "We are developing a greater understanding of the capabilities of SSRIs, which offer promise for the future as preventive measures, as we continue to uncover the complex mechanisms in the brain that trigger Alzheimer's and dementia."

Funding for this research was provided by NIH grants R21 AG03969002, R01 AG04140202, R01 AG042513, R21 NS082529, R01 NS067905, Washington University Hope Center for Neurological Diseases and Washington University Biomedical Mass Spectrometry Resource.

www.eurekalert.org/pub_releases/2014-05/uoc--cmr051414.php

California mountains rise as groundwater depleted in state's Central Valley

Pumping for agriculture has raised Sierra Nevada mountain range 6 inches in 150 years

Winter rains and summer groundwater pumping in California's Central Valley make the Sierra Nevada and Coast Ranges sink and rise by a few millimeters each year, creating stress on the state's earthquake faults that could increase the risk of a quake.

Gradual depletion of the Central Valley aquifer because of groundwater pumping also raises these mountain ranges by a similar amount each year – about the thickness of a dime – with a cumulative rise over the past 150 years of up to 15 centimeters (6 inches), according to calculations by a team of geophysicists.

While the seasonal changes in the Central Valley aquifer have not yet been firmly associated with any earthquakes, studies have shown that similar levels of periodic stress, such as that caused by the motions of the moon and sun, increase the number of microquakes on the San Andreas Fault, which runs parallel to the mountain ranges. If these subtle seasonal load changes are capable of influencing the occurrence of microquakes, it is possible that they can sometimes also trigger a larger event, said Roland Bürgmann, UC Berkeley professor of earth and planetary science at UC Berkeley.

"The stress is very small, much less than you need to build up stress on a fault toward an earthquake, but in some circumstances such small stress changes can be the straw that broke the camel's back; it could just give that extra push to get a fault to fail," Bürgmann said.

Bürgmann is a coauthor of a report published online this week by the journal Nature. The study, based on detailed global positioning satellite (GPS) measurements from California and Nevada between 2007 and 2010, was led by former UC Berkeley postdoctoral fellows Colin Amos, now at Western Washington University, and Pascal Audet, now of the University of Ottawa. The detailed GPS analysis was performed by William C. Hammond and Geoffrey Blewitt of the University of Nevada, Reno.

Draining of Central Valley

Water has been pumped from California's Central Valley for more than 150 years, reducing what used to be a marsh and extensive lake, Tulare Lake, into fertile agricultural fields that feed the world. In that time, approximately 160 cubic kilometers (40 cubic miles) of water was removed – the capacity of Lake Tahoe – dropping the water table in some areas more than 120 meters (400 feet) and the ground surface 5 meters (16 feet) or more.

The weight of water removed allowed the underlying crust or lithosphere to rise by so-called isostatic rebound, which has raised the Sierra probably as much as half a foot since about 1860, Bürgmann said.

The same rebound happens as a result of the state's seasonal rains. Torrential winter storms drop water and snow across the state, which eventually flow into Central Valley streams, reservoirs and underground aquifer, pushing down the crust and lowering the Sierra 1-3 millimeters. In the summer, water flow through the delta into the Pacific Ocean, evaporation and ground water pumping for irrigation, which has accelerated in the past few years because of a drought, allows the crust and surrounding mountains to rise again.

Bürgmann said that the flexing of Earth's crust downward in winter would clamp the San Andreas Fault tighter, lowering the risk of quakes, while in summer the upward flexure would relieve this clamping and perhaps increase the risk.

"The hazard is ever so slightly higher in the summer than in the wintertime," he said. "This suggests that climate and tectonics interact; that water changes ultimately affect the deeper Earth too."

High-resolution mapping with continuous GPS

Millimeter-precision measurements of elevation have been possible only in the last few years, with improved continuous GPS networks – part of the National Science Foundation-funded Plate Boundary Observatory, which operates 1,100 stations around the western U.S. – and satellite-based interferometric synthetic aperture radar (InSAR). These measurements revealed a steady yearly rise of the Sierra of 1-2 millimeters per year, which was initially ascribed to tectonic activity deep underground, even though the rate was unusually high, Bürgmann said. The new study provides an alternative and more reasonable explanation for the rise of the Sierra in historic times.

"The Coast Range is doing the same thing as the Sierra Nevada, which is part of the evidence that this can't be explained by tectonics," he said. "Both ranges have uplifted over the last few years and they both exhibit the same seasonal up and down movement in phase. This tells us that something has to be driving the system at a seasonal and long-term sense, and that has to be groundwater recharging and depletion."

In response to the current drought, about 30 cubic kilometers (7.5 cubic miles) of water were removed from Central Valley aquifers between 2003 and 2010, causing a rise of about 10 millimeters (2/5 inch) in the Sierra over that time.

After the new results were shared with colleagues, Bürgmann said, some geologists suggested that the state could get a better or at least comparable inventory of available water each year by using GPS to measure ground deformation instead of measuring snowpack and reservoir levels.

Other coauthors are Colin B. Amos of Western Washington University in Bellingham, Ingrid A. Johanson of UC Berkeley. Funding for the research came from NSF EarthScope and UC Berkeley's Miller Institute.

http://www.eurekalert.org/pub_releases/2014-05/ps-sie051414.php

Strongly interacting electrons in wacky oxide synchronize to work like the brain

Thin film of vanadium oxide on a titanium dioxide substrate used to create an oscillating switch

Current computing is based on binary logic -- zeroes and ones -- also called Boolean computing, but a new type of computing architecture stores information in the frequencies and phases of periodic signals and could work more like the human brain using a fraction of the energy necessary for today's computers, according to a team of engineers.

Vanadium dioxide is called a "wacky oxide" because it transitions from a conducting metal to an insulating semiconductor and vice versa with the addition of a small amount of heat or electrical current. A device created by electrical engineers at Penn State uses a thin film of vanadium oxide on a titanium dioxide substrate to create an oscillating switch.

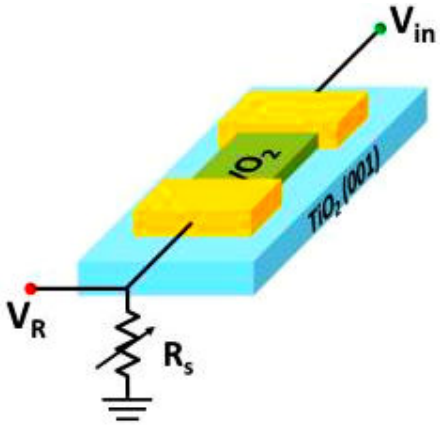
Using a standard electrical engineering trick, Nikhil Shukla, graduate student in electrical engineering, added a series resistor to the oxide device to stabilize oscillations over billions of cycles. When Shukla added a second similar oscillating system, he discovered that, over time, the two devices began to oscillate in unison. This coupled system could provide the basis for non-Boolean computing. Shukla worked with Suman Datta, professor of electrical engineering, and co-advisor

Roman Engel-Herbert, assistant professor of materials science and engineering, Penn State. They reported their results today (May 14) in Scientific Reports.

"It's called a small-world network," explained Shukla. "You see it in lots of biological systems, such as certain species of fireflies. The males will flash randomly, but then for some unknown reason the flashes synchronize over time."

The brain is also a small-world network of closely clustered nodes that evolved for more efficient information processing.

"Biological synchronization is everywhere," added Datta. "We wanted to use it for a different kind of computing called associative processing, which is an analog rather than digital way to compute."



This is a cartoon of an oscillating switch, the basis of a new type of low-power analog computing. **Nikhil Shukla, Penn State**

An array of oscillators can store patterns -- for instance, the color of someone's hair, their height and skin texture. If a second area of oscillators has the same pattern, they will begin to synchronize, and the degree of match can be read out.

"They are doing this sort of thing already digitally, but it consumes tons of energy and lots of transistors," Datta said.

Datta is collaborating with Vijay Narayanan, professor of computer science and engineering, Penn State, in exploring the use of these coupled oscillations to solve visual recognition problems more efficiently than existing embedded vision processors.

Shukla and Datta called on the expertise of Cornell University materials scientist Darrell Schlom to make the vanadium dioxide thin film, which has extremely high quality similar to single crystal silicon. Arijit Raychowdhury, computer engineer, and Abhinav Parihar graduate student, both of Georgia Tech, mathematically simulated the nonlinear dynamics of coupled phase transitions in the vanadium dioxide devices. Parihar created a short video simulation of the transitions, which occur at a rate close to a million times per second, to show the way the oscillations synchronize. Venkatraman Gopalan, professor of materials science and engineering, Penn State, used the Advanced Photon Source at Argonne National Laboratory to visually characterize the structural changes occurring in the oxide thin film in the midst of the oscillations.

Datta believes it will take seven to 10 years to scale up from their current network of two-three coupled oscillators to the 100 million or so closely packed oscillators required to make a neuromorphic computer chip. One of the benefits of the novel device is that it will use only about one percent of the energy of digital computing, allowing for new ways to design computers. Much work remains to determine if vanadium dioxide can be integrated into current silicon wafer technology.

"It's a fundamental building block for a different computing paradigm that is analog rather than digital," said Shukla.

Also contributing to this work are Eugene Freeman and Greg Stone, all of Penn State; Haidan Wen and Zhonghou Cai, Argonne National Laboratory; and Hanjong Paik, Cornell University. The Office of Naval Research primarily supported this work. The National Science Foundation's Expeditions in Computing Award also supported this work.

http://bit.ly/1mEB38T

New planet-hunting hardware needs just a minute to image an exoplanet

Survey with the telescope may add 50 exoplanets that we've seen directly.

by John Timmer - May 15 2014, 12:23am TST

Most of the exoplanets we've detected have been spotted during transits, when they pass between their host star and Earth. Almost all the others have been inferred based on the fact that they gravitationally tug at their host star as they orbit around it. Very few exoplanets have been imaged directly, but that may be about to change. Earlier this week, scientists revealed the first images taken with a new instrument, the Gemini Planet Imager, which has been installed on the (you guessed it) Gemini South telescope located in the Chilean Andes. The new hardware is so efficient that a known exoplanet that once took over an hour and considerable post-processing to image was apparent in a one-minute exposure, with no processing needed.

The twin Gemini telescopes (Gemini North is in Hawaii to image the northern sky) are already some of the most advanced hardware on the planet, featuring adaptive optics that correct the gaze of an eight-meter mirror. But directly imaging a planet is a distinct challenge due to the relative brightness of the planet relative to the host star. In terms of our own Solar System, Jupiter would appear 109 times fainter than the Sun when imaged at a distance.

Successfully imaging an exoplanet requires two things: the right planet and some very specialized hardware. The planet part is simple. For many years after their formation, large gas giants (called super-Jupiters) radiate a lot of heat trapped by their initial gravitational collapse. So any relatively young star can be targeted for imaging, as a super-Jupiters that's sufficiently distant from the star can be imaged in the infrared, where its own emissions dwarfs the starlight that it reflects.

It's harder to modify an instrument to get it to actually see the exoplanets. To begin with, you have to have hardware, called a coronagraph, that blocks out the light of the central star. Some of this light will naturally diffract around the coronagraph, but it's possible to design one that directs the diffraction outside the imaging hardware. That's the part of the hardware that comprises the Gemini Planet Hunter. The rest involves the optimization of existing hardware. Adaptive optics work great for adjusting the shape of the mirror to compensate for atmospheric distortions. Unfortunately, there are limits to how much a mirror can bend and how finely these bends can be controlled. Under the right circumstances (or, really, the wrong circumstances), the adaptive optics can create a speckle that remains stationary during the imaging. That could potentially be misinterpreted as a planet.

New observations of the star β Pictoris reveal that gas giant exoplanets can …

The team behind the Gemini Planet Imager carefully examined everything that affects the optical path through their telescope. They were so thorough that they were actually able to detect the presence of a vibration caused by the cooling equipment that keeps the imaging hardware chilled. A redesign of that hardware to eliminate this vibration is now in progress; in the meantime, the researchers started imaging while running it at one-third power.

To test things out, the authors turned to the exoplanet ß Pictoris b, which had been previously imaged by several different observatories. The results were impressive. "The planet was immediately visible in a single raw 60s exposure," the authors write. "For comparison, a lower signal-to-noise H-band detection using [Gemini] required 3,962s of exposure and extensive [post-image processing]."

The test observations were done back in December of last year. With the hardware checked out, the Gemini Planet Imager is set to begin a survey of 600 young stars in our neighborhood, starting this year. Based on initial performance, it should be able to image planets with Jupiter's mass and up, orbiting within three Astronomical Units from their host star. (An Astronomical Unit is the average distance from the Earth to the Sun.) That survey is scheduled to start this year, and estimates are that it will find anywhere from 20-50 new exoplanets.

PNAS, 2014. DOI: 10.1073/pnas.1304215111 (About DOIs).

http://bit.ly/1jFXCEO

A squeeze on the arm could save lives in heart surgery

Could the humble blood-pressure cuff hold the secret to a life-saving new treatment?

14 May 2014 by Clare Wilson

Briefly restricting blood flow to a person's arm seems to prime the heart and other organs to cope with a more severe loss of their blood supply.

The technique could improve recovery from surgery, a heart attack or stroke. "There's tremendous interest because it's a simple, cheap and non-invasive form of protection," said Derek Yellon of University College London at a conference on the approach in London last month.

The effect relies on a phenomenon called ischaemic conditioning, first seen in animal experiments that temporarily cut off the heart's blood supply. Researchers found that there was less damage to the heart if its blood supply was briefly lowered beforehand. It was as if the heart muscle had been trained to withstand oxygen deprivation.

Surprisingly, reducing blood supply in one of the animal's limbs, simply by squeezing it, produced the same benefit. The effect could even be passed from one animal to another with a blood transfusion, suggesting that the squeezed limb released some sort of beneficial chemical signal into the blood. Researchers are now trying to uncover the exact mechanism involved.

Using the method in the clinic involves four cycles of inflating a blood-pressure cuff for five minutes, then deflating it for five minutes. Several studies show that this cuts damage to heart muscle by about one-third following surgery to bypass blocked arteries, when the heart's blood supply must be stopped for up to an hour. It can also be used before the artery-widening treatment given immediately after a heart attack, to lessen damage caused by the sudden return of blood.

Such studies suggest that ischaemic conditioning can lower death rates by as much as two-thirds. But not all trial results have shown a significant effect, although none has found the technique to cause harm. We need to wait for evidence from larger trials, says Gerd Heusch of the University of Essen in Germany, who carried out one of the artery-bypass studies.

Even so, a few hospitals in India and China are already using ischaemic conditioning before heart surgery or as a treatment for heart attacks. In Europe, a computer-controlled cuff that carries out the procedure will be launched later this year. It is already on trial in ambulances in several countries for use following heart attacks.

Work on animals suggests the technique also benefits the brain and other organs. It is now being investigated as a treatment for newborns deprived of oxygen and adults after a stroke, as well as before organ transplants.

"All the data so far suggest that if you get the right patient and you deliver it in the right way, you can have profound effects," says Andrew Redington of the Hospital for Sick Children in Toronto, Canada. "But people can't believe it – it seems too simple."

http://phys.org/news/2014-05-climate-empire-fall-tree-reveal.html

Climate change caused empire's fall, tree rings reveal

Helps confirm that the "higher" Egyptian chronology for the time period is correct

Phys.org - A handful of tree ring samples stored in an old cigar box have shed unexpected light on the ancient world, thanks to research by archaeologist Sturt Manning and collaborators at Cornell, Arizona, Chicago, Oxford and Vienna, forthcoming in the June issue of the Journal of Archaeological Science.

The samples were taken from an Egyptian coffin; Manning also examined wood from funeral boats buried near the pyramid of Sesostris III. He used a technique called "dendro radiocarbon wiggle matching," which calibrates radiocarbon isotopes found in the sample tree rings with patterns known from other places in the world that have already identified chronologies, such as the long European oak chronology or the bristle cone pine trees of North America.

The coffin of Ipi-ha-ishutef showing details of the decorations on the walls. This is the coffin tree ring samples were taken from. **S. Cristanetti, A. Whyte/University of Chicago's Oriental Institute**

Because the dating was so precise – plus or minus about 10 years – it helps confirm that the "higher" Egyptian chronology for the time period is correct, a question scholars have hotly debated.

But the samples also showed a small, unusual anomaly following the year 2200 B.C. Paleoclimate research has suggested a major short-term arid event about this time.

"This radiocarbon anomaly would be explained by a change in growing season, i.e., climate, dating to exactly this arid period of time," says Manning. "We're showing that radiocarbon and these archaeological objects can confirm and in some ways better date a key climate episode."

That climate episode, says Manning, had major political implications. There was just enough change in the climate to upset food resources and other infrastructure, which is likely what led to the collapse of the Akkadian Empire and affected the Old Kingdom of Egypt and a number of other civilizations, he says.

"The tree rings show the kind of rapid climate change that we and policymakers fear," says Manning. "This record shows that climate change doesn't have to be as catastrophic as an Ice Age to wreak havoc. We're in exactly the same situation as the Akkadians: If something suddenly undid the standard food production model in large areas of the U.S. it would be a disaster."

Provided by Cornell University

http://bit.ly/TeAI2j

Cancer is common in pets; learn the signs during Pet Cancer Awareness Month

Did you know that cancer is the leading cause of death among dogs more than 2 years old?

This is a startling statistic and might be unknown to people who haven't confronted cancer in a pet. May is designated as Pet Cancer Awareness Month by the American Veterinary Medical Association, and it's a good time to bone up on the risks and signs of cancer in pets – and to understand current treatment options.

The Colorado State University Flint Animal Cancer Center is the world's largest center focused on veterinary oncology, with about 100 scientists and clinicians who handle about 6,000 appointments and 3,000 consultations annually. We also train veterinary students and conduct clinical trials to treat dogs with naturally occurring tumors, while also gaining critical insight in our quest for a cancer cure.

The mission of our Animal Cancer Center is to successfully treat pets with cancer – and to use the knowledge we attain to advance cancer treatment for people. If that sounds far-fetched, it's useful to know that tumors and their growth are remarkably similar between pets and people; that makes cancer treatment in dogs an ideal model for advancing cancer treatment for human patients.

Here are a couple things we know about cancer in dogs: About half of dogs over the age of 10 will develop cancer; in some breeds, the mortality rate is 50 percent or greater. By comparison, 41 percent of men and women will be diagnosed with cancer during their lifetimes, according to the latest data from the National Cancer Institute.

The prevalence of pet cancers is distressing for those of us who consider our dogs as family members. Yet there's also good news: About 50 percent of cancers in dogs are curable with surgery, chemotherapy or radiation.

Another 25 percent of canine cancers are controllable, meaning treatment will help to extend life and improve quality of life.

In the final 25 percent of canine cancer patients, it is unreasonable to consider prolonging survival because of the advanced nature of the cancer. In these cases, veterinarians have many tools to provide palliative care, meaning we seek to relieve pain and provide other supportive therapies so the patient is comfortable until the end of life.

As is the case in people, there are different types of cancer in dogs.

Among U.S. men, prostate, lung and colorectal cancers are most common; in U.S. women, breast, lung and colorectal cancers develop most frequently, data from the National Cancer Institute show.

In dogs, we most often see tumors of the lymph nodes; hemangiosarcomas, or tumors that develop in the blood vessels; and osteosarcomas, or bone cancers; and sarcomas in general.

Early detection and treatment are important for dogs, just as for people. So it's helpful to know the top 10 warning signs of cancer in pets:

Abnormal swellings that persist or grow: As we like to suggest, pet your pet! ***This is the best way to find lumps, bumps or swelling that could be anywhere on the body.***

Sores that don't heal: Non-healing sores can be a sign of infection or cancer. Your veterinarian can determine the reason a sore is not healing.

Weight loss: Illness could be to blame if your pet is losing weight but is not on a diet.

Loss of appetite: It's not normal for pets to lose their appetite; inappetence is another sign of possible illness.

Bleeding or discharge from any body opening: Bleeding can occur for a number of reasons, most of which are abnormal. We consider unexplained vomiting and diarrhea as abnormal discharges, as well.

Offensive odor: This is a common sign, especially for tumors of the anus, mouth or nose.

Difficulty eating or swallowing: This is a common sign of cancers of the mouth or neck.

Hesitation to exercise or loss of stamina: This can be one of the first signs that your pet is not feeling well.

Persistent lameness: There can be many causes of lameness, including nerve, muscle or bone cancer.

Difficulty breathing, urinating or defecating: Schedule a veterinary evaluation if your pet displays any of these symptoms.

Your pet should be seen by a veterinarian if any of these signs arise, as these symptoms may point to a variety of illnesses and diseases, including cancer. Early diagnosis often means better treatment options. We recommend checkups so your pet's health is monitored regularly.

http://www.medscape.com/viewarticle/825210?src=rss#1

Warfarin for Long-term Psychosis Remission?

Warfarin has been linked to a decrease in and even long-term remission of psychotic symptoms in patients with schizophrenia, preliminary research suggests.

Deborah Brauser

NEW YORK — A study examining adults at an anticoagulation clinic for deep venous thrombosis (DVT) showed that 5 patients who also had schizophrenia and who received long-term treatment with warfarin for recurrent DVT achieved full psychosis remission. In addition, these patients remained free of any psychotropic medication for 2 to 11 years.

The investigators note that the underlying mechanism could be tissue-plasminogen activator (tPA), a protein that not only promotes the dissolution of blood clots but also plays a role in neurogenesis after severe stress.

"Our findings suggest that normalization of [tPA] function may induce long-term remission of psychotic symptoms," they write.

However, lead author Silvia Hoirisch-Clapauch, MD, a hematologist specializing in vascular medicine at the Federal University of Rio de Janeiro in Brazil, told *Medscape Medical News* that she is not (yet) suggesting that psychiatrists should start prescribing warfarin for these patients.

"What we found seems to make sense, but we need other scientists to help us to search for markers in a population with schizophrenia that is medication naive," said Dr. Hoirisch-Clapauch. She added that larger studies, including randomized controlled trials, are also needed to clarify exactly how and if anticoagulation should be used in the treatment of psychosis.

The findings were presented here at the American Psychiatric Association's (APA's) 2014 Annual Meeting.

More Than a Coincidence

Warfarin, an anticoagulant medication, is commonly used to treat DVT and other clotting disorders.

Dr. Hoirisch-Clapauch reported that her university's anticoagulation clinic takes care of patients with repeated episodes of DVT, including approximately 350 who are on long-term warfarin therapy.

While providing care for these patients, she noticed that the 5 who also had schizophrenia and schizoaffective disorders achieved psychiatric remission and became "psychotropic free."

"Finding this with 1 patient was strange, 2 was a coincidence, but with all 5 patients, I had to look for an explanation of what happened," said Dr. Hoirisch-Clapauch, adding that she wanted to work specifically with Antonio E. Nardi, MD, PhD, from the Institute of Psychiatry at the Federal University of Rio de Janeiro.

The researchers note that patients with schizophrenia commonly have a reduction of hippocampal volume, which is often explained as being caused by a trigger (such as use of illicit drugs or a previous traumatic event) and/or a predisposing condition that impairs neuronal plasticity.

In November 2012, they searched PubMed for data on a protein or proteins that could participate in both "the anticoagulation-fibrinolytic mechanism and in hippocampal neurogenesis or neuronal plasticity."

"The search pointed to a single candidate: tPA," they write. Warfarin inhibits activation of thrombin-activatable fibrinolysis inhibitor. And that process in turn increases tPA levels.

Low tPA Activity

All 5 of the patients with schizophrenia "had 2 or more conditions characterized by low tPA activity, including prothrombin G20210A, fasting hyperinsulinemia, hyperhomocysteinemia, or antiphospholipid antibodies in medium or high titers."

The researchers add that deficient dopamine transmission at D1 receptors in the brain's prefrontal cortex and "impaired cleavage of pro brain-derived neurotrophic factor" are among biochemical abnormalities that can be related to impaired tPA activity in patients with schizophrenia.

Other tPA-related abnormalities include reduced Akt phosphorylation, problems with *N*-methyl-D-aspartate receptor-mediated signaling, and deficient activation of reelin.

Overall, "plasminogen activator mediates hippocampal neurogenesis," write the investigators.

They add that none of the 5 patients with schizophrenia showed any ischemic brain injury on neuroimaging tests.

"At the very beginning, I thought maybe these patients had had a stroke, but they did not," said Dr. Hoirisch-Clapauch. Instead, she said that the research points to tPA activity.

"We knew we had found the joker that performs a role as a clot buster and in neurochemistry. And we were able to insert our joker in all these chemical reactions that occur during the pathogenesis of schizophrenia," she said.

"What we found with our 5 patients wasn't an accident. It was serendipity."

Inflammation and Psychiatric Illness

"One of the things that you're seeing in the literature more and more often is the role of the inflammatory system in psychiatric illness, particularly in people who have difficulty responding to the usual sorts of treatment," Jeffrey Clothier, MD, professor of psychiatry at the University of Arkansas in Little Rock, told *Medscape Medical News*.

"This study presented some interesting pathways where some of that could be mediated for long-term effects. And it suggests that perhaps some of the things we do for patients we need to start rethinking, such as long-term antipsychotic use for those who don't really need antipsychotics," said Dr. Clothier, who was not involved with this research.

He noted that although the study only looked at 5 patients, it was interesting that all 5 entered psychosis remission.

"I think this brings back the whole question, how do we approach patients? Do we approach them at a diagnostic level, or should we be approaching them with more of a mind towards the RDoC, Research Domain Criteria?" he asked.

"And does this study give us a little bit of insight, even though it was a small number examined, into some novel pathways that need to be investigated in subgroups of patients we haven't really been thinking about?"

Dr. Clothier agreed that there are no clinical implications based on these early findings.

However, he said it is good information to keep in mind, especially because it could represent future possibilities.

"I just watched presentations on neuroimaging of schizophrenia [at the APA meeting] and how there's a loss of volume and loss of neuropil in some of these patients. And it makes you wonder: exactly what is the mechanism for this? Is it a loss or reduction of tPA activity?" he asked.

"It'll be interesting to see what happens with this."

The study authors and Dr. Clothier report no relevant financial relationships.

American Psychiatric Association's 2014 Annual Meeting. Abstract NR3-14. Poster presented May 4, 2014.

http://bit.ly/1qKVRQh

Life Span Boosted in Worms via Dietary Supplement Compound

It's premature to call the compound, alpha-ketoglutarate, an antiaging drug, but it has been found to extend the longevity of C. elegans by 50 percent

May 14, 2014 |By Heidi Ledford and Nature magazine

A compound available in some dietary supplements extends lifespan in the nematode worm Caenorhabditis elegans by interfering with cellular energy production and mimicking the effects of severe calorie restriction. The results, published online in Nature today, suggest that the compound, called α-ketoglutarate, could provide a way to increase longevity.

Though intriguing, data linking the compound to longevity are limited to short-term studies in a worm and should not lead people to start taking α-ketoglutarate supplements, cautions Matt Kaeberlein, who studies ageing at the University of Washington in Seattle.

“I'm not sure I would characterize α-ketoglutarate as an anti-ageing drug yet,” says Kaeberlein, who was not involved in the study. “It’s premature.”

Power interruption

Chemical biologist Jing Huang at the University of California in Los Angeles and her colleagues stumbled on α-ketoglutarate while screening metabolites for the

ability to improve lifespan in C. elegans. α-ketoglutarate boosted longevity by about 50% over untreated controls.

Differences in behavior were also clear, says Huang: as untreated worms surpassed the age of two weeks, they became sluggish. “They move their head if you poke them,” she says, “but otherwise there’s not much activity.” Treated nematodes, however, wriggled and squirmed with youthful vigor.

α-Ketoglutarate is a component of a metabolic pathway called the tricarboxylic acid cycle, which is part of cells' energy-generating machinery. Huang and her colleagues found that α-ketoglutarate can also inhibit a crucial enzyme called ATP synthase. That enzyme is the main producer of ATP, the chemical energy currency in cells, and so reduces energy production in the body.

Huang and her colleagues reasoned that the interruption in energy production could mimic the effects of diets very low in calories, which have been shown to extend lifespan in some animals. To back up this notion, they also showed that calorie restriction raised levels of α-ketoglutarate.

Calorie counter

Calorie restriction had no added effect on longevity in worms given α-ketoglutarate, suggesting that the metabolite is a key part of the mechanism by which low-calorie diets aid longevity. If this is so, the findings hint at a way to gain the benefits of calorie restriction without the suffering. Only a dedicated few are able to withstand the rigors of such dietary deprivation.

But while the results are promising, researchers need to pursue longer-term studies in animals that more closely resemble humans to fully understand α-ketoglutarate’s potential, cautions Brian Kennedy, president of the Buck Institute for Research on Aging in Novato, California. “We don’t just want to make the animals live longer,” he adds. “We want to make them healthy longer.”

And impairing the body's ability to produce energy could have unpleasant side-effects. Depleted energy stores can lead to muscle fatigue, says Michael Ristow, who studies energy metabolism at the Swiss Federal Institute of Technology in Zurich. “Exercise does the same thing.”

If the results do stand up in future studies, α-ketoglutarate may become the latest addition to an expanding medicine chest of potential life-lengthening elixirs. Last week, researchers reported that a protein enriched in the blood of young mice could rejuvenate older mice. And previous studies have suggested that the drug rapamycin, used to suppress the immune system following organ transplants, could also boost lifespan in mice.

http://www.eurekalert.org/pub_releases/2014-05/uoth-urc051514.php

UTHealth research: Children of parents in technical jobs at higher risk for autism

Children of fathers who are in technical occupations are more likely to have an autism spectrum disorder

HOUSTON – Children of fathers who are in technical occupations are more likely to have an autism spectrum disorder, according to researchers at The University of Texas Health Science Center at Houston (UTHealth).

The findings will be presented Friday at the International Meeting for Autism Research in Atlanta.

During participation in the LoneStar LEND program, first author Aisha S. Dickerson, Ph.D., a researcher at UTHealth's Center for Clinical and Translational Sciences, used the United States government's Standard Occupational Classification system. Parents were divided into those who had more non-people-oriented jobs (technical) or more people-oriented jobs (non-technical).

Fathers who worked in engineering were two times as likely to have a child with an autism spectrum disorder (ASD). Those who worked in finance were four times more likely and those who worked in health care occupations were six times more likely to have a child on the autism spectrum.

There was no association with a mother's occupation. However, children who had both parents in technical fields were at a higher risk of having a more severe form of autism.

"Parental occupation could be indicative of autistic-like behaviors and preferences and serve as another factor in a clinician's diagnosis of a child with suspected autism. Medical students can be taught that this is one of the things to consider," Dickerson said.

Senior author of the paper, "Role of Parental Occupation in Autism Spectrum Disorder Diagnosis and Severity," is Pauline A. Filipek, M.D., professor and director of the Autism Center at the UTHealth Medical School's Children's Learning Institute. UTHealth co-authors include Deborah Pearson, Ph.D., professor of psychiatry and behavioral sciences; Katherine Loveland, Ph.D., professor of psychiatry and behavioral sciences and professor at The University of Texas Graduate School of Biomedical Sciences at Houston; and Mohammad Hossein Rahbar, Ph.D., director of the Division of Clinical and Translational Sciences in the Department of Internal Medicine and professor of epidemiology and biostatics in the UTHealth School of Public Health.

http://www.eurekalert.org/pub_releases/2014-05/aaft-asc050614.php

A skeleton clue to early American ancestry

Early American skeleton has genetic signature of modern Native Americans

The discovery of a near-complete human skeleton in a watery cave in Mexico is helping scientists answer the question, "Who were the first Americans?" The finding, reported in the 16 May issue of the journal Science, sheds new light on a decades-long debate among archaeologists and anthropologists.

Deciphering the ancestry of the first people to populate the Americas has been a challenge.

On the basis of genetics, modern Native Americans are thought to descend from Siberians who moved into eastern Beringia (the landmass connecting Asia and North America) between 26,000 and 18,000 years ago. These people, the earliest Americans, then spread southward.

Despite widespread support for this idea, the ancestry of the earliest Americans is still debated because the facial features of the oldest American skeletons don't look much like those of modern Native Americans.

"Modern Native Americans closely resemble people of China, Korea, and Japan," James Chatters, lead author on the study, said, "but the oldest American skeletons do not." They have longer, narrower crania than later Native Americans, and smaller, shorter faces, too -- more closely resembling modern peoples of Africa, Australia, and the Southern Pacific Rim. "This has led to speculation that perhaps the first Americans and Native Americans came from different homelands," Chatters continued, "or migrated from Asia at different stages in their evolution."

Complicating the puzzle, it's been very difficult to find intact Paleoamerican skeletons for study.

"Paleoamerican skeletons are rare for several reasons," Chatters explained. "The people themselves were few; they were highly nomadic and seem to have buried or cremated the dead where they fell, making the locations of graves unpredictable; also, geologic processes have destroyed or deeply buried their graves."

Meanwhile, those skeletal remains that have been unearthed are lacking, often only fragments, and most estimated to be younger than 10,000 years old. (The earliest Americans reached the continent farther back in time than that.)

Now, however, Chatters and colleagues report the discovery of a near-complete Late Pleistocene-age human skeleton. It was hidden deep in a submerged chamber in the Sac Actun cave system on Mexico's Eastern Yucatán Peninsula.

"Hoyo Negro is a more than 100-foot-deep, bell-shaped, water-filled void about the size of a professional basketball arena deep inside a drowned cave system," Chatters said. "Only technical cave divers can reach the bottom. First they must climb down a 30-foot ladder in a nearby sinkhole; then they swim along 200 feet of tunnel to the pit rim before making a final 100-foot drop. The divers are the astronauts of this project; we scientists are their mission control."

Like nearby caves, Hoyo Negro was accessible only via sinkhole; people and animals fell in and were trapped. Then, starting about 10,000 years ago, global glaciers melted, filling the caves with water. In addition to the near-complete human skeleton, the researchers found the remains of 26 large mammals, including extinct taxa such as sabertooths and gomphotheres.

The nearly-intact skeleton was that of a small human female about 15 or 16 years old. Based on radiocarbon dating of tooth enamel and analyses of mineral deposits on her bones, the researchers inferred her remains to be at least 12,000 years old. She possesses the unique craniofacial morphology of the earliest Americans, but to understand more about her ancestry and its potential linkage to modern Native Americans, the researchers extracted DNA from one of her molars. "We tried a DNA extraction on the outside chance some fragments might remain," Chatters said. "I was shocked when we actually got intact DNA."

He and colleagues analyzed the girl's mitochondrial DNA (mtDNA), a useful tool for examining the relatedness of populations. Their analysis revealed a haplotype common to modern Native Americans, subhaplogroup D1. This genetic signature occurs only in the Americas, likely having developed in Beringia after populations there split from other Asians.

The sample shows that individuals of the Pleistocene era with Beringian-derived mtDNA traveled far and wide through the Americas, all the way down to Mexico, for example.

Critically, it shows that despite differences in craniofacial form, this early American woman was related to modern Native Americans; the differences in craniofacial form are probably best explained as evolutionary changes that happened after the divergence of Beringians from their Siberian ancestors, the authors say.

Their work suggests that America was not colonized by separate migration events from different parts of Eurasia. Rather, the earliest Americans represent an early population expansion out of Beringia. This aligns with the hypothesis that both Paleoamericans and Native Americans derive from a single source population.

Chatters and colleagues were delighted with their find: "This project is exciting on so many fronts: the beautiful cave, the incredibly well-preserved animal skeletons, the completeness of the human skeleton, the success of our innovative dating approach. But for me," he said, "what is most exciting is that we finally have an answer, after 20 years, to a question that has plagued me since my first look at Kennewick Man: 'Who were the first Americans?'"

http://www.eurekalert.org/pub_releases/2014-05/d-tlm051314.php

2 large meals beats 6 small meals to control weight and blood sugar in people with type 2 diabetes

Two large meals (breakfast and lunch) better than 6 small meals with same calories for controlling weight and blood sugar in people with type 2 diabetes

Research published in Diabetologia (the journal of the European Association for the Study of Diabetes) suggests that two large meals (breakfast and lunch), rather than six small meals with the same total calories, are better for controlling weight and blood sugar in people with type 2 diabetes. The research is by Dr Hana Kahleová, Diabetes Centre, Institute for Clinical and Experimental Medicine, Prague, Czech Republic, and colleagues.

The study assessed 54 patients (29 men, 25 women) treated with oral diabetes drugs, aged 30–70 years, BMI 27–50 kg/m2 and HbA1c of 6–11.8% (42–105 mmol/mol). They were asked to follow one of two regimens of a restricted calorie diet, each containing 500 calories less than the recommended daily amount; in one programme the meals were six small meals (A6) and the other 2 large meals, breakfast and lunch (B2). In this cross-over trial, the 54 participants were divided into 2 groups of 27, with each group doing one of the two programmes for 12 weeks, and then after finishing moving on to the other programme, again for 12 weeks. The diet in both regimens had the same macronutrient and calorie content. Liver fat content, insulin sensitivity and pancreatic beta cell function (the cells that produce insulin) were measured using a variety of techniques and mathematical modelling.

The researchers found that body weight decreased in both regimens, more for B2 (-3.7kg) than for A6 (-2.3kg). Liver fat content decreased in response to both regimens, more for B2 (-0.04%) than for A6 (-0.03%). Fasting plasma glucose and C-peptide* levels decreased in both regimens, again more for B2. Fasting plasma glucagon (the hormone that converts glycogen back to glucose) decreased with the B2 regimen, whereas it increased for the A6 regimen. Oral glucose insulin sensitivity (OGIS) increased in both regimens, more for B2. No adverse events were observed for either regimen.

The authors say: "Eating only breakfast and lunch reduced body weight, liver fat content, fasting plasma glucose, C-peptide and glucagon, and increased OGIS, more than the same caloric restriction split into six meals. These results suggest that, for type 2 diabetic patients on a calorie-restricted diet, eating larger breakfasts and lunches may be more beneficial than six smaller meals during the day."

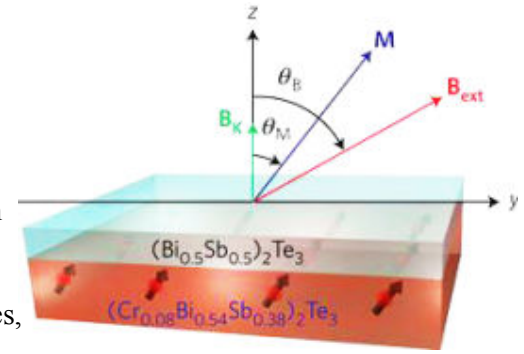
They add: "Novel therapeutic strategies should incorporate not only the energy and macronutrient content but also the frequency and timing of food. Further larger scale, long-term studies are essential before offering recommendations in terms of meal frequency."

http://bit.ly/1hV9Dq4

New Class of Topological Insulators is 1,000 Times More Energy-Efficient

UCLA researchers have developed a new class of topological insulators that use 1,000 times less energy to switch polarity than comparable memory structures

Researchers at the UCLA Henry Samueli School of Engineering and Applied Science have developed a new class of topological insulators that use 1,000 times less energy to switch polarity than comparable memory structures. Topological insulators are an emerging class of materials that act as both insulators and conductors, and could potentially be used in smartphones, computers and other electronic devices.



Structure of the two-layer topological insulator developed by UCLA Engineering researchers.

A research team at the UCLA Henry Samueli School of Engineering and Applied Science has developed a new class of topological insulators in which one of two layers is magnetized. The advance could lead to the development of much more energy-efficient big-data processing systems and ultra-low power electronics.

Led by Kang Wang, the Raytheon Professor of Electrical Engineering at UCLA and the study's principal investigator, the team demonstrated for the first time that the new topological insulators can be electrically "switched" to make them significantly more energy-efficient than current devices. The research was published April 28 in the journal Nature Materials. "We are very excited about this important result with the new topological insulators, which should lead to the advancement of future low-power, green electronics," Wang said.

The interiors of topological insulators prevent the flow of electrical currents, but their surfaces allow a current to move with very little resistance. Perhaps most importantly, their surfaces enable the transport of spin-polarized electrons while preventing the "scattering" of electrons that causes energy to be dissipated and wasted.

The topological insulator created at UCLA comprises two layers, one of which contains chromium, a magnetic element. An electrical current that drives spin-polarized electrons can switch the up-down polarity of the magnetic chromium

atoms. This switching is what enables the device to write memory or perform calculations.

Most significantly, the new two-layer structure uses 1,000 times less energy to switch polarity than comparable memory structures. “This is the first time that topological insulators have been incorporated in a magnetic structure that can be efficiently switched, and is perhaps the first demonstration of potential applicable devices based on topological insulators,” said Yabin Fan, the paper’s lead author and a UCLA graduate student in electrical engineering.

The study’s other authors include UCLA Engineering graduate students Pramey Upadhyaya and Xufeng Kou. The research was supported by the Defense Advanced Research Projects Agency’s Mesodynamic Architectures program. Additional support came from two UCLA Engineering research centers, the Western Institute of Nanoelectronics and the center for Functional Accelerated nanoMaterial Engineering.

***Publication**: Yabin Fan, et al., “Magnetization switching through giant spin–orbit torque in a magnetically doped topological insulator heterostructure,” Nature Materials, 2014; doi:10.1038/nmat3973 **Source**: Matthew Chin, UCLA Newsroom*

http://www.medscape.com/viewarticle/825221?src=rss#1

Altered Hippocampus a Key Player in Psychotic Disorders

Hippocampal alterations appear to be a common trait shared across the spectrum of psychotic disorders, new research suggests.

Megan Brooks

Investigators found reductions in hippocampal volume and its subfields not only in patients with schizophrenia but also in those with schizoaffective disorder and psychotic bipolar disorder. "This study firmly establishes the hippocampus as one of the key nodes in the pathway to psychosis," write Matcheri Keshavan, MD, of the Department of Psychiatry, Beth Israel Deaconess Medical Center and Harvard Medical School, Boston, Massachusetts, and colleagues.

The study was published online May 14 in *JAMA Psychiatry.*

Widespread Volume Reductions

The pathophysiology of schizophrenia and other psychotic disorders remains unclear. Structural alterations in the hippocampus and other medial temporal lobe (MTL) regions have been observed in schizophrenia. But how these alterations and hippocampal subfields might differ across the psychosis spectrum is unknown, the researchers note.

To investigate, they quantified MTL and hippocampal subfields in 219 patients with schizophrenia, 142 with schizoaffective disorder, 188 with psychotic bipolar disorder, and 337 healthy control individuals. The mean age of the patients in the sample was 37.3 years.

The researchers took advantage of recent advances in imaging processing that allow for precise parceling of specific hippocampal subfields. They recruited study participants at university health centers taking part in the Bipolar-Schizophrenia Network on Intermediate Phenotypes (B-SNIP).

The researchers observed "widespread" volumetric reductions in the hippocampus and its subfields in all 3 groups of patients with psychotic disorders, compared with healthy control participants, "consistent with and extending numerous previous observations." This suggests that smaller hippocampal volumes may be a common trait shared across the psychosis spectrum, the researchers say.

As predicted, hippocampal volumes were positively associated with the severity of psychosis, declarative memory, and overall cognitive performance ($P < .05$), they note. "Causal mechanisms involved in the pathogenesis of the observed hippocampal abnormalities remain unclear," the researchers write.

The investigators point out that the study was cross-sectional and that most patients were receiving medications. "Further study is needed to examine hippocampal subfield data prospectively before and after introduction of antipsychotics in previously untreated patients," they write.

Despite these limitations and others, "our samples are some of the largest to date, we tested specificity among the psychoses, and we used the most sophisticated tool for subdividing the hippocampus to date," they add.

The study was funded by the National Institute of Mental Health and the Commonwealth Research Center. The authors' conflict of interest disclosures are listed with the original article. JAMA Psychiatry. Published online May 14, 2014. Abstract

http://bit.ly/RMyXIx

Baffling Chronic Fatigue Syndrome Set for Diagnostic Overhaul

Researchers might soon redefine the mysterious condition, while the latest findings point to the role of brain inflammation

May 16, 2014 |By Katherine Harmon Courage

More than one million people in the U.S. suffer from a poorly understood, difficult-to-diagnose condition that can leave them debilitated by unshakable exhaustion, pain, depression and cognitive trouble. Researchers, however, are still unsure what causes chronic fatigue syndrome (CFS), how to treat it, how best to diagnose it and even what to call it.

A new study is now providing hope for better understanding - and potentially better diagnosing - the disease. It has revealed a striking pattern of brain inflammation in CFS patients. Meanwhile, diagnosis and definition of the disease could soon be getting a major overhaul as a new $1-million Institute of Medicine (IOM) study gets underway at the request of the U.S. Department of Health and Human Services (HHS). Is the exhausting search for answers about CFS finally coming to an end?

In your head

Chronic fatigue syndrome was first formally described in the late 1980s. Soon thereafter it was lumped in with another perplexing condition known as myalgic encephalomyelitis (ME), which had been classified as a disease of the nervous system in the 1960s. A precise definition and diagnosis of CFS - sometimes called CFS/ME - has largely eluded doctors and researchers, however. Its subjectively described symptoms seem untestable: everyone is exhausted from time to time; many people suffer from occasional aches and pains; and, sure, we all have foggy days as well as down ones.

A large obstacle is that, unlike cancers or high blood pressure, researchers have no particular biomarkers that would allow them to test for the condition. Doctors rely exclusively on patient reports of the severity and duration of the symptoms - usually requiring the symptoms to be present for at least six consecutive months - along with the presence of extreme post-physical or mental exertion, fatigue and unrefreshing sleep, to diagnose the condition. Remissions and relapses confound clinicians further.

A change might be on the distant horizon, however, thanks in part to a new study of the brains of patients living with CFS. Doctors have long suspected brain inflammation as a potential cause, but no definite traces of it had been detected. New research, in the June issue of the Journal of Nuclear Medicine, shows for the first time distinct increases in inflammation in particular regions of CFS patients' brains.

Yasuyoshi Watanabe, director of the RIKEN Center for Life Science Technologies and professor of physiology at Osaka City University Graduate School of Medicine, and his colleagues studied positron emission tomography (PET) scans of the brains of 10 health controls and nine patients with CFS. "Many researchers and clinicians, including our group, thought of this before, but apparently no one tried it using PET," Watanabe says.

The research team found increases in inflammatory markers in regions including the amygdala, thalamus and midbrain in CFS patients who had more severe cognitive troubles. They found more of these markers in thalamus and cingulate cortex in individuals who reported worse pain. And they found higher traces of inflammation in the hippocampus in patients with severe depression.

More than a decade ago, Watanabe's group found tantalizing suggestions that certain neurotransmitters were not being synthesized as well in people with CFS. These patients also had lower levels of serotonin transporters in particular brain areas. Other research had found higher levels of inflammatory cell-signaling proteins called cytokines circulating in the blood. All of these results led Watanabe to look closer for inflammation.

These PET-scan correlations do not precisely explain the symptoms, Watanabe notes. And only a handful of patients were in the study. But the work opens a new trail researchers can follow. Watanabe and his team are now looking into the amount of neuroinflammation in patients with CFS as well as the levels of circulating cytokines, which could both lead to the development of tests for the condition. Having a biologically based test could help those who do have the disease as well as patients who might have a different condition that has similar symptoms, such as depression, fibromyalgia or late-stage Lyme disease, which would be managed differently and potentially be cured with antidepressants, pain relievers or antibiotics. "Most important," Watanabe says, is "how to treat [CFS] patients and how to prevent this disorder." Currently, clinicians can only try to treat the symptoms - not the disease - with medications or lifestyle recommendations. "We are now planning to study therapeutics, such as anti-inflammatory agents, including herbal medicine," which might treat the underlying pathology, Watanabe says.

By any other name

Watanabe's study, and other new and forthcoming findings, however, may not be included in the current IOM review of the disease. "It is possible that the committee could examine new research that comes out during the study," says Jennifer Walsh, a spokesperson for the IOM. But, she notes, it depends on the study.

The study committee members will largely be assessing major research efforts and definitions developed previously for the disorder. "There were a number of case definitions that had come up over the years," says Nancy Lee, director of the Office on Women's Health at HHS and the department's designated federal officer of the Chronic Fatigue Syndrome Advisory Committee. Bringing so much of the work together to come up with a unified definition would help researchers not only better understand the illness, as well as help to convey information to clinicians so they can make faster, more definitive diagnoses. As Lee points out, "most U.S. physicians do not have a good understanding of how to make the diagnosis of ME/CFS." The IOM will try to develop new evidence-based criteria for diagnosing CFS, decide whether the condition should be renamed and come up with a way to best get the new recommendations to health care providers. It will not, however, be making recommendations on treatment, for now. The report is due by spring 2015.

The group's conclusions could have far-reaching consequences for how patients are diagnosed and treated in the U.S. and worldwide. Another recent study in Australia, published April 30 in the journal of Health and Quality of Life Outcomes, showed a large discrepancy in severity of illness for 45 CFS patients and 30 healthy volunteers who met the U.S. Centers for Disease Control and Prevention criteria set

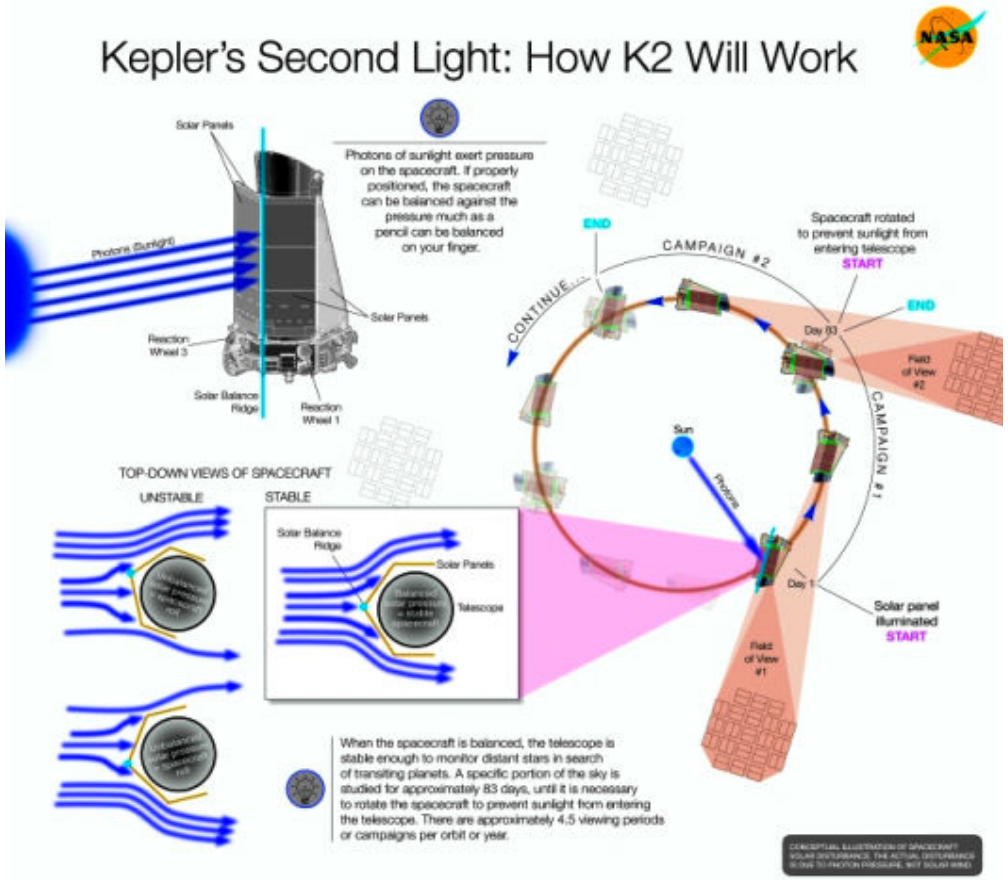
in 1994 versus international standards revised in 2011. Better definitions could prevent some patients from being underdiagnosed.

http://1.usa.gov/1sHkNnA

Kepler Mission Manager Update: K2 Has Been Approved!

Mission to continue exoplanet discovery, and introduce opportunities to observe notable star clusters

The team received good news from NASA HQ - the K2 mission, the two-wheel operation mode of the Kepler spacecraft observing in the ecliptic, has been approved based on a recommendation from the agency's 2014 Senior Review of its operating missions.



The conception illustration depicts how solar pressure can be used to balance NASA's Kepler spacecraft, keeping the space telescope stable enough to continue monitoring distant stars in search of transiting planets. **NASA Ames/W. Stenzel**

The approval provides two years of funding for the K2 mission to continue exoplanet discovery, and introduces new scientific observation opportunities to observe notable star clusters, young and old stars, active galaxies and supernovae. The 2014 Senior Review report is available at http://science.nasa.gov/astrophysics/documents.

After the second wheel of Kepler's guidance control system failed last year during the spacecraft's extended mission, engineers devised a clever solution to manage the sun's radiation pressure and limit its effect on the spacecraft pointing. K2 will observe target fields along the ecliptic plane, the orbital path of planets in our solar system also know as the zodiac, for approximately 75-day campaigns.

The team is currently finishing up an end-to-end shakedown of this approach with a full-length campaign (Campaign 0), and is preparing for Campaign 1, the first K2 science observation run, scheduled to begin May 30. To learn more about the K2 mission visit the Kepler Science Center website.

Regards, Charlie

http://read.bi/1jIQRSx

For A Brief Moment Last Week, Electricity Prices In Germany Dropped To Zero

It didn't last long - maybe an hour or so - but for a brief, electrifying moment, the price of energy in the German electricity markets dipped **below zero.**

Aaron Gell

The reason is demonstrated in a fascinating chart created by Bernard Chabot, a French renewable energy consultant, and published by Renewables International. Germany is one of the world leaders in renewable energy. Wind and solar power vary with the weather - and it's relatively rare for both to be cranking out full power at the same time - but May 11 was one of the exceptions: A rare windy day with glorious sunshine. As a result, in the early afternoon, the total amount of renewable power entering the grid (which also includes a bit of biomass and hydropower) met nearly three quarters of demand.

Due to regulations designed to encourage investment in clean energy, the grid is obliged to purchase every kilowatt produced by renewable sources. This creates certain challenges, since the yield varies over time. But there tends to be around 24 hours of warning before a surge from renewable power, in which case the system's operators tell the producers of conventional energy to slow production.

As Chabot explained in a Skype chat, while it's a relatively simple procedure to lower production at a natural gas plant, doing the same for a coal or nuclear plant can be difficult. So last week, rather than ramp down energy production, those

plants opted to unload the extra power at firesale prices, which even briefly dipped into negative territory.

Interestingly, most of the wind farms and solar arrays in Germany are owned by private citizens, cooperatives and independent contractors. The big power companies have maintained a commitment to fossil fuels - a decision they are coming to regret.

The ability of Germany to produce so much power from renewables - an average of 27% for Q1 of 2014 - would seem to be good news for the planet, since fossil fuel has been definitively linked to climate change.

Just one little problem: With America suddenly up to its armpits in natural gas due to the fracking boom, Chabot explains, "The U.S. is now exporting low-cost coal to Europe and Asia."

According to Bloomberg, "Eight hard-coal power plants are scheduled to start in the next two years" in Germany.

Meanwhile, the other leader in renewable energy, China - America's chief economic and geopolitical rival - just announced an ambitious plan to triple production of solar power by 2017, and to increase wind capacity by 50% in the same time frame.

Chabot points out that both Germany and China owe their success to so-called feed-in tariffs, or FITs, which offer producers of clean energy long-term contracts that guarantee a fixed price, based on costs, designed to reward investment.

The U.S. would benefit from something similar, though Chabot proposes a more politically palatable name, such as "advanced renewable rates."

But don't hold your breath. On Thursday, the Senate struck down an $85 billion tax bill because Republicans objected to a provision that would have renewed an expiring tax break for the wind industry.

http://phys.org/news/2014-05-japanese-car-giants-team-green.html

Japanese car giants team up on green engines

Japan's eight carmakers have joined forces to develop environmentally friendly engines to stave off fierce competition from foreign rivals, a press report said Sunday.

Two of Japan's leading universities will join Toyota, Honda, Nissan, Suzuki, Mazda, Mitsubishi, Daihatsu and Fuji Heavy in the project, which is mainly aimed at slashing engine emissions to meet tougher environmental standards, the business daily Nikkei reported.

By 2020 the group, which includes the University of Tokyo and Waseda University, plans to develop technology which can cut diesel engine carbon-dioxide emissions by 30 percent from 2010 levels.

The manufacturers plan to adapt the technology for commercial use in both diesel and gasoline-powered vehicles, the Nikkei said, hoping to gain a leg up over European carmakers as well as helping to meet tightening environmental regulations around the world.

Japanese carmakers long held the advantage in low-emission and fuel-efficient engines, but German giants BMW and Volkswagen are seen as having caught up in recent years, particularly in diesel engine development.

The project is forecast to cost about two billion yen ($19.7 million) in its first three years from the current fiscal year which started on April 1, Nikkei said, with the Japanese government set to subsidise two-thirds of the first year costs.

Two of Japan's leading universities will join Toyota, Honda, Nissan, Suzuki, Mazda, Mitsubishi, Daihatsu and Fuji Heavy in working out ways to slash engine emissions to meet tougher environmental standards, the daily Nikkei reports

Despite growing demand for electric vehicles, internal combustion engines are expected to remain the main source of power for cars for the time being.

Conventional combustion-powered vehicles are estimated to account for 89 percent of cars produced worldwide in 2030, according to a survey by the thinktank Fuji Keizai Group.

http://www.eurekalert.org/pub_releases/2014-05/ats-htm051214.php

Higher temperatures may cause greater illness among COPD patients

If you suffer from COPD, staying cool this summer may provide much more significant benefits than simply feeling more comfortable.

San Diego- A study from researchers at Johns Hopkins University says it may also keep you healthier.

The study found COPD patients who were exposed to warm indoor temperatures had greater disease-related morbidity, including an increase in symptoms, a rise in the use of rescue medications and a decline in lung function. Higher outdoor temperatures were also associated with increased COPD symptoms.

The study's results have important implications for the treatment of COPD as the climate gradually becomes warmer, the researchers said. The study was presented at the 2014 American Thoracic Society International Conference.

"Understanding the effect of heat on susceptible populations is increasingly important in order to anticipate and prepare for health effects related to climate change," said study lead author Meredith McCormack, M.D., MHS.

"Although outdoor heat has been associated with increased mortality and with hospitalizations in specific populations, including COPD, less is known about

individual-level exposure to heat and the impact on disease-specific outcomes. That was the focus of our study."

The study included 84 former smokers with moderate to severe COPD who each underwent three week-long observation periods spaced three months apart. During these periods, daily in-home and outdoor temperature monitoring was performed and study participants completed daily assessments of their COPD symptoms, measuring their breathlessness, cough and sputum production, their lung function, and their need for rescue inhaler medications.

To study the effects of heat, investigators looked at the time spent in the warm season, which they defined as the time between the first and last day when temperatures exceeded 90°F in the city of Baltimore, the study's locale. The study included a total of 602 days of monitoring during the warm season, and patients reported going outdoors on only 48% of those days.

At the end of the study period, the researchers found that increases in indoor temperature were associated with increases in symptoms and rescue medication use and decreases in lung function.

While the study participants spent little time outdoors, on days when some time was spent outdoors, increases in outdoor temperature were associated with increases in symptoms, but they did not affect medication use or lung function. These health effects of heat remained even after accounting for air pollution concentrations.

"These findings support the need for adaptive approaches to COPD treatment to prevent adverse health effects related to increases in temperature," McCormack said.

"Future work is needed to understand the mechanism by which heat impacts individuals with COPD and to identify the most effective intervention strategies," she added. "The need for novel approaches is especially critical in the face of anticipated climate change."

** Please note that numbers in this release may differ slightly from those in the abstract. Many of these investigations are ongoing; the release represents the most up-to-date data available at press time.*

Abstract 56218

Indoor And Outdoor Heat Exposure Is Associated With Increased COPD Morbidity

Type: Scientific Abstract

Category: 06.03 - COPD: Epidemiology (CP/EOH)

Authors: M.C. McCormack1, A.J. Belli2, A. Saha2, G.B. Diette2, D.L. Williams3, E.C. Matsui1, R.D. Peng4, P.N. Breysse3, N.N. Hansel2; 1Johns Hopkins University - Baltimore, MD/US, 2Johns Hopkins University - Baltimore/US, 3Johns Hopkins Bloomberg School of Public Health - Baltimore, MD/US, 4Johns Hopkins Bloomberg School of Public Health - Baltimore/US

Abstract Body

RATIONALE: *Understanding the effect of heat on susceptible populations is increasingly important to anticipate health effects related to climate change. Outdoor heat has been associated with increased mortality and increases in COPD hospitalizations in population studies. Less is known about individual-level exposure to heat and the impact on disease-specific outcomes. We sought to investigate the effect of heat exposure on symptoms, lung function, and rescue medication use in a cohort of former smokers with COPD.*

METHODS: *Former smokers with moderate-severe COPD underwent week-long observation periods at baseline, 3 and 6 months. Daily in-home and outdoor temperature monitoring was performed and participants simultaneously completed daily assessment of symptoms (Breathlessness, Cough and Sputum Scale (BCSS)), rescue inhaler use, and lung function (PiKO device). Visits during the warm season, defined as the first through last day with a maximum outdoor temperature >90 F, were included. Random effects modeling analysis was used and models were adjusted for age, sex, education, and FEV1% predicted or pack-years, as appropriate.*

RESULTS: *Subjects with COPD (n=84) were older (69+7 years), Caucasian (88%), male (58%), former smokers (57 + 29 pack-years) with moderate-severe COPD (baseline FEV1 49+16 % predicted, FEV1/FVC 51+10 %). Participant had 602 days of monitoring during the warm season and reported going outdoors 48% of days (average outdoor time 2.0 + 2.1hours on these days). Increases in indoor temperature were associated with increases in symptoms and rescue medication use and decreases in lung function (Table). Among days participants went outdoors, increases in maximum temperature were associated with increases in symptoms (BCSS β=0.37, p<001 per 10ºF increase) and there was no relationship on days when participants did not go outdoors (β=-0.02, p=0.81; p-value interaction= 0.07). Outdoor temperature was not associated with medication use or lung function.*

CONCLUSIONS: *Increasing indoor temperature was associated with disease-specific indicators of COPD morbidity, including increased symptoms, increased rescue medication use, and decreased lung function. Although participants spent most of their time indoors, outdoor temperature was associated with increased symptoms on days participants went outdoors. The findings of clinically significant changes in disease-specific indicators of COPD morbidity support the need for adaptive approaches to protect such individuals from adverse respiratory health effects of heat exposure which are projected to increase with the anticipated course of climate change.*

Effect of Increases in maximum indoor temperature on COPD morbidity

Outcomes Coefficient p-value Confidence Interval

BCSS 0.49 <0.01 (0.16,0.80)

Rescue Inhaler use 0.40 <0.01 (0.22, 0.59)

evening FEV1 -0.06 <0.01 (-0.11, -0.02)

** per 10°F increase in maximum daily indoor temperature*

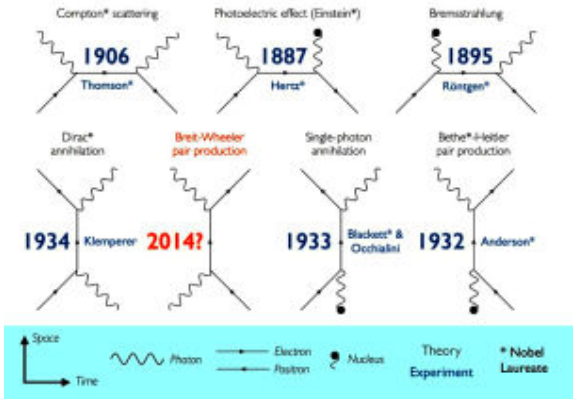
http://www.eurekalert.org/pub_releases/2014-05/icl-sdh051514.php

Scientists discover how to turn light into matter after 80-year quest

Imperial College London physicists have discovered how to create matter from light -- a feat thought impossible when the idea was first theorized 80 years ago

Imperial College London physicists have discovered how to create matter from light - a feat thought impossible when the idea was first theorised 80 years ago.

In just one day over several cups of coffee in a tiny office in Imperial's Blackett Physics Laboratory, three physicists worked out a relatively simple way to physically prove a theory first devised by scientists Breit and Wheeler in 1934.



Theories describing light and matter interactions. **Oliver Pike, Imperial College London**

Breit and Wheeler suggested that it should be possible to turn light into matter by smashing together only two particles of light (photons), to create an electron and a positron – the simplest method of turning light into matter ever predicted. The calculation was found to be theoretically sound but Breit and Wheeler said that they never expected anybody to physically demonstrate their prediction. It has never been observed in the laboratory and past experiments to test it have required the addition of massive high-energy particles.

The new research, published in Nature Photonics, shows for the first time how Breit and Wheeler's theory could be proven in practice. This 'photon-photon collider', which would convert light directly into matter using technology that is already available, would be a new type of high-energy physics experiment. This experiment would recreate a process that was important in the first 100 seconds of the universe and that is also seen in gamma ray bursts, which are the biggest explosions in the universe and one of physics' greatest unsolved mysteries.

The scientists had been investigating unrelated problems in fusion energy when they realised what they were working on could be applied to the Breit-Wheeler theory. The breakthrough was achieved in collaboration with a fellow theoretical physicist from the Max Planck Institute for Nuclear Physics, who happened to be visiting Imperial.

Demonstrating the Breit-Wheeler theory would provide the final jigsaw piece of a physics puzzle which describes the simplest ways in which light and matter interact (see image in notes to editors). The six other pieces in that puzzle, including Dirac's 1930 theory on the annihilation of electrons and positrons and Einstein's 1905 theory on the photoelectric effect, are all associated with Nobel Prize-winning research (see image).

Professor Steve Rose from the Department of Physics at Imperial College London said: "Despite all physicists accepting the theory to be true, when Breit and Wheeler first proposed the theory, they said that they never expected it be shown in the laboratory. Today, nearly 80 years later, we prove them wrong. What was so surprising to us was the discovery of how we can create matter directly from light using the technology that we have today in the UK. As we are theorists we are now talking to others who can use our ideas to undertake this landmark experiment."

The collider experiment that the scientists have proposed involves two key steps. First, the scientists would use an extremely powerful high-intensity laser to speed up electrons to just below the speed of light. They would then fire these electrons into a slab of gold to create a beam of photons a billion times more energetic than visible light.

The next stage of the experiment involves a tiny gold can called a hohlraum (German for 'empty room'). Scientists would fire a high-energy laser at the inner surface of this gold can, to create a thermal radiation field, generating light similar to the light emitted by stars.

They would then direct the photon beam from the first stage of the experiment through the centre of the can, causing the photons from the two sources to collide and form electrons and positrons. It would then be possible to detect the formation of the electrons and positrons when they exited the can.

Lead researcher Oliver Pike who is currently completing his PhD in plasma physics, said: "Although the theory is conceptually simple, it has been very difficult to verify experimentally. We were able to develop the idea for the collider very quickly, but the experimental design we propose can be carried out with relative ease and with existing technology. Within a few hours of looking for applications of hohlraums outside their traditional role in fusion energy research, we were astonished to find they provided the perfect conditions for creating a photon collider. The race to carry out and complete the experiment is on!"

The research was funded by the Engineering and Physical Sciences Research Council (EPSRC), the John Adams Institute for Accelerator Science, and the Atomic Weapons Establishment (AWE), and was carried out in collaboration with Max-Planck-Institut für Kernphysik.

Notes to editors

1. Pike, O, J. et al. 2014. 'A photon–photon collider in a vacuum hohlraum'. Nature Photonics, 18 May 2014. Once embargo has lifted, the paper can be downloaded at : http://dx.doi.org/10.1038/nphoton.2014.95

http://www.eurekalert.org/pub_releases/2014-05/asfm-pmd051414.php

Painkillers may decrease susceptibility to recurring urinary infections

Repeated urinary tract infections may be prevented with help of OTC painkillers

Women plagued by repeated urinary tract infections may be able to prevent the infections with help from over-the-counter painkillers, according to research presented at the annual meeting of the American Society for Microbiology.

Scientists at Washington University School of Medicine in St. Louis found that inhibiting COX-2, an immune protein that causes inflammation, eliminated recurrent urinary tract infections in mice. COX-2 is one of the proteins blocked by non-steroidal anti-inflammatory drugs (NSAIDs) such as ibuprofen.

"If we can confirm this link in clinical trials, many people potentially could benefit very quickly," said Thomas Hannan, who presented the research. "But for now, it's important to remember that urinary tract infections are serious, and antibiotic treatment is often necessary. Patients should not treat these infections on their own without help from a medical provider."

Scientists estimate half of all women will experience a urinary tract infection, which is the second-most common type of bacterial infection, at some point in their lives. Additional recurrent infections will affect 20 percent to 40 percent of these patients. If the infections spread to the kidneys and bloodstream, serious complications can result.

Hannan and his colleagues previously found in mouse studies that immune system overreaction to an initial infection may increase vulnerability to subsequent infections.

"We thought that the immune response was too weak in patients who kept getting urinary tract infections, but we are learning that an overly strong immune response can be just as problematic," Hannan said.

In the new study, the scientists found evidence in women and mice that immune cells, known as neutrophils, are significant contributors to repeat infections. In their eagerness to break into the bladder to fight infection, neutrophils leave tracks in the protective lining of the bladder's interior. Scientists believe that excessive damage may provide footholds that let bacteria grab hold of the bladder lining and begin to establish severe infections.

The researchers were able to manipulate the strength of the neutrophil response in mice to identify a "sweet spot" – not too much response and not too little – that eradicated urinary tract infection without increasing future infection risk.

The researchers found that mice with increased vulnerability to repeat infections had more inflammatory molecules in their bladder than mice that were resistant to repeat infections. When treated with COX-2 inhibitors, mice showed dramatically reduced susceptibility to infection.

The investigators examined the effect of COX-2 inhibition on the immune response in the bladder and found that neutrophils still came into the bladder in large numbers but caused much less damage to the protective lining. As a result, they believe COX-2 inhibitors are able to selectively target the detrimental effects of inflammation while maintaining the beneficial responses.

"These are encouraging results, and we hope to verify the potential benefits of COX-2 inhibitors soon in a large clinical trial," said senior author Scott Hultgren, who directs the Center for Women's Infectious Disease Research at Washington University.

http://www.eurekalert.org/pub_releases/2014-05/osu-csm051514.php

Cutoff switch may limit spread, duration of oxygen minimum zones

iron released from continental margin sediments may prevent ocean systems from developing feedback loop that lead to persistent "dead zones."

CORVALLIS, Ore. – A new study examining the impact of iron released from continental margin sediments has documented a natural limiting switch that may keep these ocean systems from developing a runaway feedback loop that could lead to unchecked hypoxic areas, or persistent "dead zones."

The findings are particularly important, scientists say, because as the climate warms oxygen minimum zones are expected to expand in coming decades and could affect coastal fisheries as well as the global carbon cycle. But the study, which was led by researchers at Oregon State University, suggests that there may be a limit to the expansion of these OMZs.

The results are being published this week in the journal Nature Geoscience.

It is well-documented that iron is a crucial catalyst for fueling biological productivity in the oceans. When there is an insufficient amount of iron in the water column, microscopic plants called phytoplankton cannot fully consume nitrates and phosphates, limiting their growth. There are several potential sources of iron – including river sediments, windblown dust and continental margin sediments – but to be useful to plankton, the iron must be dissolved rather than locked up in sediments.

Oxygen may be a key that unlocks the storehouse of iron.

In high-oxygen environments, most of the iron that is dissolved in the water precipitates – turning into iron oxide coatings (similar to rust) on particles, which sink to the seafloor. Organic remains of plants and animals also sink to the seafloor and their rotting remains consume the oxygen dissolved in seawater. As oxygen lowers, a hypoxic dead zone may form. When it does the iron oxides dissolve and may diffuse back into the water column where the iron again becomes available to

fertilize plankton growth, as long as other major nutrients such as nitrate and phosphate are available.

"When this moderate hypoxic state occurs, the iron release fuels more biological productivity and the organic particles fall to the sea floor where they decay and consume more oxygen, making hypoxia worse," said Florian Scholz, a postdoctoral researcher in OSU's College of Earth, Ocean, and Atmospheric Sciences and lead author on the Nature Geoscience study. "That leads to this feedback loop of more iron release triggering more productivity, triggering more iron release.

"But we found that when the oxygen approaches zero a new group of minerals, iron sulfides, are formed," Scholz added. "This is the key to the limit switch because when the iron gets locked up in sulfides, it is no longer dissolved and thus not available to the plankton. The runaway hypoxia stops and the hypoxic region is limited."

An important part of the study was the development of indicators for sedimentary iron release during past periods of ocean deoxygenation, the researchers said.

Scholz and his colleagues investigated a sediment core from the upwelling area of Peru, where the subsurface water column has one of the lowest ongoing oxygen levels on Earth.

In their study, the researchers looked at concentrations of iron, uranium and molybdenum in ocean sediments dating back 140,000 years.

The key to the discovery, they say, was determining whether sediments buried during a past period of ocean deoxygenation had an iron deficit. Sediment with an iron deficit suggests that the iron was removed and potentially transported offshore into iron-limited ocean regions. Conversely, when the sediments held a lot of iron, it likely was retained and thus not available for fertilization.

"Florian found that there are two states in which iron is locked up and unavailable to fuel plant growth," said Alan Mix, an Oregon State geochemist and co-author on the study. "When there is a lot of iron in the sediment, but no molybdenum, the iron is stored in oxide minerals.

"This happens when oxygen is abundant," Mix added. "But if there is iron and molybdenum, then the iron is stored in sulfide minerals like pyrite, meaning the system has little or no oxygen available.

What the researchers discovered in the Peru system "is a window for iron release, which could be a key to the biological productivity in this iron-limited ocean region," Scholz said.

The near-anoxic Peru system differs from the Pacific Northwest coast of the United States, which has experienced several hypoxic events over the past decade. The Northwest waters are not yet as low in oxygen or iron as Peru.

"These basic reactions have been known for a while," Mix said, "but documenting them in the real world on a large scale – and associating them with climate change – is quite significant and especially important given projections of growing hypoxia in a warming climate."

The study was supported by the European Union, the German Research Foundation and the National Science Foundation.

Other researchers on the study include James McManus of the University of Akron (a former Oregon State faculty member); Christian Hensen of the GEOMAR Helmholtz Centre for Ocean Research in Kiel, Germany; and Ralph Schneider, Kiel University.