http://www.bbc.com/news/world-latin-america-35336618

Brazil Zika outbreak: New test kits for mosquito-borne viruses

The Brazilian Health ministry says it's developed new testing kits to rapidly identify the presence of three viruses - Dengue, Zika and Chikungunya - all carried by the same mosquito.

Health Minister Marcelo Castro said priority for testing would be given to pregnant women. Brazil has the largest known outbreak of Zika, which has been linked to a sharp spike in birth defects.

Mr Castro also announced extra funds to speed up finding a vaccine for Zika. He said that the goal was to develop a vaccine "in record time".

At the moment the only way to fight Zika is to clear standing water where mosquitoes breed. The aim is that the tests will speed up diagnosis and ensure patients get correct medical treatment fast.

Since October around 3,530 babies have been born with microencephaly, which can lead to small heads and under-developed brains. Fewer than 150 cases of microencephaly were seen in Brazil throughout 2014. The US State Department confirmed its first case of a baby born with brain damage because of infection by the Zika virus. The baby was born in a hospital in Oahu, Hawaii.

The Hawaii State Department of Health said the mother was believed to have contracted Zika while living in Brazil in May 2015 and that the baby was most likely infected in the womb.

The US Center for Disease Control and Prevention issued an alert on Friday advising pregnant women to avoid travelling to Brazil and other Latin American and Caribbean countries where outbreaks of Zika have been registered. The travel alert applies to Brazil, Colombia, El Salvador, French Guiana, Guatemala, Haiti, Honduras, Martinique, Mexico, Panama, Paraguay, Suriname, Venezuela and Puerto Rico. Zika virus is transmitted by the Aedes species mosquito.

http://www.eurekalert.org/pub_releases/2016-01/hcfe-wgt011816.php

Weight gain through plasticizers

Researchers find the metabolic pathways responsible

Plasticisers such as phthalates are always found in plastics. They can get into our bodies through the skin or by the diet. They affect our hormone system and are suspected of having an influence on our body weight. The exact correlations and mechanisms have been unclear thus far. In cooperation with the Integrated Research and Treatment Center (IFB) Adiposity Diseases at the University of Leipzig and the University Hospital Leipzig, researchers from the Helmholtz Centre for Environmental Research (UFZ) have now published a study in the PLOS ONE journal showing that the phthalate DEHP leads to weight gain and revealed the metabolic processes involved.

One in two adults in Germany is overweight. This figure is as high as 15% in children and young people. "The figures are alarming," said Martin von Bergen, Head of the Department of Molecular Systems Biology at the Helmholtz Centre for Environmental Research (UFZ). "Because every kilo over the ideal weight increases the medical risk of cardiovascular disease, joint damage, chronic inflammation and cancer and the number of overweight people is constantly increasing all over the world." The development of overweight has many causes: in addition to bad dietary habits and a lack of exercise, genetic factors doubtlessly play a role. Certain environmental pollutants, e.g. phthalates, may also be partly responsible for the development of overweight. "Correlations between increased phthalate concentrations in the human body and the development of overweight have already been proven in epidemiological studies and should be analysed in more detail" von Bergen said.

Phthalates are used as plasticisers in polymer processing to make plastics soft, flexible or tensile. Under certain conditions, phthalates can also emerge from the material and be uptaken into our bodies most prominently by our diet. Phthalates are mainly transferred from the food packaging of fatty products, e.g. cheese or sausages. Von Bergen added: "We currently know very little about how exactly phthalates have an effect within the body and how they can influence body weight - we intended to evaluate this in our study."

Von Bergen and his UFZ team performed the study in collaboration with researchers Nora Klöting and Matthias Blüher (spokespersons for the Collaborative Research Centre "Obesity Mechanisms") from the Integrated Research and Treatment Center (IFB) Adiposity Diseases at the University of Leipzig and the University Hospital Leipzig. The results of the study were recently published in the PLOS ONE journal. They show where phthalates can interfere with metabolism and pave the way for weight gain. In studies at the University of Leipzig, mice exposed to the phthalate DEHP in their drinking water gained a substantial amount of weight. This was particularly true of the female animals. "It is evident that phthalates seriously interfere with the hormone balance. They give rise to significant changes, e.g. weight gain, even in low concentrations," said von Bergen.

The work at the UFZ focused on defining the metabolic products in the mice's blood. The researchers determined that the proportion of unsaturated fatty acids in the blood increased and the glucose metabolism was disrupted under the influence of phthalates. The composition of receptors in the blood also changed. These receptors are important for general metabolism and may cause it to change. "Some

metabolic products that are formed by adipose tissue also act as messengers and control functions in other organs," explained von Bergen. "However, there is no conclusive clarification of how the various effects of phthalates on metabolism influence each other and ultimately lead to weight gain."

Von Bergen will continue to research the phthalates' influence on metabolism in collaboration with his colleagues from the University of Leipzig and the University Hospital Leipzig. He is also studying the impact of phthalates on the development of early childhood diseases with UFZ colleagues from the Department of Environmental Immunology within the framework of the mother-child study (LiNA). "Our aim is to conduct solid basic research so that our results can then help the authorities responsible for assessing the risk of chemicals in Germany and at European level to perform their evaluations," said von Bergen.

„Di-(2-Ethylhexyl)-Phthalate (DEHP) Causes Impaired Adipocyte Function and Alters Serum Metabolites": Nora Klöting, Nico Hesselbarth, Martin Gericke, Anne Kunath, Ronald Biemann, Rima Chakaroun, Joanna Kosacka, Peter Kovacs, Matthias Kern, Michael Stumvoll, Bernd Fischer, Ulrike Rolle-Kampczyk, Ralph Feltens, Wolfgang Otto, Dirk K. Wissenbach, Martin von Bergen, Matthias Blüher; in PLOS ONE December 2, 2015.

http://dx.doi.org/10.1371/journal.pone.0143190

This work was supported by the German United Association for Clinical Chemistry and Laboratory Medicine (DGKL), by Deutsche Forschungsgemeinschaft (DFG), by the Federal Ministry of Education and Research (BMBF), and by the Helmholtz Alliance ICEMED - Imaging and Curing Environmental Metabolic Diseases.

Feltens R, Roeder S, Otto W, Borte M, Lehmann I, von Bergen M, Wissenbach DK: Evaluation of Population and Individual Variances of Urinary Phthalate Metabolites in Terms of epidemiological Studies. Journal of Chromatography & Separation Techniques (accepted)

http://www.eurekalert.org/pub_releases/2016-01/uos-euv011516.php

Explosive underwater volcanoes were a major feature of 'Snowball Earth'

Explosive underwater volcanoes were a major feature of 'Snowball Earth' 720-640 million years ago

Around 720-640 million years ago, much of the Earth's surface was covered in ice during a glaciation that lasted millions of years. Explosive underwater volcanoes were a major feature of this 'Snowball Earth', according to new research led by the University of Southampton.

Many aspects of this extreme glaciation remain uncertain, but it is widely thought that the breakup of the supercontinent Rodinia resulted in increased river discharge into the ocean. This changed ocean chemistry and reduced atmospheric CO2 levels, which increased global ice coverage and propelled Earth into severe icehouse conditions.

Because the land surface was then largely covered in ice, continental weathering effectively ceased. This locked the planet into a 'Snowball Earth' state until carbon dioxide released from ongoing volcanic activity warmed the atmosphere sufficiently to rapidly melt the ice cover. This model does not, however, explain one of the most puzzling features of this rapid deglaciation; namely the global formation of hundreds of metres thick deposits known as 'cap carbonates', in warm waters after Snowball Earth events.

The Southampton-led research, published in Nature Geoscience, now offers an explanation for these major changes in ocean chemistry.

Lead author of the study Dr Tom Gernon, Lecturer in Earth Science at the University of Southampton, said: "When volcanic material is deposited in the oceans it undergoes very rapid and profound chemical alteration that impacts the biogeochemistry of the oceans. We find that many geological and geochemical phenomena associated with Snowball Earth are consistent with extensive submarine volcanism along shallow mid-ocean ridges."

During the breakup of Rodinia, tens of thousands of kilometres of mid-ocean ridge were formed over tens of millions of years. The lava erupted explosively in shallow waters producing large volumes of a glassy pyroclastic rock called hyaloclastite. As these deposits piled up on the sea floor, rapid chemical changes released massive amounts of calcium, magnesium and phosphorus into the ocean.

Dr Gernon explained: "We calculated that, over the course of a Snowball glaciation, this chemical build-up is sufficient to explain the thick cap carbonates formed at the end of the Snowball event.

"This process also helps explain the unusually high oceanic phosphorus levels, thought to be the catalyst for the origin of animal life on Earth."

http://www.eurekalert.org/pub_releases/2016-01/cmaj-cai011416.php

Cardiac arrests in high-rise buildings: Low survival rates above 3rd floor

Residents of floors 1-3 had better survival rates from cardiac arrests survival was negligible for people living above the 16th floor

Residents of high-rise buildings had better survival rates from cardiac arrests if they lived on the first few floors, and survival was negligible for people living above the 16th floor, according to a study published in CMAJ (Canadian Medical Association Journal)

"As the number of high-rise buildings continues to increase and as population density rises in major urban centres, it is important to determine the effect of delays to patient care in high-rise buildings on survival after cardiac arrest," writes Ian Drennan, a paramedic with York Region Paramedic Services and a researcher

with Rescu, Li Ka Shing Knowledge Institute, St. Michael's Hospital, Toronto, with coauthors.

The further a patient with cardiac arrest is from the ground floor, the lower the survival rate. Of 8216 people who had cardiac arrests in private residences and were treated by 911-initiated first responders, 3.8% survived to be discharged from hospital. Of the 5998 (73%) people living below the 3rd floor who had cardiac arrests, 252 (4.2%) survived the arrest, but only 48 (2.6%) of the 1844 people living above the 3rd floor survived. When analysed floor by floor, the researchers found a survival rate of only 0.9% in those living above the 16th floor (2 of 216) and no survivors (0 of 30) in those living above the 25th floor.

The researchers note that the use of automated external defibrillators (AED) was very low.

The study looked at the interval from arrival of an emergency vehicle to 911-initiated first responders reaching a patient having a cardiac arrest. Other studies, which have also shown poor survival rates, have measured response time between the call to 911 and arrival of an emergency vehicle on scene, but not the time to reach the patient.

"The 911 response time, from emergency activation to arrival of first responders on scene, will remain relatively constant, so long as traffic patterns do not change; however, the time from arrival on scene to initial patient contact may increase as more of the population comes to live at or above the third floor," write the authors. "Thus, 911 response time may diminish in importance as a determinant for survival, whereas the time to patient contact may become more important in predicting who lives and who dies after out-of-hospital cardiac arrest."

The researchers outline several solutions to improve time to patient contact, such as giving 911-initiated first responders sole access to elevators for emergency service without public interference, similar to the access of firefighters during a fire; emergency alerts to building staff before arrival of the first responders; and better placement of defibrillators to increase bystander use.

The authors of a related commentary provide possible solutions to help improve survival rates, including CPR/AED training for residents of high-rise apartments, a national online registry of public-access defibrillators linked to first-responder applications, and using smartphones to activate volunteer first responders for patients with cardiac arrest.

"Singapore has a multipronged approach to address high-rise residential out-of-hospital cardiac arrests," writes Associate Professor Marcus Eng Hock Ong, Department of Emergency Medicine, Singapore General Hospital, with coauthors. "A large public campaign is currently underway to enrol residents' committees as first responders and to train one million people over the next five years."

http://bit.ly/1WAFaTP

Maths helps 'locked-in' pair show awareness for first time

'Locked-in' people show signs of awareness when faced with sums

It seems like the ultimate insult, but getting people with brain injuries to do maths may lead to better diagnoses. A trial of the approach has found two people in an apparent vegetative state that may be conscious but "locked-in".

People who are in a vegetative state are awake but have lost all cognitive function. Occasionally, people diagnosed as being in this state are actually minimally conscious with fleeting periods of awareness, or even locked-in. This occurs when they are totally aware but unable to move any part of their body.

It can be very difficult to distinguish between each state, which is why a team of researchers in China have devised a brain-computer interface that tests whether people with brain injuries can perform mental arithmetic – a clear sign of conscious awareness.

The team, led by Yuanqing Li at South China University of Technology and Jiahui Pan at the South China Normal University in Guangzhou showed 11 people with various diagnoses a maths problem on a screen. This was followed by two possible answers flickering at frequencies designed to evoke different patterns of brain activity. Frames around each number also flashed several times.

The participants were asked to focus on the correct answer and count the number of times its frame flashed. The brain patterns from the flickering answers together with the detection of another kind of brain signal that occurs when someone counts, enabled a computer to tell which answer, if any, the person was focusing on.

Two of six participants diagnosed as being in a vegetative state, one of three people in a minimally conscious state and two people who had recently emerged from a minimally conscious state were able to correctly communicate their answers to the sums with accuracies that could not have occurred by chance.

Li's results suggest that the people diagnosed as being in a vegetative state who answered correctly may well be locked-in. "Theoretically, we have changed their diagnosis," he says. "The patients' families were very happy when they found out that the patient could do maths," says Li. "It made them hopeful that they would be able to be rehabilitated."

Maths is a useful way of identifying awareness in someone with a brain injury, says Li, because the ability to do calculations uses so many different areas of the brain, including those involved in language, memory, vision and decision-making.

It isn't totally fool proof though. Although a correct answer suggests awareness, it isn't possible to draw any firm conclusions from an incorrect answer. The

computer might register a fail because the participant has no awareness, or because they could only follow some, but not all, of the commands.

Journal reference: BMC Neurology, doi.org/bbkb

http://bit.ly/1PnbPNh

Gene change could stop GM bacteria surviving outside the lab

How do you stop genetically engineered organisms from surviving and procreating outside the lab?

Fictional scientists in Jurassic Park thought they had cracked it. But boy, were they wrong. Now GM bacteria have been designed that can survive for hundreds of generations as long as they are fed nutrients that don't occur naturally. This, the researchers hope, will allow us to make use of GMOs while ensuring they can never survive on their own in the wild.

Synthetic biologists design organisms to carry out useful functions, like synthesising drugs or breaking down waste products. But making sure engineered genes stay where you put them has been a challenge.

"We need to have biosafety features that allow you to ensure that when you've made something it's not going to escape from the lab, or if it does it won't be able to prosper," says Andrew Ellington at the University of Texas at Austin.

There are 20 naturally occurring amino acids, which our bodies assemble to create proteins. In Jurassic Park, fictional scientists made the dinosaurs unable to produce lysine, one of the natural amino acids, so they would need lysine supplements. In reality, all animals are unable to synthesise lysine, but, as the dinosaurs showed in the film, it is easy to find it in our diet.

Unnatural amino acids

Ellington's solution should be more effective. His team has engineered E. coli bacteria to make proteins using an unnatural amino acid.

To do so, the researchers reengineered the gene TEM-1 β-lactamase, which confers resistance to an antibiotic, altering it so that an unnatural analogue of an amino acid was used in the creation of its protein. They also induced mutations in part of the gene coding for six nearby amino acids so that the artificial amino acid made contact with them, and then selected for mutations that restored the function of the protein.

This led to the bacteria having a modified, yet functioning, gene that gave them antibiotic resistance. But the bacteria could not return to using the natural amino acid, since it would no longer fit in that part of the protein. As a result, the bacteria will die if they don't have the unnatural amino acid. They were grown in the lab for hundreds of generations without evolving out of their reliance on it.

"In the presence of antibiotics and the absence of the [artificial] amino acid, there's very little way for our circuitry to leave the lab," says Ellington.

Bigger toolkit

Two studies last year achieved the same feat by modifying the whole genome of E. coli. But Ellington's method would be much easier to apply to other organisms, since dependence on the unnatural amino acid is established by a single gene that can be easily transferred between organisms.

Apart from helping to contain bacteria engineered to do useful things for us, such as making fuel or fighting tooth decay, getting them to use unnatural amino acids could give synthetic biologists a bigger toolkit to work with.

But persuading bacteria to evolve new functions has proven a challenge. "No one's been able to evolve proteins that use unnatural amino acids in interesting ways," says Floyd Romesburg at the Scripps Research Institute in La Jolla. "Basically what we've been able to do is simply coax organisms into having the unnatural amino acid there, but it's pretty fragile and you could lose it easily."

Ellington's method addresses that problem by reengineering the protein to create a pressure to maintain the unnatural amino acid.

This may be valuable for designing drugs that improve on naturally occurring proteins, says Ellington: "Proteins used as drugs will need tweaking. The ability to tweak them and use functionality that's not provided by the natural amino acids is significant."

Journal reference: Nature Chemical Biology, DOI: 10.1038/nchembio.2002

http://www.bbc.com/news/health-35341354

EU nurses face English language checks

Nurses and midwives coming to Britain from the EU will now need to prove they are fluent in English, under new rules.

Until now, checks have only been applied to nurses outside the EU. It means any nurse who is unable to show they have sufficient language skills will need to have an English language assessment. The move by the Nursing and Midwifery Council brings the profession in line with doctors, who are already vetted in this way for patient safety.

The risk of a doctor not being fluent in English was highlighted by a lethal mistake made by Dr Daniel Ubani, a German doctor doing an out-of-hours shift who gave a lethal dose of a painkiller to patient David Gray in 2008. As a German citizen he was able to register to work in the UK without passing a language test.

Language checks

NMC Chief Executive Jackie Smith said: "From now on all nurses and midwives applying to join the register from outside the UK, including the EU, will have to demonstrate they can communicate effectively to a high standard of English. "The ability to communicate effectively with patients is fundamental to patient safety and a principle that is central to our code." Tests will check listening, reading,

writing and speaking fluency. And if an allegation is made that a nurse or midwife already working in the UK does not meet the necessary English language skills, they could be investigated under fitness to practise rules.

The NMC has more than 690,000 nurses and midwives on its register. Around 66,000 of these come from non-EU countries and 33,000 from the EU.

The UK is looking to recruit more foreign nurses. In October, the government temporarily lifted restrictions on recruiting nurses from overseas by adding the profession to its Shortage Occupation List. This means nurses from outside the European Economic Area now have their applications prioritised.

The Department of Health said the move was designed to ease pressure on the NHS without having to rely on expensive agency staff.

Katherine Murphy of The Patients Association said: "Nurses from other countries make an extremely important contribution to healthcare in the UK. However, we hear from patients on our National Helpline that there can be real issues with some overseas health professionals; including problems with communication and a lack of understanding of processes and procedures.

"The Patients Association calls on all Trusts to ensure that their staff meet these new requirements, and that all overseas nurses have the necessary support and training to be able to offer patients safe and effective care."

http://www.eurekalert.org/pub_releases/2016-01/w-woa011916.php

When older adults stop driving, they may experience health declines

In older adults, declining health is a major reason they stop driving.

But when they stop driving, what impact does this have on their subsequent health and well-being?

A new review of published studies indicates that driving cessation in older adults may contribute to a variety of health problems, especially depression.

"For many older adults, driving is instrumental to their daily living and is a strong indicator of self-control, personal freedom and independence. Unfortunately, it is almost inevitable to face the decision to stop driving during the process of aging as cognitive and physical functions continue to decline," said Dr. Guohua Li, senior author of the Journal of the American Geriatrics Society study and professor of epidemiology at Columbia University Mailman School of Public Health. "When the decision time comes, it is important to take into consideration the adverse health consequences of driving cessation and make personalized plans to maintain mobility and social functions."

http://www.eurekalert.org/pub_releases/2016-01/mu-nt011916.php

Nearing the limits of life on Earth

Failure to find active microbes in coldest Antarctic soils has implications for search for life on Mars

It took Jackie Goordial over 1000 Petri dishes before she was ready to accept what she was seeing. Or not seeing. Goordial, a post-doctoral fellow in the Department of Natural Resource Sciences at McGill University has spent the past four years looking for signs of active microbial life in permafrost soil taken from one of the coldest, oldest and driest places on Earth: in University Valley, located in the high elevation McMurdo Dry Valleys of Antarctica, where extremely cold and dry conditions have persisted for over 150,000 years. The reason that scientists are looking for life in this area is that it is thought to be the place on Earth that most closely resembles the permafrost found in the northern polar region of Mars at the Phoenix landing site.

In University Valley, there is a layer of dry permafrost soil overlaying ice-rich permanently frozen ground. The ice in the permafrost is formed not by liquid water, but by frozen water vapor; the absence of liquid water, makes the soil less likely to be able to sustain life. **Jackie Goordial**

"I've been trying to cheer her up by telling her that not finding life is important too," says Lyle Whyte, Goordial's supervisor. "Going into the study, we were sure that we would detect a functioning and viable microbial ecosystem in the permafrost soils of University Valley as we and others have done in Arctic and Antarctic permafrost, including in other sites at lower elevations in Antarctica. It is hard for both of us to believe that we may have reached a cold and arid threshold where even microbial life cannot actively exist."

Drilling for microbes in Antarctica

What brought the researchers to University Valley was a NASA ASTEP (astrobiology science and technology for exploring planets) project to test the IceBite auger, a permafrost drill designed to drill into Martian permafrost. The average daily air temperature in the Antarctic summer of 2013, when Goordial collected the permafrost samples which she tested both on the spot and later in the lab, was -14 °C and it never rose above 0 °C, making the permafrost difficult to drill.

The McGill team analyzed samples from two permafrost boreholes which reached a depth of just 42 cm and 55 cms below the surface. This may not sound like a lot, but drilling into permafrost to get soil samples for testing is very difficult.

"Anytime you drill into frozen ground and it has some ice in it the drilling process creates friction which melts the ice. The hole will refreeze within seconds if the drilling is interrupted, freezing the drill bit into the hole" says Whyte." I remember drilling in the Arctic and losing a drill bit in one of the holes we had made, just because it froze into the ice before we could get it out."

"Previous studies in the lower dry valleys of Antarctica and in subglacial lakes were giving us the impression that microbial life was rich in the cold regions. But this is finally Mars!" says Chris McKay of NASA's Ames Research Centre. "University Valley has the coldest driest soil we can find on Earth. And life is really having a hard time of it there. This is certainly the training ground for the search for evidence of life on Mars and an extremely important result for NASA's astrobiology effort."

All the tests came out negative

The research team carried out a variety of tests, both in the field (where they failed to find evidence of carbon dioxide or methane - a gas used by all living things - in the soil) and then back in the lab at McGill in Montreal. They sent soil samples for DNA testing, looking for matches with particular genes known to be found in microbes and fungi; they tried to stimulate microbial growth on a wide variety of substances and then count the cells produced; and they used highly sensitive radiorespiration activity assays, which involve feeding the soil microorganisms a food source which has been labelled with radioactive carbon, which can then be used to detect if the microorganisms are active.

The tests failed to show any signs of active life.

"We couldn't detect any microbial activity within these samples," says Whyte. "Any, very limited traces we were able to find of microbial life in these samples are most likely the remnants of microbes that are dormant or are slowly dying off. Given the continuous dryness and subfreezing temperatures, and the lack of available water, even in summer, it is unlikely that any microbial communities can grow in these soils."

Goordial adds, "We don't know if there is activity beyond our limits of detection. All we can say for sure is that after using all the current methods of testing available to us, the samples are unlike any other permafrost we have encountered to date on Earth"

Implications for the search for life on Mars

"If conditions are too cold and dry to support active microbial life on an analogous climate on Earth, then the colder dryer conditions in the near surface permafrost on Mars are unlikely to contain life." Says Whyte. "Additionally, if we cannot detect activity on Earth, in an environment which is teeming with microorganisms, it will be extremely unlikely and difficult to detect such activity on Mars."

On a positive note however, the researchers add that this suggests that any microorganisms that may be transported to Mars from Earth by mistake are unlikely to be able to survive on the Martian surface, something that is of current concern for planetary protection.

The research was funded by NASA ASTEP program, the Natural Sciences and Engineering Research Council (NSERC) Discovery Grant Program, and NSERC and CREATE Canadian Astrobiology Training Program (CATP).

To read "Nearing the cold-arid limits of microbial life in permafrost of an upper dry valley, Antarctica" by Jacqueline Goordial et al in The ISME Journal: 10.1038/ismej.2015.239

http://www.eurekalert.org/pub_releases/2016-01/uov-mes011916.php

Mounting evidence suggests early agriculture staved off global cooling

7,000 years ago humans likely slowed a natural cooling process of the global climate

A new analysis of ice-core climate data, archeological evidence and ancient pollen samples strongly suggests that agriculture by humans 7,000 years ago likely slowed a natural cooling process of the global climate, playing a role in the relatively warmer climate we experience today.

A study detailing the findings is published online in a recent edition of the journal Reviews of Geophysics, published by the American Geophysical Union.

"Early farming helped keep the planet warm," said William Ruddiman, a University of Virginia climate scientist and lead author of the study, who specializes in investigating ocean sediment and ice-core records for evidence of climate fluctuations.

A dozen years ago, Ruddiman hypothesized that early humans altered the climate by burning massive areas of forests to clear the way for crops and livestock grazing. The resulting carbon dioxide and methane released into the atmosphere had a warming effect that "cancelled most or all of a natural cooling that should have occurred," he said.

That idea, which came to be known as the "early anthropogenic hypothesis" was hotly debated for years by climate scientists, and is still considered debatable by some of these scientists. But in the new paper, Ruddiman and his 11 co-authors from institutions in the United States and Europe say that accumulating evidence in the past few years, particularly from ice-core records dating back to 800,000 years ago, show that an expected cooling period was halted after the advent of

large-scale agriculture. Otherwise, they say, the Earth would have entered the early stages of a natural ice age, or glaciation period.

The Earth naturally cycles between cool glacial periods and warmer interglacial periods because of variations in its orbit around the sun. We currently are in an interglacial period, called the Holocene epoch, which began nearly 12,000 years ago.

In 2003, Ruddiman developed his early anthropogenic hypothesis after examining 350,000 years of climate data from ice cores and other sources. He found that during interglacial periods, carbon dioxide and methane levels decreased, cooling the climate and making way for a succeeding glacial period. But, only during the Holocene era, these gas levels rose, coinciding, he said, with the beginning of large-scale agriculture. He attributed the rise to this human activity, which began occurring millennia before the industrial era.

He attributed the rise in carbon dioxide emissions to the slash and burn techniques widely used by early farmers to make available large areas of land for crops. Ruddiman found that carbon dioxide levels rose beginning 7,000 years ago, and that methane began rising 5,000 years ago. He said this explains why a cooling trend didn't happen that likely otherwise would have led to a new glacial period.

In the new study, Ruddiman and his colleagues have delved more deeply into the climate record using Antarctic ice-core data, dating back to 800,000 years ago. This use of a deeper historical data set clearly shows, they say, that the Holocene is unlike other interglacial periods in its abundance of carbon dioxide and methane, further implicating the impact of humans.

In the development of his hypothesis, Ruddiman and colleagues have drawn from numerous studies across scientific disciplines: climatology, anthropology, archaeology, paleoecology, and population dynamics, all to better understand how humans may have affected climate beyond the relatively recent industrial revolution and the widespread burning of fossil fuels.

They cite a recent study that also summarized archaeological studies and found that early rice irrigation, which releases methane gas to the atmosphere, explains most of the anomalously high rise in atmospheric methane beginning about 5,000 years ago. A proliferation of livestock farming during that time period also may explain part of the methane increase.

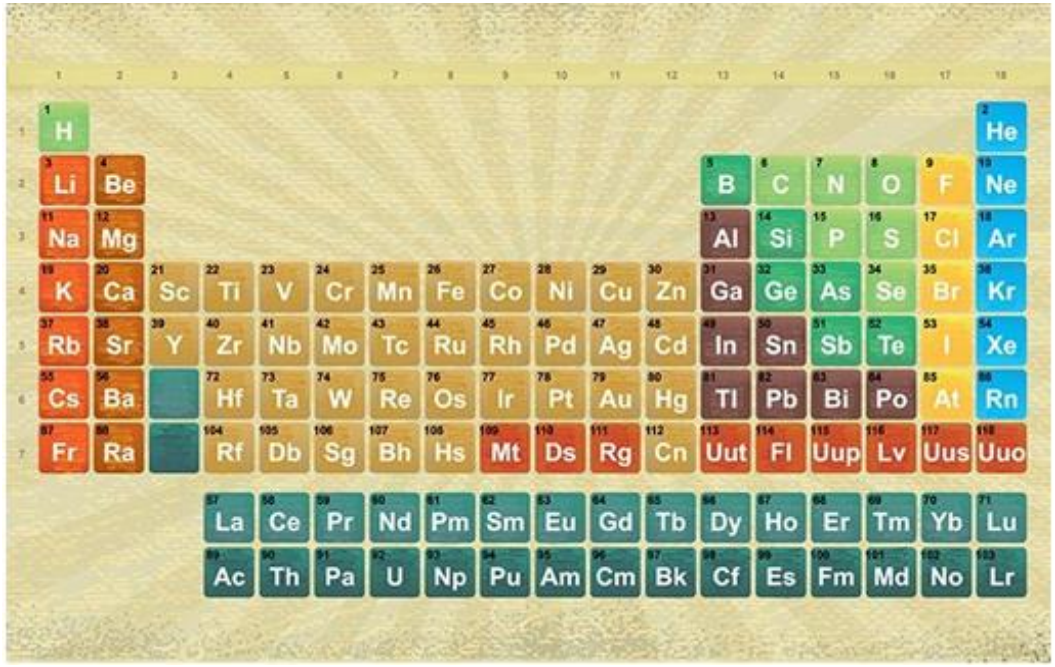
"After 12 years of debate about whether the climate of the last several thousand years has been entirely natural or in considerable part the result of early agriculture, converging evidence from several scientific disciplines points to a major anthropogenic influence," Ruddiman said.

http://bit.ly/1RE6CAR

When Will We Reach the End of the Periodic Table?

Even with new elements in hand, scientists are struggling to predict the future of the iconic chemical roadmap

By Devin Powell



How many more seats are left at the table? **JDawnInk/iStock**

Chemistry teachers recently had to update their classroom décor, with the announcement that scientists have confirmed the discovery of four new elements on the periodic table. The as-yet unnamed elements 113, 115, 117 and 118 filled in the remaining gaps at the bottom of the famous chart—a roadmap of matter's building blocks that has successfully guided chemists for nearly a century and a half.

The official confirmation, granted by the International Union of Pure and Applied Chemistry (IUPAC), was years in the making, as these superheavy elements are highly unstable and tough to create. But scientists had strong reason to believe they existed, in part because the periodic table has been remarkably consistent so far. Efforts to conjure up elements 119 and 120, which would start a new row, are already underway.

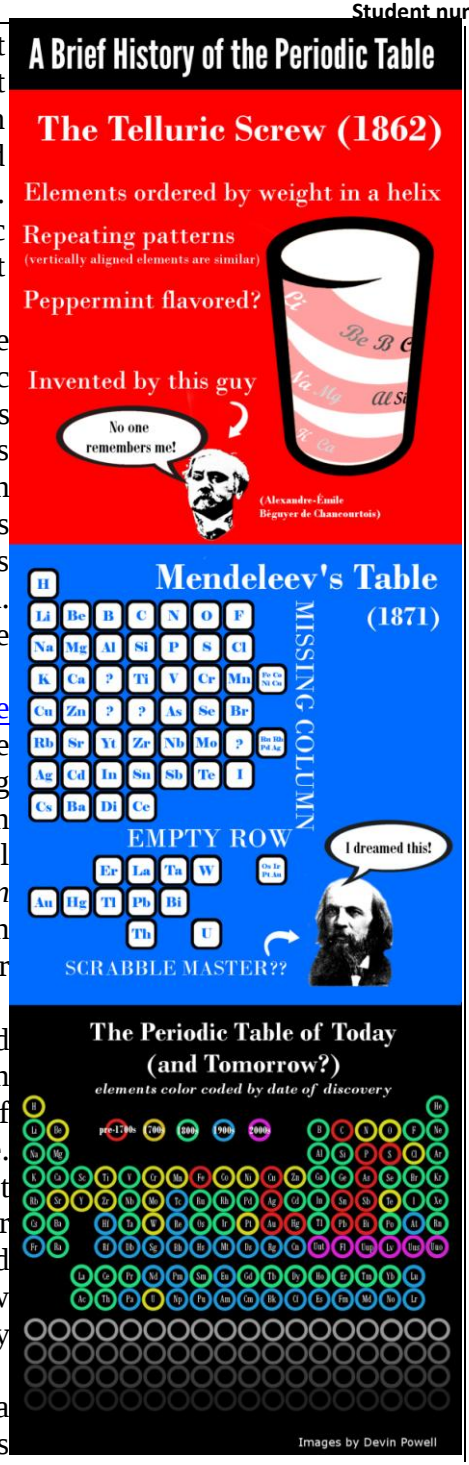
But exactly how many more elements are out there remains one of chemistry's most persistent mysteries, especially as our modern understanding of physics has revealed anomalies even in the established players. "Cracks are beginning to show in the periodic table," says Walter Loveland, a chemist at Oregon State University.

The modern incarnation of the periodic table organizes elements by rows based on atomic number—the number of protons in an atom's nucleus—and by columns based on the orbits of their outermost electrons, which in turn usually dictate their personalities. Soft metals that tend to react strongly with others, such as lithium and potassium, live in one column. Non-metallic reactive elements, like fluorine and iodine, inhabit another.

French geologist Alexandre-Émile Béguyer de Chancourtois was the first person to recognize that elements could be grouped in recurring patterns. He displayed the elements known in 1862, ordered by their weights, as a spiral wrapped around a cylinder (*see the illustration below*). Elements vertically in line with each other on this cylinder had similar characteristics.

But it was the organizational scheme created by Dmitri Mendeleev, a hot-tempered Russian who claimed to have seen groupings of elements in a dream, that stood the test of time. His 1871 periodic table wasn't perfect; it predicted eight elements that do not exist, for instance. However, it also correctly foretold gallium (now used in lasers), germanium (now used in transistors) and other increasingly heavy elements.

The Mendeleev periodic table easily accepted a brand new column for the noble gases, such as



helium, which had eluded detection until the end of the 19th century because of their proclivity to not react with other elements.

The modern periodic table has been more or less consistent with quantum physics, introduced in the 20th century to explain the behavior of subatomic particles like protons and electrons. In addition, the groupings have mostly held as heavier elements have been confirmed. Bohrium, the name given to element 107 after its discovery in 1981, fits so neatly with the other so-called transition metals that surround it, one of the researchers who discovered it proclaimed "bohrium is boring." But interesting times may lie ahead.

One open question concerns lanthanum and actinium, which have less in common with the other members of their respective groups than lutetium and lawrencium. IUPAC recently appointed a task force to look into this issue. Even helium, element 2, isn't straightforward—an alternative version of the periodic table exists that places helium with beryllium and magnesium instead of its noble gas neighbors, based on the arrangements of all its electrons instead of only the outermost ones.

"There's trouble at the beginning, middle and end of the periodic table," says Eric Scerri, a historian in the chemistry department at the University of California, Los Angeles.

Einstein's special theory of relativity, published decades after Mendeleev's table, also introduced some chinks in the system. Relativity dictates that the mass of a particle increases with its speed. That can cause the negatively charged electrons orbiting the positively charged core of an atom to behave strangely, affecting the properties of an element.

Consider gold: The nucleus is packed with 79 positive protons, so to keep from falling inward, gold's electrons have to whiz around at more than half the speed of light. That makes them more massive and pulls them into a tighter, lower-energy orbit. In this configuration, the electrons absorb blue light instead of reflecting it, giving wedding bands their distinctive gleam.

The notorious bongo-playing physicist Richard Feynman is said to have invoked relativity to predict the end of the periodic table at element 137. To Feynman, 137 was a "magic number"—it had popped up for no obvious reason elsewhere in physics. His calculations showed that electrons in elements beyond 137 would have to move faster than the speed of light, and thus violate the rules of relativity, to avoid crashing into the nucleus.

More recent calculations have since overturned that limit. Feynman treated the nucleus as a single point. Allow it to be a ball of particles, and the elements can keep going until about 173. Then all hell breaks loose. Atoms beyond this limit

may exist but only as strange creatures capable of summoning electrons from empty space.

Relativity isn't the only problem. Positively charged protons repel each other, so the more you pack into a nucleus, the less stable it tends to be. Uranium, with an atomic number of 92, is the last element stable enough to occur naturally on Earth. Every element beyond it has a nucleus that falls apart quickly, and their half-lives—the time it takes for half of the material to decay—can be minutes, seconds or even split seconds.

Heavier, unstable elements may exist elsewhere in the universe, like inside dense neutron stars, but scientists can study them here only by smashing together lighter atoms to make heavier ones and then sifting through the decay chain.

"We really do not know what is the heaviest element that could exist," says nuclear physicist Witold Nazarewicz of Michigan State University.

Theory predicts that there will be a point at which our lab-made nuclei won't live long enough to form a proper atom. A radioactive nucleus that falls apart in less than ten trillionths of a second wouldn't have time to gather electrons around itself and make a new element.

Still, many scientists expect islands of stability to exist further down the road, where superheavy elements have relatively long-lived nuclei. Loading up certain superheavy atoms with lots of extra neutrons could confer stability by preventing the proton-rich nuclei from deforming. Element 114, for instance, is expected to have a magically stable number of neutrons at 184. Elements 120 and 126 have also been predicted to have the potential to be more durable.

But some claims of superheavy stability have already fallen apart. In the late 1960s chemist Edward Anders proposed that xenon in a meteorite that fell onto Mexican soil had come from the breakdown of a mystery element between 112 and 119 that would be stable enough to occur in nature. After spending years narrowing his search, he ultimately retracted his hypothesis in the 1980s.

Predicting the potential stability of heavy elements isn't easy. The calculations, which require tremendous computing power, haven't been done for many of the known players. And even when they have, this is very new territory for nuclear physics, where even small changes in the inputs can have profound impacts on the expected results.

One thing is for certain: Making each new element is going to get harder, not only because shorter-lived atoms are harder to detect, but because making superheavies may require beams of atoms that are themselves radioactive. Whether or not there is an end to the periodic table, there may be an end to our ability for creating new ones. "I think we're a long way off from the end of the periodic table," says Scerri. "The limiting factor right now seems to be human ingenuity."

http://bit.ly/1nFQMsN

Head transplant carried out on monkey, claims maverick surgeon

The plan to perform a human head transplant is on track, says Sergio Canavero, after successful experiments on monkeys and mice

The head transplant juggernaut rolls on. Last year, maverick surgeon Sergio Canavero caused a worldwide storm when he revealed his plan to attempt a human head transplant to *New Scientist*. He claimed that the surgical protocol would be ready within two years and said he intended to offer the surgery as a treatment for complete paralysis.

Now, working with other scientists in China and South Korea, he claims to have moved closer to that goal with a series of experiments in animals and human cadavers.

"I would say we have plenty of data to go on," says Canavero. "It's important that people stop thinking this is impossible. This is absolutely possible and we're working towards it."

"Science through PR"

The work is described in seven papers set to be published in the journals *Surgery* and *CNS Neuroscience & Therapeutics* over the next few months. *New Scientist* has not seen the papers and has not been able verify the latest claims. The issue of *CNS Neuroscience & Therapeutics* will be guest-edited by one of Canavero's collaborators.

The fact that Canavero has gone public with the latest results before the papers are published has raised eyebrows. "It's science through public relations," says Arthur Caplan, a bioethicist at New York University School of Medicine. "When it gets published in a peer-reviewed journal I'll be interested. I think the rest of it is BS."

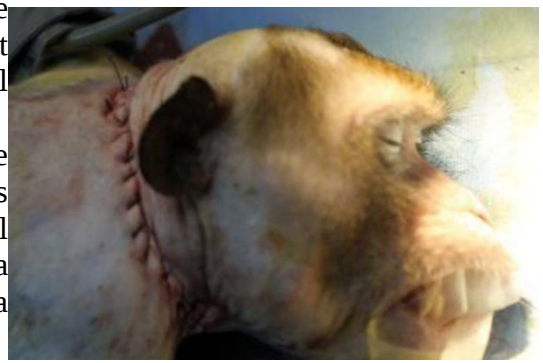
Thomas Cochrane, a neurologist at Harvard Medical School's Centre for Bioethics, agrees that Canavero's premature disclosure is unorthodox. "It's frowned upon for good reason," he says. "It generates excitement before excitement is warranted. It distracts people from actual work that everyone can agree has a valid foundation. As far as I can tell, that operation has mostly been about publicity rather than the production of good science."

Although we can't verify them, *New Scientist* has seen images and videos of some of the procedures Canavero describes.

These include the video above of mice sniffing and moving their legs, apparently weeks after having the spinal cord in their necks severed and then re-fused. C-Yoon Kim, at Konkuk University School of Medicine in South Korea, who carried out the procedure, says his team have demonstrated the recovery of motor

function in the forelimbs and hindlimbs of the animals. "Therefore I guess it is possible to reconnect the [spinal] cord after complete severance," he says.

Canavero says Kim's work shows that the spinal cord can re-fuse if it is cut cleanly in the presence of polyethylene glycol (PEG), a chemical that preserves nerve cell membranes. "These experiments prove once and for all that simply using PEG, you can see partial recovery," he says.



Surgery/Ren/HEAVEN-AHBR

As well as the use of PEG, the procedure Canavero outlines in the papers includes techniques to aid recovery such as spinal cord stimulation and the use of a negative pressure device to create a vacuum to encourage the nerves to fuse.

According to Canavero, researchers led by Xiaoping Ren at Harbin Medical University, China, have carried out a head transplant on a monkey. They connected up the blood supply between the head and the new body, but did not attempt to connect the spinal cord. Canavero says the experiment, which repeats the work of Robert White in the US in 1970, demonstrates that if the head is cooled to 15 °C, a monkey can survive the procedure without suffering brain injury.

"The monkey fully survived the procedure without any neurological injury of whatever kind," says Canavero, adding that it was kept alive for only 20 hours after the procedure for ethical reasons. *New Scientist* was, however, unable to obtain further details on this experiment.

"We've done a pilot study testing some ideas about how to prevent injury," says Ren, whose work is sponsored by the Chinese government. He and his team have also performed experiments on human cadavers in preparation for carrying out the surgery, he says.

Rich backers needed

Canavero is seeking funds to offer a head transplant to a 31-year-old Russian patient, Valery Spriridonov, who has a genetic muscle-wasting disease. Canavero says he intends to make a plea to Mark Zuckerberg to finance the surgery. Last week, Trinh Hong Son, director of the Vietnam-Germany Hospital in Hanoi, Vietnam, offered to host the procedure.

"If the so-called head transplant works, this is going to open up a whole new science of spinal cord trauma reconstruction," says Michael Sarr, editor of the journal *Surgery* and a surgeon at the Mayo Clinic in Rochester, Minnesota. "We are most interested in spinal cord reconstruction using head transplantation as a proof of principle. Our journal does not necessarily support head transplantation because of multiple ethical issues and multiple considerations of informed consent and the possibility of negative consequences of a head transplant."

Against the odds

Caplan says Canavero should study nerve regrowth with PEG in people with spinal cord injury before attempting a head transplant. "There are hundreds of thousands of people who could benefit from something that would regrow the spinal cord. It's like saying I want to fly to the next galaxy when it would be nice to set up a colony on Mars, and I think about the same odds."

Nevertheless, Canavero believes head transplantation is the only treatment that will work for paralysed patients. "Gene therapy has failed. Stem cells, we're still waiting. Even if they come now, for these patients there is no hope. Tetraplegia can only be cured with this. Long term, the body decays, organs decay. You have to give them a new body because even if you take care of the cord, you're going nowhere."

http://nyti.ms/1lF51q5

How to View Five Planets Aligning in a Celestial Spectacle

Five planets paraded across the dawn sky early Wednesday in a rare celestial spectacle set to repeat every morning until late next month.

By NICHOLAS ST. FLEUR JAN. 19, 2016

Headlining the planetary performance are Mercury, Venus, Mars, Saturn and Jupiter. It is the first time in more than a decade that the fab five are simultaneously visible to the naked eye, according to Jason Kendall, who is on the board of the Amateur Astronomers Association of New York.

Admission to the daily show is free, though stargazers in the Northern Hemisphere should plan to get up about 45 minutes before sunrise to catch it. City dwellers can stay in their neighborhoods to watch, as long as they point their attention to the east, according to Mr. Kendall, who took his telescope to Inwood Hill Park in Manhattan around 4 a.m. Wednesday.

Mr. Kendall said he immediately saw Jupiter, Mars and Saturn after looking into the crystal clear sky. Venus glowed as bright as an airplane against the darkness when it rose. Aided by his telescope, he also saw Jupiter's moons and Saturn's rings.

"For Mercury you will need binoculars," he said. "It will not jump out at you, but everybody should be able to see Venus and Jupiter."

He said that Mercury, which was too low to see clearly, will most likely become more visible on Feb. 5 or 6 when it is at its greatest distance from the sun along the horizon. The hardest task for viewers is discerning the planets from stars

twinkling in the sky. But Mr. Kendall offered a simple trick: close one eye, stretch out your arm and slowly pass your thumb over a bright dot in the sky. If the dot slowly dims out when your thumb passes over it, it's a planet. If it quickly blinks out, it's a distant star.

The show was expected to run from Jan. 20 until Feb. 20, but the peak time to see all five is from the end of January until the first week of February, when Mercury is at its highest points, according to Sky & Telescope. The display is made possible by the uncommon alignment of all five planets along what is called the "ecliptic" plane of their orbits, according to Jim Green, the planetary science division director at NASA.

Over five weeks, each planet will appear one by one across the sky of the Northern Hemisphere. As it did Wednesday morning, Jupiter will rise first, emerging sometime at night, while the other four planets will make their debuts in the wee hours of the morning. Mars rises second, then Saturn and then Venus — the brightest orb — followed finally by Mercury, which appears about an hour before sunrise.

Each morning display will last until the sun comes up and makes it too bright to see the planets, typically around 7 a.m. It is possible to find specific times when each planet will rise on a given city's horizon by checking The Old Farmer's Almanac.

"It's not super-often you get to see them all at the same time in the sky, it's like seeing all of your friends at once," said Jackie Faherty, an astronomer from the American Museum of Natural History. "There they are, the other rocks or balls of gas that are running around the sun."

Those who miss the planetary alignment in the next few weeks will have another opportunity from Aug. 13 to 19, when the cosmic motley crew gives an encore performance, according to EarthSky.org. That show will take place in the dusk sky, giving stargazers in the Southern Hemisphere the best vantage points.

http://www.bbc.com/news/magazine-35350886

Are beards good for your health?

If you were in search of a new, disease-fighting antibiotic, where might you start? In a swamp? A remote island? Well, how about combing beards? Michael Mosley investigates.

On Trust Me I'm a Doctor we do experiments which sometimes throw up genuinely new science. In a previous series, for example, we discovered you can cut the calories in pasta by cooking, cooling and then reheating it.

That was a very pleasing result. But our most recent discovery, finding bacteria which appear to be producing a novel form of antibiotic, feels altogether more significant. What was particularly delightful was that they were found growing in someone's beard.

Beards, as you may have noticed, are back. The chin-strap, the goatee, the neck beard and the Van Dyke, they all have their fans. But with beards sprouting everywhere, like new grass in the spring sunshine, there has inevitably been a backlash.

Critics claim that beards are not only an irritating affectation but can potentially harbour unpleasant bugs.

So, what's the evidence that beards pose any sort of health risk? Pogonophobes, people who fear beards, had those fears confirmed by a recent study in New Mexico where they found traces of enteric bacteria, the sort usually found in faeces, in randomly sampled beards.

As one newspaper put it: "'Some beards contain more poo than a toilet."

But is this typical? A recent and rather more scientific study, carried in an American hospital, came to very different conclusions.

In this study, published in the Journal of Hospital Infection, they swabbed the faces of 408 hospital staff with and without facial hair.

They had good reasons for doing so. We know that hospital-acquired infections are a major cause of disease and death in hospitals, with many patients acquiring an infection they didn't have when they went in. Hands, white coats, ties and equipment have all been blamed, but what about beards?

Well, the researchers were surprised to find that it was the clean-shaven staff, and not the beardies, who were more likely to be carrying something unpleasant on their faces.

The beardless group were more than three times as likely to be harbouring a species known as methicillin-resistant staph aureus on their freshly shaven cheeks. MRSA is a particularly common and troublesome source of hospital-acquired infections because it is resistant to so many of our current antibiotics.

So what's going on? The researchers suggested that shaving might cause micro-abrasions in the skin "which may support bacterial colonisation and proliferation".

Perhaps. But there was another more plausible explanation staring them in the face. That beards fight infection.

Unlikely? Well, driven by curiosity we recently swabbed the beards of a random assortment of men and sent them off to Dr Adam Roberts, a microbiologist based at University College London, to see what, if anything, he could grow.

Adam managed to grow over 100 different bacteria from our beards, including one that is more commonly found in the small intestine. But, as he quickly explains, that doesn't mean it came from faeces. Such findings are normal and nothing to worry about.

Far more interesting, in a few of the petri dishes he noticed that something was clearly killing the other bacteria. The most obvious suspect was a fellow microbe.

We see microbes as our enemy, but they clearly don't see us that way. Down at their level bacteria and fungi spend their time competing with each other. They fight for food, resources and space. By doing so, over millennia, they have evolved some of the most sophisticated weapons known to microbe-kind - antibiotics.

Penicillin was originally extracted from Penicillium notatum, a species of fungus. The microbe-killing properties of this fungus were discovered by Alexander Fleming when he noticed that a fungus spore, which had accidently blown into his lab from researchers further down the corridor, had killed some bacteria he was growing on a petri dish. So could our mysterious microbes be doing something similar? Killing fellow bacteria by producing some sort of toxin?

"Yes," says Adam extremely cautiously. "Possibly."

Adam indentified the silent assassins as part of a species called Staphylococcus epidermidis. When he tested them against a particularly drug-resistant form of Eschercichia coli (E. coli), the sort that cause urinary tract infections, they killed with abandon.

Purifying and properly testing a novel antibiotic is so expensive and has such a high failure rate that it is extremely unlikely doctors will be prescribing Beardicillin any time soon, but Adam is deadly serious about looking for replacements for our current stock of antibiotics.

As he pointed out, antibiotic-resistant infections kill at least 700,000 people a year, projected to rise to 10 million by 2050. There have been no new antibiotics released in the past 30 years.

As well as our beardy findings, Adam's team have recently isolated, from microbes sent in by the general public, anti-adhesion molecules which stop bacteria binding to other surfaces. They think there may be potential for adding this to toothpaste and mouthwash, as it could stop acid-producing bacteria from binding to enamel. Surprising, isn't it, what you can find in a beard?

http://www.eurekalert.org/pub_releases/2016-01/r-gvm012016.php

Genetic variation may explain Asian susceptibility to Kawasaki disease

Riken scientists find two variations in a gene, one of which may help explain why people of Asian descent are more susceptible to Kawasaki disease

Scientists from the RIKEN Center for Integrative Medical Sciences (IMS) in Yokohama, Japan, in collaboration with researchers from a number of hospitals around Japan, have found two variations in a gene called ORAI1, one of which may help explain why people of Asian descent are more susceptible to Kawasaki disease, a poorly understand ailment that mostly afflicts young children. The work was published in PLOS ONE. The etiology of Kawasaki disease, which causes inflammation of blood vessels leading to symptoms such as fever and redness of the eyes, lips, and tongue, is a mystery, because it shows seasonal variations--hinting at an infectious or other environmental cause--but is also more prevalent in children of East Asian ancestry--suggesting that there are genetic factors behind it. Kawasaki disease is normally a self-limiting condition, improving over time, but in some cases it is accompanied with potentially fatal aneurysms of the coronary arteries.

Previous studies have linked Kawasaki disease to the calcium NFAT pathway, which regulates immune function in response to calcium signals, but which is also known to be involved in the development of the cardiac and other systems. Considering this, the RIKEN-led team decided to focus their work on ORA1, a gene within a chromosomal region where a positive linkage signal has been seen in a previous genome-wide linkage study and had shown to be involved in the activation of the calcium NFAT pathway.

To identify variations that might be associated with susceptibility to the disease, the group examined the genes of 729 Kawasaki disease patients and 1,315 healthy adults. To identify variations that were most strongly associated with the disease, they then looked at variations in a further 1,813 patients and 1,097 non-patients. From these analyses, they identified a single nucleotide polymorphism (SNP), rs3741596, that was much more common in the patients than in the healthy controls. This SNP had not been identified in previous studies on Kawasaki, but intriguingly, it had been found from genomic studies of populations (HapMap) that the variant is common in East Asian populations, and to a lesser extent in African populations, but was very rare elsewhere. They also discovered a second, rare variation that was also highly correlated with the diseases.

According to Yoshihiro Onouchi of the IMS Laboratory for Cardiovascular Disease, who led the study, "It has been suggested that a pathway involved in the immune response is associated with Kawasaki disease, and we knew from our previous work that the calcium NFAT pathway is somehow linked to the disease. It was interesting--and makes a lot of sense--that the common variation we discovered is common in East Asia."

He continues, "These findings give added credence to the idea that the NFAT pathway is involved in the etiology of Kawasaki disease, and will help us to understand the causes and mechanisms behind it. We hope also that it could lead to treatments for the disease, which in some cases has devastating consequences."

http://www.eurekalert.org/pub_releases/2016-01/si-mco012016.php

Memory capacity of brain is 10 times more than previously thought

New measurements of the brain's memory capacity increase conservative estimates to at least a petabyte, in the same ballpark as the World Wide Web

LA JOLLA - Salk researchers and collaborators have achieved critical insight into the size of neural connections, putting the memory capacity of the brain far higher than common estimates. The new work also answers a longstanding question as to how the brain is so energy efficient and could help engineers build computers that are incredibly powerful but also conserve energy.

"This is a real bombshell in the field of neuroscience," says Terry Sejnowski, Salk professor and co-senior author of the paper, which was published in eLife. "We discovered the key to unlocking the design principle for how hippocampal neurons function with low energy but high computation power. Our new measurements of the brain's memory capacity increase conservative estimates by a factor of 10 to at least a petabyte, in the same ballpark as the World Wide Web."

Our memories and thoughts are the result of patterns of electrical and chemical activity in the brain. A key part of the activity happens when branches of neurons, much like electrical wire, interact at certain junctions, known as synapses. An output 'wire' (an axon) from one neuron connects to an input 'wire' (a dendrite) of a second neuron. Signals travel across the synapse as chemicals called neurotransmitters to tell the receiving neuron whether to convey an electrical signal to other neurons. Each neuron can have thousands of these synapses with thousands of other neurons.

"When we first reconstructed every dendrite, axon, glial process, and synapse from a volume of hippocampus the size of a single red blood cell, we were somewhat bewildered by the complexity and diversity amongst the synapses," says Kristen Harris, co-senior author of the work and professor of neuroscience at the University of Texas, Austin. "While I had hoped to learn fundamental principles about how the brain is organized from these detailed reconstructions, I have been truly amazed at the precision obtained in the analyses of this report."

Synapses are still a mystery, though their dysfunction can cause a range of neurological diseases. Larger synapses--with more surface area and vesicles of neurotransmitters--are stronger, making them more likely to activate their surrounding neurons than medium or small synapses.

The Salk team, while building a 3D reconstruction of rat hippocampus tissue (the memory center of the brain), noticed something unusual. In some cases, a single axon from one neuron formed two synapses reaching out to a single dendrite of a second neuron, signifying that the first neuron seemed to be sending a duplicate message to the receiving neuron.

At first, the researchers didn't think much of this duplicity, which occurs about 10 percent of the time in the hippocampus. But Tom Bartol, a Salk staff scientist, had an idea: if they could measure the difference between two very similar synapses such as these, they might glean insight into synaptic sizes, which so far had only been classified in the field as small, medium and large.

To do this, researchers used advanced microscopy and computational algorithms they had developed to image rat brains and reconstruct the connectivity, shapes, volumes and surface area of the brain tissue down to a nanomolecular level.

The scientists expected the synapses would be roughly similar in size, but were surprised to discover the synapses were nearly identical.

"We were amazed to find that the difference in the sizes of the pairs of synapses were very small, on average, only about eight percent different in size. No one thought it would be such a small difference. This was a curveball from nature," says Bartol.

Because the memory capacity of neurons is dependent upon synapse size, this eight percent difference turned out to be a key number the team could then plug into their algorithmic models of the brain to measure how much information could potentially be stored in synaptic connections.

It was known before that the range in sizes between the smallest and largest synapses was a factor of 60 and that most are small.

But armed with the knowledge that synapses of all sizes could vary in increments as little as eight percent between sizes within a factor of 60, the team determined there could be about 26 categories of sizes of synapses, rather than just a few.

"Our data suggests there are 10 times more discrete sizes of synapses than previously thought," says Bartol. In computer terms, 26 sizes of synapses correspond to about 4.7 "bits" of information. Previously, it was thought that the brain was capable of just one to two bits for short and long memory storage in the hippocampus. "This is roughly an order of magnitude of precision more than anyone has ever imagined," says Sejnowski.

What makes this precision puzzling is that hippocampal synapses are notoriously unreliable. When a signal travels from one neuron to another, it typically activates that second neuron only 10 to 20 percent of the time.

"We had often wondered how the remarkable precision of the brain can come out of such unreliable synapses," says Bartol. One answer, it seems, is in the constant adjustment of synapses, averaging out their success and failure rates over time. The team used their new data and a statistical model to find out how many signals it would take a pair of synapses to get to that eight percent difference.

The researchers calculated that for the smallest synapses, about 1,500 events cause a change in their size/ability (20 minutes) and for the largest synapses, only a couple hundred signaling events (1 to 2 minutes) cause a change.

"This means that every 2 or 20 minutes, your synapses are going up or down to the next size. The synapses are adjusting themselves according to the signals they receive," says Bartol.

"Our prior work had hinted at the possibility that spines and axons that synapse together would be similar in size, but the reality of the precision is truly remarkable and lays the foundation for whole new ways to think about brains and computers," says Harris. "The work resulting from this collaboration has opened a new chapter in the search for learning and memory mechanisms." Harris adds that the findings suggest more questions to explore, for example, if similar rules apply for synapses in other regions of the brain and how those rules differ during development and as synapses change during the initial stages of learning.

"The implications of what we found are far-reaching," adds Sejnowski. "Hidden under the apparent chaos and messiness of the brain is an underlying precision to the size and shapes of synapses that was hidden from us."

The findings also offer a valuable explanation for the brain's surprising efficiency. The waking adult brain generates only about 20 watts of continuous power--as much as a very dim light bulb. The Salk discovery could help computer scientists build ultraprecise, but energy-efficient, computers, particularly ones that employ "deep learning" and artificial neural nets--techniques capable of sophisticated learning and analysis, such as speech, object recognition and translation.

"This trick of the brain absolutely points to a way to design better computers," says Sejnowski. "Using probabilistic transmission turns out to be as accurate and require much less energy for both computers and brains."

Other authors on the paper were Cailey Bromer of the Salk Institute; Justin Kinney of the McGovern Institute for Brain Research; and Michael A. Chirillo and Jennifer N. Bourne of the University of Texas, Austin.

The work was supported by the NIH and the Howard Hughes Medical Institute.

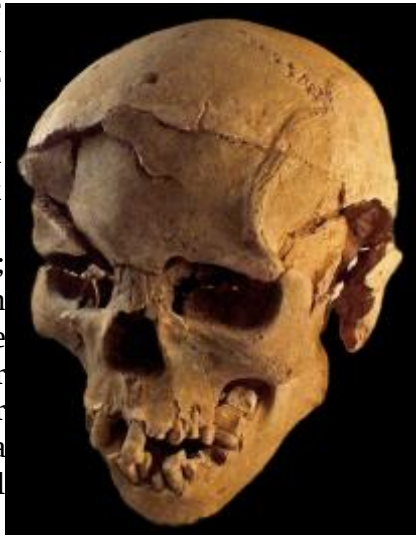
http://www.eurekalert.org/pub_releases/2016-01/uoc-eoa011516.php

Evidence of a prehistoric massacre extends the history of warfare

The fossilised bones of a group of prehistoric hunter-gatherers who were massacred around 10,000 years ago have been unearthed 30km west of Lake Turkana, Kenya, at a place called Nataruk.

Researchers from Cambridge University's Leverhulme Centre for Human Evolutionary Studies found the partial remains of 27 individuals, including at least eight women and six children.

Twelve skeletons were in a relatively complete state, and ten of these showed clear signs of a violent death: including extreme blunt-force trauma to crania and cheekbones, broken hands, knees and ribs, arrow lesions to the neck, and stone projectile tips lodged in the skull and thorax of two men.



This skeleton was that of a man, found lying prone in the lagoon's sediments. The skull has multiple lesions on the front and on the left side, consistent with wounds from a blunt implement, such as a club. **Marta Mirazon Lahr**

Several of the skeletons were found face down; most had severe cranial fractures. Among the in situ skeletons, at least five showed "sharp-force trauma", some suggestive of arrow wounds. Four were discovered in a position indicating their hands had probably been bound, including a woman in the last stages of pregnancy. Foetal bones were uncovered.

The bodies were not buried. Some had fallen into a lagoon that has long since dried; the bones preserved in sediment.

The findings suggest these hunter-gatherers, perhaps members of an extended family, were attacked and killed by a rival group of prehistoric foragers. Researchers believe it is the earliest scientifically-dated historical evidence of human conflict - an ancient precursor to what we call warfare.

The origins of warfare are controversial: whether the capacity for organised violence occurs deep in the evolutionary history of our species, or is a symptom of the idea of ownership that came with the settling of land and agriculture.

The Nataruk massacre is the earliest record of inter-group violence among prehistoric hunter-gatherers who remained largely nomadic.

"The deaths at Nataruk are testimony to the antiquity of inter-group violence and war," said Dr Marta Mirazon Lahr, from Cambridge's LCHES, who directs the IN-AFRICA Project and led the Nataruk study, published today in the journal Nature.

"These human remains record the intentional killing of a small band of foragers with no deliberate burial, and provide unique evidence that warfare was part of the repertoire of inter-group relations among some prehistoric hunter-gatherers," she said.

The site was first discovered in 2012. Following careful excavation, the researchers used radiocarbon and other dating techniques on the skeletons - as

well as on samples of shell and sediment surrounding the remains - to place Nataruk in time. They estimate the event occurred between 9,500 to 10,500 years ago, around the start of the Holocene: the geological epoch that followed the last Ice Age.

Now scrubland, 10,000 years ago the area around Nataruk was a fertile lakeshore sustaining a substantial population of hunter-gatherers. The site would have been the edge of a lagoon near the shores of a much larger Lake Turkana, likely covered in marshland and bordered by forest and wooded corridors.

This lagoon-side location may have been an ideal place for prehistoric foragers to inhabit, with easy access to drinking water and fishing - and consequently, perhaps, a location coveted by others. The presence of pottery suggests the storage of foraged food occurred.

"The Nataruk massacre may have resulted from an attempt to seize resources - territory, women, children, food stored in pots - whose value was similar to those of later food-producing agricultural societies, among whom violent attacks on settlements became part of life," said Mirazon Lahr.

"This would extend the history of the same underlying socio-economic conditions that characterise other instances of early warfare: a more settled, materially richer way of life. However, Nataruk may simply be evidence of a standard antagonistic response to an encounter between two social groups at that time."

Antagonism between hunter-gatherer groups in recent history often resulted in men being killed, with women and children subsumed into the victorious group. At Nataruk, however, it seems few, if any, were spared.

Of the 27 individuals recorded, 21 were adults: eight males, eight females, and five unknown. Partial remains of six children were found co-mingled or in close proximity to the remains of four adult women and of two fragmentary adults of unknown sex.

No children were found near or with any of the men. All except one of the juvenile remains are children under the age of six; the exception is a young teenager, aged 12-15 years dentally, but whose bones are noticeably small for his or her age.

Ten skeletons show evidence of major lesions likely to have been immediately lethal. As well as five - possibly six - cases of trauma associated with arrow wounds, five cases of extreme blunt-force to the head can be seen, possibly caused by a wooden club. Other recorded traumas include fractured knees, hands and ribs.

Three artefacts were found within two of the bodies, likely the remains of arrow or spear tips. Two of these are made from obsidian: a black volcanic rock easily worked to razor-like sharpness. "Obsidian is rare in other late Stone Age sites of this area in West Turkana, which may suggest that the two groups confronted at Nataruk had different home ranges," said Mirazon Lahr.

One adult male skeleton had an obsidian 'bladelet' still embedded in his skull. It didn't perforate the bone, but another lesion suggests a second weapon did, crushing the entire right-front part of the head and face. "The man appears to have been hit in the head by at least two projectiles and in the knees by a blunt instrument, falling face down into the lagoon's shallow water," said Mirazon Lahr.

Another adult male took two blows to the head - one above the right eye, the other on the left side of the skull - both crushing his skull at the point of impact, causing it to crack in different directions.

The remains of a six-to-nine month-old foetus were recovered from within the abdominal cavity of one of the women, who was discovered in an unusual sitting position - her broken knees protruding from the earth were all Mirazon Lahr and colleagues could see when they found her. The position of the body suggests that her hands and feet may have been bound.

While we will never know why these people were so violently killed, Nataruk is one of the clearest cases of inter-group violence among prehistoric hunter-gatherers, says Mirazon Lahr, and evidence for the presence of small-scale warfare among foraging societies.

For study co-author Professor Robert Foley, also from Cambridge's LCHES, the findings at Nataruk are an echo of human violence as ancient, perhaps, as the altruism that has led us to be the most cooperative species on the planet.

"I've no doubt it is in our biology to be aggressive and lethal, just as it is to be deeply caring and loving. A lot of what we understand about human evolutionary biology suggests these are two sides of the same coin," Foley said.

http://bit.ly/1Tiz0bh

Strong Evidence Suggests a Super Earth Lies beyond Pluto

Astronomers have found compelling hints of a huge, unseen world that may reside in the murky reaches of the Kuiper Belt

By Michael D. Lemonick on January 20, 2016

“New Planet Found” is about as exciting a headline nowadays as “Dog Bites Man,” which is to say, not very. Thanks largely to the space-based Kepler Mission, astronomers have identified about 2,000 new worlds, orbiting stars that lie tens or even hundreds of light-years from Earth, in the last two decades. Collectively, these are scientifically important, but with so many in hand no single addition to the list is likely to be much of a big deal. But a new planet announcement today from the California Institute of Technology is a very different proposition, because the world it describes does not circle a distant star. It is part of our own solar system—a place you would think we had explored pretty well by now.

Evidently not: in an analysis accepted for publication at *The Astronomical Journal*, California Institute of Technology planetary scientists Konstantin Batygin and Mike Brown present what they say is strong circumstantial evidence for a very large undiscovered planet, perhaps 10 times as massive as Earth, orbiting in the solar system's outer darkness beyond Pluto. The scientists infer its presence from anomalies in the orbits of a handful of smaller bodies they can see. "I haven't been this excited about something in quite a while," says Greg Laughlin, an expert on planet formation and dynamics at the University of California, Santa Cruz, who was not involved in the research.

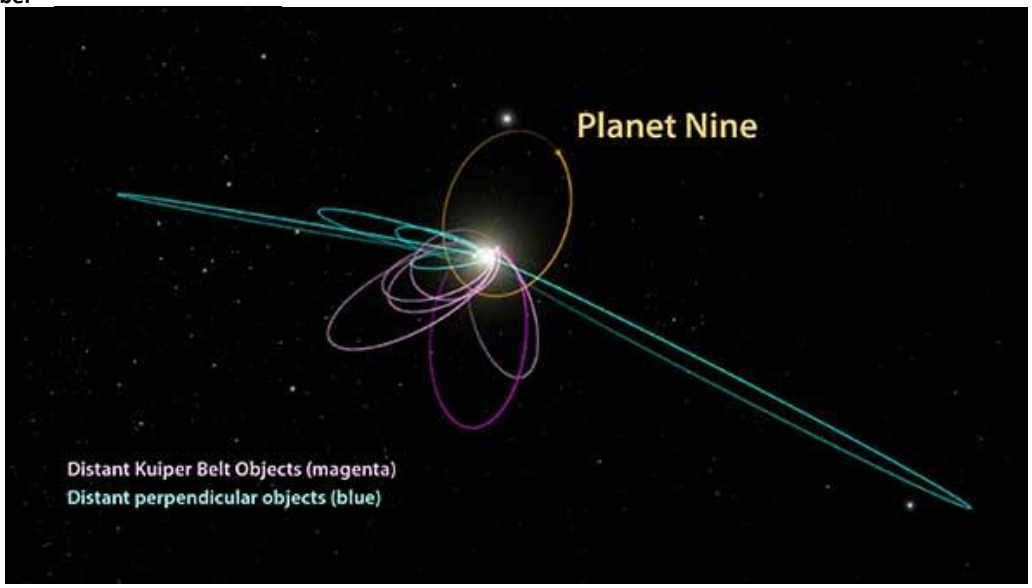
The object, which the researchers have provisionally named "Planet Nine," comes no closer than 30.5 billion or so kilometers from the sun, or five times farther than Pluto's average distance. Despite its enormous size, it would be so dim, the authors say, that it is unsurprising that nobody has spotted it yet.

If it exists, that is. "Sadly," Brown says, "we don't have an actual detection yet." But the evidence is strong enough that other experts are taking very serious notice. "I think it's pretty convincing," says Chad Trujillo of the Gemini Observatory in Hawaii. David Nesvorny, a solar system theorist at the Southwest Research Institute (SwRI), in Boulder, Colo., is impressed as well. "These guys are really good," he says. "They make a good case."

Strange orbits

Batygin and Brown are not the first to argue for an extra planet in our solar system. In 2014 Trujillo and Scott Sheppard, of the Carnegie Institution for Science, argued in *Nature* that their own discovery of a much smaller object, called 2012 VP113 , along with the existence of a handful of previously identified bodies in the outer solar system, hinted that there might be something planet-size out there. The evidence lay with their orbits, specifically with an obscure parameter called the "argument of perihelion"—the relationship between the time a body makes its closest approach to the sun and the time it passes through the plane of the solar system. The objects Trujillo and Shepherd identified all had uncannily similar arguments of perihelion, which could mean they were being shepherded by the gravity of an unseen world. "We noticed something curious," Trujillo says, "and said 'someone should go explore this further.'" (*Scientific American* is part of Nature Publishing Group.)

Several groups did, and agreed that the case for a hidden planet was plausible but still quite speculative. (See "The Search for Planet X" in the current *Scientific American*). The new analysis strengthens that case dramatically, however. The similarity of the arguments of perihelion turns out to be "just the tip of the iceberg," Batygin says.



***The gravity of a hypothetical Planet Nine could explain the peculiar orbits of two different sets of objects that lie out beyond Pluto. The diagram was created using WorldWide Telescope.*Caltech/R. Hurt (IPAC)**

The first thing he and Brown did, he says, was to analyze Trujillo and Sheppard's data with entirely fresh eyes. "What we noticed," Batygin says, "was that the long axes of these objects' orbits fall into the same quadrant of the sky." In other words, they point in the same direction. That outcome was not guaranteed; two bodies can have similar arguments of perihelion even if their orbits are not otherwise physically similar. But when Brown and Batygin plotted the orbits of those outer solar system objects, they noticed that their highly elliptical orbit shapes were closely aligned. "Shouldn't something like that be hard to miss?" Brown asks. "Yes, you would think so. This a case where we had our noses buried in the data, never stepping back and looking at the solar system from above. I couldn't believe I'd never noticed this before," he says. "It's ridiculous."

The directionality of the orbits was an even stronger hint that something was physically herding these distant objects. "At first," Brown says, "we said 'there can't be a planet out there—that's crazy.'" So they examined the most likely alternative—that the Kuiper Belt of icy objects beyond Pluto had formed all of its bodies into a clump naturally, much as galaxies pulled themselves into shape gravitationally out of the cosmic cloud of gas that emerged from the big bang.

The problem with that scenario, the authors realized, was that the Kuiper Belt lacks the mass to make it happen. When the scientists turned to the "crazy" notion of a planet, however, their simulations generated just the right kind of aligned

orbits. They also revealed something else: The gravity of a giant planet should lead to an entirely independent set of objects whose orbits are not aligned with one another but are sharply tilted compared with the orbits of the planets—up to 90 degrees away from the plane of the solar system or even more. "That seemed really puzzling," Batygin says. "But then Mike said, 'I think I've seen something like these in the data.'" Sure enough, observers have spotted a half dozen or so objects just like this and nobody had come up with a good explanation of how they might have gotten there. Now Batygin and Brown's simulation was providing one. "The fact that they're now marshaling two new, independent lines of evidence for a hypothetical planet," Laughlin says, "makes their case even stronger."

Super Earth

The planet that best fits the data would be on the order of 10 times as massive as Earth—putting it in the so-called "Super Earth" category, which includes many planets around other stars but none, until now, in our own solar system—and smaller than Neptune, the fourth-largest known planet orbiting the sun, which has about 17 Earth masses. Its most probable orbit is a highly elongated one that brings it to within 35 billion kilometers of the sun at the closest ("that's where it does all the damage," Brown says) and between three and six times as far away at its most distant.

Even at that enormous distance, Planet Nine could in principle be spotted with existing telescopes—most easily with the Japanese Subaru Telescope in Hawaii, which not only has a huge mirror for trapping faint light but also a wide field of view that would allow searchers to efficiently scan big swaths of sky. "Unfortunately, we don't own the Subaru," Brown says, "which means we're unlikely to be the ones who find it. So we're telling everyone else where to look."

Until they actually see it, astronomers cannot say definitively that Planet Nine is real. "I tend to be very suspicious of claims of an extra planet in the solar system," says Hal Levison of SwRI. "I have seen many, many such claims in my career, and all of them have been wrong." The orbital alignment is genuine, he acknowledges. "Something is creating it. But what that something is needs to be explored a bit more."

Overall, however, planetary scientists are clearly thrilled by the prospect that we might be on the verge of such a major discovery. "When I was growing up," Sheppard says, "we thought the big planets had all been found. It would be very exciting and very surprising to learn that we were wrong."

The mood of the astronomical community is perfectly captured, Laughlin says, by something British astronomer John Herschel said to the British Association for the Advancement of Science in a talk on September 10, 1846. Irregularities had been spotted in the orbit of Uranus, suggesting that the gravity of an unknown, massive planet was tugging on it. Referring to the mystery object, Hershel said:

"We see it as Columbus saw America from the shores of Spain. Its movements have been felt along the far-reaching line of our analysis with a certainly hardly inferior to ocular demonstration." Just two weeks later Neptune was discovered, right where the theorists' calculations said it should be.

http://www.bbc.com/news/science-environment-35362733

Five planets align in dawn sky

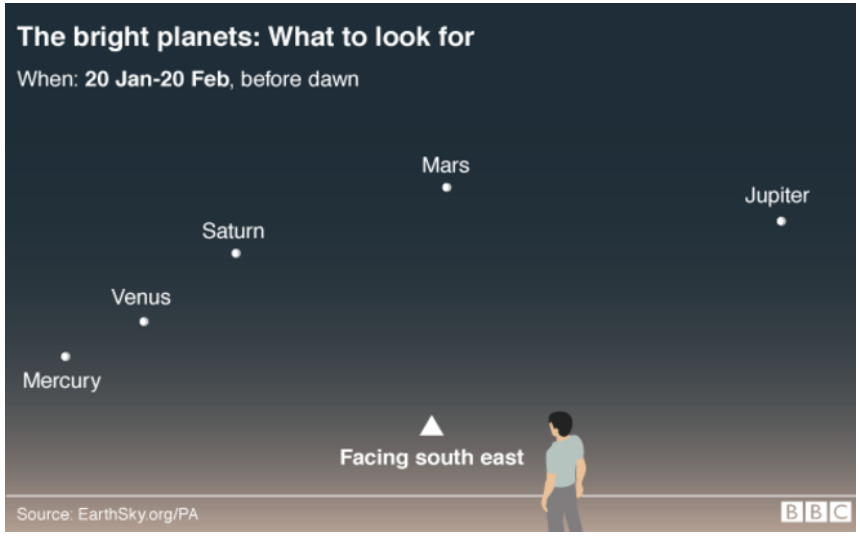
Five planets are aligning across the dawn sky over the next month, in a rare treat for skywatchers.

Mercury, Venus, Mars, Saturn and Jupiter will be simultaneously visible to the naked eye for the first time in more than a decade. The spectacle is visible from Wednesday until 20 February, but experts warn that Mercury will become fainter towards the end of that window. Experts advise stargazers to begin their viewing 45 minutes before dawn.

The display is made possible by the unusual alignment of the five planets along what's known as the ecliptic plane of their orbits. In practice, this means the planets lie near the plane of Earth's orbit, projecting as a line.

There will be another opportunity to view the planets in alignment from 13 August to 19 August. At that time, the spectacle will take place around dusk, and skywatchers in the southern hemisphere will be best placed to view it.

The last occasion when the planets were visible before dawn in this way was late December 2004 to early January 2005, when their order in the sky briefly matched their relative order outward from the Sun: Mercury, Venus, Mars, Jupiter, and Saturn.



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Fairy Tales Could Be Older Than You Ever Imagined

Jack may have been climbing that beanstalk for more than 5,000 years

By Erin Blakemore

A few hundred years ago, fairy tale auteurs like the Brothers Grimm, Hans Christian Andersen and Charles Perrault helped bring magical tales of princesses, evil ogres, dark forests, weird spells and thwarted love into the storybooks—and to the bedsides—of children, everywhere. But how old are the tales they transcribed? A new study suggests that their origins go all the way back to prehistory.

In a new study published in the journal Royal Society Open Science, a folklorist and anthropologist say that stories like Rumpelstiltskin and Jack and the Beanstalk are much older than originally thought. Instead of dating from the 1500s, the researchers say that some of these classic stories are 4,000 and 5,000 years old, respectively. This contradicts previous speculation that story collectors like the Brothers Grimm were relaying tales that were only a few hundred years old.

It turns out that it's pretty hard to figure out how old fairy tales are using simple historical data. Since the tales were passed down orally, they can be almost impossible to unwind using a historian or anthropologist's traditional toolbox. So the team borrowed from biology, instead, using a technique called phylogenetic analysis. Usually, phylogenetic analysis is used to show how organisms evolved.

In this case, researchers used strategies created by evolutionary biologists to trace the roots of 275 fairy tales through complex trees of language, population and culture.

Using the Aarne-Thompson-Uther Classification of Folk Tales, a kind of über index that breaks fairy tales down into groups like "the obstinate wife learns to obey" and "partnership between man and ogre," the team tracked the presence of the tales in 50 Indo-European language-speaking populations. They were able to find the ancestries of 76 tales, tracking them backward using language trees.

As they tracked, they found evidence that some tales were actually based in other stories. More than a quarter of the stories turned out to have ancient roots—Jack and the Beanstalk was traced back to the split between Western and Eastern Indo-European languages more than 5,000 years ago and a tale called The Smith and the Devil appears to be more than 6,000 years old.

The findings might confirm the long-disregarded theory of fairy tale writer Wilhelm Grimm, who thought that all Indo-European cultures shared common tales. But not everyone is certain that the study proves fairy tales are that old. As Chris Samoray writes for Science News, other folklorists are finding fault with the study's insistence that The Smith and the Devil dates back to the Bronze Age—a time before a word for "metalsmith" is thought to have existed.

Are the days of using historical records and written clues to learn more about a culture's oral history numbered? No way, says the research team. "Of course, this does not diminish the value of excavating the literary record for evidence about the origins and development of oral tales," they write. Translation: Researchers will still keep looking for the origins of fairy tales in books, too. In the meantime, it might be time to pick up that once-familiar storybook and dream about who told the same tales thousands of years ago.

http://www.bbc.com/news/health-35350450

Desert island toxic algae may hint to a treatment for dementia

Scientists say they now have good evidence in animals that exposure to a toxin from algae can trigger dementia-like changes in the brain.

By Michelle Roberts Health editor, BBC News online

If the US team is right, they may have found a new route towards treating and preventing neurodegenerative diseases such as Alzheimer's . Their work, in the Proceedings B journal, lends weight to a scientific theory experts have been chasing for decades.

The story began in the 1950s on a small Pacific Island called Guam. Many of the indigenous people who lived there - the Chamorros - were dying from a perplexing paralytic disease. US Army doctors described symptoms similar to dementia, Parkinson's and motor neuron disease.

Post-mortem examinations revealed abnormal collections of proteins in the brain that can also be seen in patients with Alzheimer's. Researchers began to look at the island environment and what the Chamorros were eating to see if there was any link. And a hypothesis began to emerge that an environmental toxin called BMAA could be to blame.

Beta-N-methylamino-L-alanine is made by bacteria found on and around the island. Experts identified it in algae-rich pools of water and in the roots and seeds of the native cycad palm trees. Fruit bats, known as flying foxes, a local delicacy, which feast on the cycad seeds, also harboured the toxin.

What was missing, until now, was experimental evidence that BMAA could trigger the telltale brain changes seen in the villagers.

So, Dr Paul Cox, from the Institute of Ethnomedicine, and colleagues from the University of Miami fed monkeys fruit laced with BMAA. After 140 days, they all had abnormal proteins (tangles) in the brain.The control monkeys, who received only regular fruit, had none of these brain changes.

Dr Cox repeated the experiment with more monkeys - 32 in total - and found the same. "Every single one that had eaten the BMAA bananas developed the brain

tangles," he said, "even the cohort given low-dose BMAA." "If what we found in these animals holds up in man, then it means a few things. "We need to protect people from this toxin. "We have to get very serious about clean water supplies.

"And it may be possible to prevent some other neurodegenerative diseases."

Dr Cox has been focusing on motor neuron disease - a progressive condition that attacks the nerves. Working with Dr Ken Rodgers and Dr Rachael Dunlop in Sydney, his team has found BMAA mimics an amino acid called L-serine and inserts itself into brain proteins, causing them to misfold and tangle.

And clinical trials are testing whether giving patients L-serine tablets might prevent this.

"We do not know if it will work, but we really hope so," Dr Cox said.

Dr Laura Phipps, from Alzheimer's Research UK, said: "This research in animals suggests that BMAA exposure could directly lead to hallmark features of neurodegenerative disease, providing new insight into the likely cause of this condition on Guam.

"While investigating rare forms of dementia can lead to insights into the more common causes of the condition, further research is needed to understand whether the findings have relevance to diseases like Alzheimer's or motor neurone disease in other parts of the world.

"The research suggests that L-serine could reduce the build-up of toxic proteins in the brain associated with high levels of BMAA exposure.

"There are early stage clinical trials for L-serine in motor neuron disease, and similar trials would be needed to explore whether L-serine could have any benefit for typical forms of Alzheimer's, not associated with the toxin.

"There is currently no evidence to suggest that taking L-serine supplements could help improve symptoms in Alzheimer's disease."

Most cases of Alzheimer's are caused by a mix of age, genetic and lifestyle factors. The risk can be cut by:

not smoking
keeping blood pressure in check
getting enough exercise
eating a healthy and balanced diet

http://www.eurekalert.org/pub_releases/2016-01/uom-nsz012016.php

New study zeros in on plate tectonics' start date

Analysis of trace elements places the onset of plate tectonics about 3 billion years ago

Earth has some special features that set it apart from its close cousins in the solar system, including large oceans of liquid water and a rich atmosphere with just the right ingredients to support life as we know it. Earth is also the only planet that has an active outer layer made of large tectonic plates that grind together and dip beneath each other, giving rise to mountains, volcanoes, earthquakes and large continents of land.

Geologists have long debated when these processes, collectively known as plate tectonics, first got underway. Some scientists propose that the process began as early as 4.5 billion years ago, shortly after Earth's formation. Others suggest a much more recent start within the last 800 million years. A study from the University of Maryland provides new geochemical evidence for a middle ground between these two extremes: An analysis of trace element ratios that correlate to magnesium content suggests that plate tectonics began about 3 billion years ago. The results appear in the January 22, 2016 issue of the journal Science.

"By linking crustal composition and plate tectonics, we have provided first-order geochemical evidence for the onset of plate tectonics, which is a fundamental Earth science question," said Ming Tang, a graduate student in geology at UMD and lead author of the study. "Because plate tectonics is necessary for the building of continents, this work also represents a further step in understanding when and how Earth's continents formed."

The study zeros in on one key characteristic of Earth's crust that sets it apart geochemically from other terrestrial planets in the solar system. Compared with Mars, Mercury, Venus and even our own moon, Earth's continental crust contains less magnesium. Early in its history, however, Earth's crust more closely resembled its cousins, with a higher proportion of magnesium.

At some point, Earth's crust evolved to contain more granite, a magnesium-poor rock that forms the basis of Earth's continents. Many geoscientists agree that the start of plate tectonics drove this transition by dragging water underneath the crust, which is a necessary step to make granite.

"You can't have continents without granite, and you can't have granite without taking water deep into the Earth," said Roberta Rudnick, former chair of the Department of Geology at UMD and senior author on the study. Rudnick, who is now a professor of earth sciences at the University of California, Santa Barbara, conducted this research while at UMD. "So at some point plate tectonics began and started bringing lots of water down into the mantle. The big question is when did that happen?"

A logical approach would be to look at the magnesium content in ancient rocks formed across a wide span of time, to determine when this transition toward low-magnesium crustal rocks began. However, this has proven difficult because the direct evidence--magnesium--has a pesky habit of washing away into the ocean once rocks are exposed to the surface.

Tang, Rudnick and Kang Chen, a graduate student at China University of Geosciences on a one and a half-year research visit to UMD, sidestepped this problem by looking at trace elements that are not soluble in water. These elements--nickel, cobalt, chromium and zinc--stay behind long after most of the magnesium has washed away. The researchers found that the ratios of these elements hold the key: higher ratios of nickel to cobalt and chromium to zinc both correlate to higher magnesium content in the original rock.

"To our knowledge, we are the first to discover this correlation and use this approach," Tang said. "Because the ratios of these trace elements correlate to magnesium, they serve as a very reliable 'fingerprint' of past magnesium content."

Tang and his coauthors compiled trace element data taken from a variety of ancient rocks that formed in the Archean eon, a time period between 4 and 2.5 billion years ago, and used it to determine the magnesium content in the rocks when they were first formed. They used these data to construct a computer model of the early Earth's geochemical composition. This model accounted for how magnesium (specifically, magnesium oxide) content in the crust changed over time.

The results suggest that 3 billion years ago, the Earth's crust had roughly 11 percent magnesium oxide by weight. Within a half billion years, that number had dropped to about 4 percent, which is very close to the 2 or 3 percent magnesium oxide seen in today's crust. This suggested that plate tectonics began about 3 billion years ago, giving rise to the continents we see today.

"It's really kind of a radical idea, to suggest that continental crust in Archean had that much magnesium," said Rudnick, pointing out that Tang was the first to work out the correlation between trace element ratios and magnesium. "Ming's discovery is powerful because he found that trace insoluble elements correlate with a major element, allowing us to address a long-standing question in Earth history."

"Because the evolution of continental crust is linked to many major geological processes on Earth, this work may provide a basis for a variety of future studies of Earth history," Tang said. "For example, weathering of this magnesium-rich crust may have affected the chemistry of the ancient ocean, where life on Earth evolved. As for the onset of plate tectonics, I don't think this study will close the argument, but it certainly adds a compelling new dimension to the discussion."

The research paper, "Archean upper crust transition from mafic to felsic marks the onset of plate tectonics," Ming Tang, Kang Chen and Roberta Rudnick, was published in the January 22, 2016 issue of the journal Science.

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http://www.eurekalert.org/pub_releases/2016-01/cfb-ssd012016.php

Stop spoon dosing

Changing dosing instructions from teaspoon to milliliter could reduce the risk of dosage errors by 50 percent

You grab for the cough syrup for some relief from that nasty lingering cold, what do you measure the dose with? Many of us use teaspoons or table spoons to measure out doses for ourselves and our children but this results in dosage errors! This new study finds that errors in estimating doses can be mitigated by changing the serving measurements on the dosage facts panel from teaspoons to milliliters.

A previous study by authors Koert van Ittersum, PhD at the University of Groningen (The Netherlands) and Brian Wansink, PhD of Cornell University found that when individuals use teaspoons to measure medicine they tend to under-serve by 8.4% and when using table spoons they over-serve by 11.6%.

For this study, Van Ittersum and Wansink proposed that by writing the Drug Facts and dosage information in milliliters, which are more difficult to estimate visually, people would choose more accurate measuring devices to measure out doses and would be less likely to make dosage errors.

Many of us use teaspoons or table spoons to measure out doses for ourselves and our children but this results in dosage errors! This new study finds that errors in estimating doses can be mitigated by changing the serving measurements on the dosage facts panel from teaspoons to milliliters. **Patricia Natalie, Cornell Food and Brand Lab**

Of the 177 young adults that participated in this study, 34.5% reported using kitchen spoons most frequently to measure medicine. The researchers found that when these study participants were given dosage information in teaspoons 60.9% chose a teaspoon to measure with while none of them chose the milliliter measuring cup. However, when the dosage recommendation was given in

milliliters the teaspoon and the measuring cup were equally popular among this group. These results indicate that the risk of dosage error decreases by around 50% by simply changing the recommended units of measurement from tea spoons to milliliters.

"When measuring medicine for ourselves or our children, we often use regular kitchen spoons but they are not accurate measuring instruments," explains lead author Koert van Ittersum, "While we feel that we can estimate teaspoon doses, milliliters are much harder to estimate visually, therefore people are more likely to use accurate measuring spoons or cups when given dosage information in milliliters." In conclusion, the authors recommend that the US Food and Drug Administration mandates that the pharmaceutical industry not use teaspoons on Drug Facts and dosing information. They also emphasize the importance of not spoon-dosing at home, instead using the measuring cups that typically come with liquid medicine.

http://www.eurekalert.org/pub_releases/2016-01/aeco-sel012016.php

Study examines link between HPV and risk of head and neck cancers

Those with detectable HPV-16 are 22 times more likely to develop a type of head and neck cancer

Researchers at Albert Einstein College of Medicine have found that when human papillomavirus (HPV)-16 is detected in peoples' mouths, they are 22 times more likely than those without HPV-16 to develop a type of head and neck cancer. The study was published online today in JAMA Oncology and was led by Ilir Agalliu, M.D., Sc.D., and Robert D. Burk, M.D.

HPV-16 is a well-known cause of head and neck cancers. A rising proportion of these cancers are oropharyngeal cancers (cancers of the middle part of the throat including the soft palate, the base of the tongue and the tonsils).

This study is the first to demonstrate conclusively that HPV-16's presence in the oral cavity precedes the development of oropharyngeal cancers. (HPV-16 is also responsible for the majority of cervical cancers.) Other studies indicate that detection of HPV in the oral cavity is related to sexual behavior.

The Einstein study involved nearly 97,000 people taking part in two large, national prospective studies. At the start of the studies, participants provided mouthwash samples and were cancer-free. A total of 132 cases of head and neck cancer were identified during an average of nearly four years of follow-up. The study also included a comparison group of 396 healthy subjects (controls), i.e., three controls for each case. Mouthwashes samples for head-and-neck cancer cases and for the controls were analyzed for the presence of several types of oral HPVs.

People with HPV-16 in their mouthwash samples were 22 times more likely to develop oropharyngeal cancer than were study participants with no detectable HPV-16 in their samples, the researchers found. In addition, the researchers found for the first time that the presence of other types of oral HPVs--beta- and gamma-HPVs, which are usually detected in the skin--was also associated with the development of head and neck cancers, indicating a broader role for HPVs in causing these cancers than has been recognized to date. This study shows that using easily collected oral mouthwash samples may help in predicting people's risk for developing head and neck cancers.

Dr. Agalliu is assistant professor of epidemiology and population health and Dr. Burk is professor of pediatrics, of microbiology & immunology, of obstetrics & gynecology and women's health and of epidemiology & population health at Einstein and attending physician, pediatrics at Montefiore Health System. Drs. Agalliu and Burk are also members of the NCI-designated Albert Einstein Cancer Center's Cancer Epidemiology program.

The study is titled "Associations of Oral Alpha, Beta, and Gamma Human Papillomavirus Types With Risk of Incident Head and Neck Cancer." In addition to Drs. Agalliu and Burk, other Einstein authors are Tao Wang, Ph.D., and Zigui Chen, Ph.D. Additional authors are Susan Gapstur, Ph.D., Rebecca L. Anderson, M.P.H., and Lauren Teras, Ph.D., at the American Cancer Society, Atlanta, GA; Aimee R. Kreimer, Ph.D. and Neal D. Freedman, Ph.D. at the National Cancer Institute, National Institutes of Health, Bethesda, MD; and Richard B. Hayes, Ph.D., at New York University, New York.

This study was supported by public funds through a grant to Drs. Agalliu and Burk from the National Institutes of Health (R21-CA152785-2 and P30-CA013330). The authors report no conflicts of interest.

http://www.eurekalert.org/pub_releases/2016-01/cp-gtc011516.php

Glowing tumors could help surgeons cut out cancer

Optical probes meant to improve tumor removal, could be a common procedure in the next 5-10 years

A breast cancer patient is wheeled into the operating room. She is connected to an IV that sends dye molecules into her blood that travel to her tumors. The surgeon inserts a small camera into the patient's chest and her breast tissue appears on a nearby monitor. The cancer cells are glowing a bright green.

Such optical probes, which are meant to improve tumor removal, are already in phase I and phase II clinical trials in humans and could be a common procedure in the next 5-10 years.

A review of their progress is published January 21 in the premier issue of Cell Chemical Biology, previously known as Chemistry & Biology.

Fluorescence detection is already in use during surgery. Surgeons can use instruments to detect dyes in the blood that make the blood glow. This is meant to help surgical teams find blood vessels or detect successful perfusion of tissues during transplant.

In addition to the non-targeted dye to detect blood flow, there has been a revolution in the development of chemical dyes that can bind to specific cancer cells over the past two decades. This has led to quite a variety in how such reporters bind, the cell types they bind to, and the light the reporters emit.

"It's a field that's up and coming really fast right now," says biochemist Matthew Bogyo, senior author on the review. "Most people have no idea this stuff can be done, its sounds like science fiction, but we're less than a decade away from this becoming standard practice."

Molecular imaging is a major focus of Bogyo's lab at the Stanford University School of Medicine. Since 2003, he and his team have been working on chemical agents that can target enzymes (proteases) that are specifically secreted by cancer cells.

The light that these optical probes emit can then be picked up by cameras that can see light that penetrates through skin and tissues. In 2008, Bogyo co-founded a company, Akrotome Imaging, to help translate some of his lab's discoveries into the clinic.

From Bogyo's perspective, some of the barriers to moving this early stage research along faster are the costs to funding larger phase II and III clinical trials, as well as questions around what the regulatory path will be like. Another unknown is whether these fluorescent dyes will work for all types of tumors.

"Ideally, we'd like a silver bullet that can light up any lesions that you want to remove," Bogyo says.

"The proteases my lab works on tend to be involved in any kind of inflammatory process, but other agents are more specific--say, looking at markers only upregulated in prostate cancer."

However they work, having precise optical probes for cancer working in the operating room is predicted to help in two ways: by cutting the cost of having to do repeat tumor removal surgeries because more surgeries will be successful the first time, and most importantly, by helping improve patient outcomes.

This work was funded by the National Institutes of Health, the Stanford Medical Scientist Training Program, and by a National Science Foundation Graduate Research Fellowship.

Cell Chemical Biology, Garland et al.: "A Bright Future for Precision Medicine: Advances in Fluorescent Chemical Probe Design and Their Clinical Application" http://dx.doi.org/10.1016/j.chembiol.2015.12.003

http://www.eurekalert.org/pub_releases/2016-01/cp-hso011516.php

Hunting secrets of the Venus flytrap (hint: they can count)

Close examination of how the plants decide when to keep their traps shut and begin producing their acidic, prey-decomposing cocktail of enzymes

VIDEO

Carnivorous plants such as the Venus flytrap depend on meals of insects to survive in nutrient-poor soil. They sense the arrival of juicy insects, lured by the plants' fruity scent, with the aid of sensitive trigger hairs on the inner surfaces of their traps. Now, researchers reporting in the Cell Press journal Current Biology on January 21 have looked more closely at exactly how the plants decide when to keep their traps shut and begin producing their acidic, prey-decomposing cocktail of enzymes. The short answer is: they count.

"The carnivorous plant Dionaea muscipula, also known as Venus flytrap, can count how often it has been touched by an insect visiting its capture organ in order to trap and consume the animal prey," says Rainer Hedrich of Universität Würzburg in Germany.

To find out whether Venus flytraps record touches, in the new study Hedrich and his colleagues fooled the plants into thinking they'd landed an insect by applying increasing numbers of mechano-electric stimuli to their trap and monitoring their responses. The studies show that a single touch to the trigger hair is enough to generate a response, setting the trap into a "ready-to-go" mode. In other words, the plants make note but don't snap just yet. It might be a false alarm, after all.

With the second stroke, the trap closes around the prey to form what Hedrich and his colleagues liken to a green stomach. As the prey attempt to escape, they wind up touching the mechano-sensitive trigger hairs again and again, which serves only to excite the plant further.

At this stage, the plant begins to produce a special touch hormone. After five triggers, glands on the inner surface of the trap also produce digestive enzymes and transporters to take up nutrients. Hedrich calls it a "deadly spiral of capture and disintegration." This input also allows the plant to scale its production of costly ingredients to the size of the meal.

"The number of action potentials informs [the plant] about the size and nutrient content of the struggling prey," Hedrich said. "This allows the Venus flytrap to balance the cost and benefit of hunting."

Interestingly, the plants show a particularly marked increase in production of a transporter that allows them to take up sodium. It's not clear exactly what the salt does for the plant, but the researchers suggest that it may have something to do with how Venus flytraps maintain the right balance of water inside their cell walls.

Hedrich and his colleagues are now sequencing the Venus flytrap genome. In those sequences, they expect to find additional clues about the plants' sensory systems and chemistry needed to support a carnivorous lifestyle and how those traits have evolved over time.

This work was supported by the European Research Council; MINECO; the International Research Group Program; the Deanship of Scientific Research, King Saud University; the Australian Research Council; and the Grain Research and Development Corporation.

Current Biology, Böhm and Scherzer et al.: "The Venus Flytrap Dionaea muscipula Counts Prey-Induced Action Potentials to Induce Sodium Uptake"

http://dx.doi.org/10.1016/j.cub.2015.11.057

http://www.eurekalert.org/pub_releases/2016-01/anu-taa012116.php

The aliens are silent because they're dead

Life on other planets would probably go extinct soon after its origin, due to runaway heating or cooling on their fledgling planets

Life on other planets would likely be brief and become extinct very quickly, say astrobiologists from The Australian National University (ANU).

In research aiming to understand how life might develop, the scientists realised new life would commonly die out due to runaway heating or cooling on their fledgling planets.

"The universe is probably filled with habitable planets, so many scientists think it should be teeming with aliens," said Dr Aditya Chopra from the ANU Research School of Earth Sciences and lead author on the paper, which is published in Astrobiology.

"Early life is fragile, so we believe it rarely evolves quickly enough to survive."

"Most early planetary environments are unstable. To produce a habitable planet, life forms need to regulate greenhouse gases such as water and carbon dioxide to keep surface temperatures stable."

About four billion years ago Earth, Venus and Mars may have all been habitable. However, a billion years or so after formation, Venus turned into a hothouse and Mars froze into an icebox.

Early microbial life on Venus and Mars, if there was any, failed to stabilise the rapidly changing environment, said co-author Associate Professor Charley Lineweaver from the ANU Planetary Science Institute. "Life on Earth probably played a leading role in stabilising the planet's climate," he said.

Dr Chopra said their theory solved a puzzle.

"The mystery of why we haven't yet found signs of aliens may have less to do with the likelihood of the origin of life or intelligence and have more to do with the rarity of the rapid emergence of biological regulation of feedback cycles on planetary surfaces," he said.

Wet, rocky planets, with the ingredients and energy sources required for life seem to be ubiquitous, however, as physicist Enrico Fermi pointed out in 1950, no signs of surviving extra-terrestrial life have been found.

A plausible solution to Fermi's paradox, say the researchers, is near universal early extinction, which they have named the Gaian Bottleneck.

"One intriguing prediction of the Gaian Bottleneck model is that the vast majority of fossils in the universe will be from extinct microbial life, not from multicellular species such as dinosaurs or humanoids that take billions of years to evolve," said Associate Professor Lineweaver.

A copy of the paper can be downloaded at http://bit.ly/gaianbottleneck.

http://bit.ly/1Qnc87R

These Unusual American Ants Never Get Old

P. dentata ants are among the very few species to show no signs of deterioration as they age

By Marcus Woo

Almost everyone succumbs to the ravages of time. Once quick and strong, both body and mind eventually break down as aging takes its toll. Except, it seems, for at least one species of ant.

Pheidole dentata, a native of the southeastern U.S., isn't immortal. But scientists have found that it doesn't seem to show any signs of aging. Old worker ants can take care of infants, forage and attack prey just as well as the youngsters, and their brains appear just as sharp.

"We really get a picture that these ants—throughout much of the lifespan that we measured, which is probably longer than the lifespan under natural conditions—really don't decline," says Ysabel Giraldo, who studied the ants for her doctoral thesis at Boston University.

Such age-defying feats are rare in the animal kingdom. Naked mole rats can live for almost 30 years and stay spry for nearly their entire lives. They can still reproduce even when old, and they never get cancer. But the vast majority of animals deteriorate with age just like people do.

Like the naked mole rat, ants are social creatures that usually live in highly organized colonies. It's this social complexity that makes P. dentata useful for studying aging in people, says Giraldo, now at the California Institute of Technology. Humans are also highly social, a trait that has been connected to healthier aging. By contrast, most animal studies of aging use mice, worms or fruit flies, which all lead much more isolated lives.

"Maybe the social component could be important," she says. "This could be a really exciting system to understand the neurobiology of aging."

In the lab, P. dentata worker ants typically live for around 140 days. Giraldo focused on ants at four age ranges: 20 to 22 days, 45 to 47 days, 95 to 97 days and 120 to 122 days. Unlike previous studies, which only estimated how old the ants were, her work tracked the ants from the time the pupae became adults, so she knew their exact ages. Then she put them through a gamut of tests.

The researchers watched how well the ants took care of larvae, recording how often each ant attended, carried and fed the young. They compared how well 20-day-old and 95-day-old ants followed the telltale scent that the insects usually leave to mark a trail to food. They tested how ants responded to light and how active they were by counting how often ants in a small dish walked across a line. And they experimented with how ants react to live prey: a tethered fruit fly.

Giraldo expected the older ants to perform poorly in all these tasks. But the elderly insects were all good caretakers and trail-followers—the 95-day-old ants could track the scent even longer than their younger counterparts. They all responded to light well, and the older ants were more active. Ants of all ages attacked the poor fruit fly with the same level of aggressiveness, flaring their mandibles or pulling at the fly's legs.

Then the researchers compared the brains of 20-day-old and 95-day-old ants, identifying any cells that were on the verge of dying. They saw no major differences with age, nor was there any difference in the location of the dying cells, showing that age didn't seem to affect specific brain functions.

Ants and other insects have structures in their brains called mushroom bodies, which are important for processing information, learning and memory. The researchers also wanted to see if aging affects the density of synaptic complexes within these structures—regions where neurons come together. Again, the answer was no.

The old ants didn't experience any drop in serotonin or dopamine levels either, two brain chemicals whose decline often coincides with aging. In humans, for example, a decrease in serotonin has been linked to Alzheimer's disease.

This is the first time anyone has looked at both behavioral and neural changes in these ants with known ages, says Giraldo, who recently published the findings in the Proceedings of the Royal Society B. Scientists have looked at some similar aspects in bees, but the results were mixed—some studies showed age-related declines, which biologists call senescence, and others didn't.

As for P. dentata, no one expected them to remain so youthful.

"The apparent absence of senescence in these ants is very surprising," Gene E. Robinson, an entomologist at the University of Illinois at Urbana-Champaign, said in an email. "Theory predicts declines in performance that roughly track the lifespan."

For now, the study raises more questions than it answers, Giraldo says, including how P. dentata stays in such good shape.

Also, if the ants don't deteriorate with age, why do they die at all? Out in the wild, the ants probably don't live for a full 140 days thanks to predators, disease and just being in an environment that's much harsher than the comforts of the lab. The lucky ants that do live into their golden days may suffer a steep decline just before dying, Giraldo says, but she can't say for sure because her study wasn't designed to follow an ant's final moments.

"It will be important to extend these findings to other species of social insects," wrote Robinson, who's also the director of the Illinois Bee Research Facility. This ant might be unique, or it might represent a broader pattern among other social bugs with possible clues to the science of aging in larger animals.

Either way, it seems that for these ants, age really is just a number.

http://www.eurekalert.org/pub_releases/2016-01/ehs-teo012216.php

The effects of the Trans-Pacific Partnership on pharmaceutical innovation

Concerns and potential outcomes, including diminishing access to medicines for the underserved, discussed in a commentary in Research in Social and Administrative Pharmacy

Philadelphia, PA - The Trans-Pacific Partnership (TPP) is a multi-national trade agreement now being considered by 12 countries.

In an insightful commentary in Research in Social and Administrative Pharmacy (RSAP), the ramifications of major components of the agreement are discussed, especially those potentially impacting the worldwide pharmaceutical industry.

According to author Robert A. Freeman, PhD, of the Department of Pharmacy Practice and Administration at The University of Maryland Eastern Shore, Princess Anne, Maryland, USA, there are three main areas of controversy.

First, pharmaceutical prices will be driven up, with especially negative effects on low-income countries.

Second, there is potential for litigation for individual countries whose policies might affect the financial health of large, multi-national pharmaceutical companies.

Finally, the multi-national pharmaceutical industry has an undue, protectionist influence in the negotiations, and its negotiation positions are at odds with public health.

Editor-in-Chief of RSAP, Shane P. Desselle, PhD, of Touro University California College of Pharmacy, and Applied Pharmacy Solutions, adds, "The effect on drug

prices, particularly generic drugs, will diminish access to essential medications among underserved populations in developing nations."

With regard to the pricing issue, Professor Freeman discusses the industry-wide form of price discrimination, known as Ramsey pricing, in which prices are set on the basis of a market segment's or country's wiliness and ability to pay.

The concern is that if the agreement forces a single price for all countries party to the agreement, this price may well be lower than is economically viable for pharmaceutical companies to maintain.

The litigation question, governed by the investor-state dispute settlement (ISDS) proposal in the TPP, is formulated differently than the World Trade Organization's normal procedures for anti-competitive practices resolution.

In the TPP, legal disputes would be tried before a court of private attorneys appointed by the World Bank or United Nations. It is feared that the suits could challenge national laws that violate free market principles outlined in the agreement.

The author claims that "The concern is very real; however, it may be overstated in that it is rare for a pharmaceutical company to litigate under current WTO provisions."

Further, Professor Freeman believes that the ISDS proposal may not survive as part of the TPP due to pressure from countries like Australia and New Zealand, which maintain low drug prices as a matter of national health policy.

The United States Trade Representative (USTR) is responsible for the U.S. position on the TPP, and the third concern is that the pharmaceutical industry has been able to exert undue influence in past trade negotiations.

The author relates his personal experience as an industry trade association consultant during WTO negotiations, and suggests that the priorities of the USTR are constantly changing, and different industries find themselves in- and out-of-favor at different times.

Although trade policies are often ignored when studying pricing, national financing schemes and comparative health systems, the author suggests that the TPP could affect drug counterfeiting activities, could imperil Australia's and New Zealand's national drug policies, and might significantly affect the profitability of the biologic drug industry.

Professor Freeman concludes with a caution. "While impact of the TPP on public health status in the member states is a valid public policy concern, it should be noted that trade agreements such as the TPP are not concerned with these outcomes, and that it is unrealistic to expect they will be an overriding consideration in the final agreement."

http://www.eurekalert.org/pub_releases/2016-01/luhs-mc012216.php

Most cases of brain-damaged newborns not due to mismanaged deliveries

A study by researchers at Loyola University Medical Center and Loyola University Chicago is providing new evidence that the vast majority of babies who are born with severe brain damage are not the result of mismanaged deliveries.

MAYWOOD, Ill. - Lead author Jonathan Muraskas, MD, and colleagues examined the medical records of 32 full-term infants who developed severe cerebral palsy and mental retardation. The records indicate that this brain damage occurred after the babies were born, and despite proper resuscitation.

The study is published in the Journal of Perinatology

"All too often in cases of professional liability, the focus is on the last two hours of a normal 7,000-hour term pregnancy," Dr. Muraskas and colleagues wrote. "This study would support closer scrutiny of the first two hours [following birth] as a possible [cause] for non-preventable adverse neurological outcomes in newborns." Dr. Muraskas is co-medical director of Loyola's neonatal intensive care unit and a professor in the Department of Pediatrics of Loyola University Chicago Stritch School of Medicine.

Out of every 1,000 full-term newborns, between one and three infants experience encephalopathy (disease in the brain), marked by impaired level of consciousness, seizures, difficulty breathing and depressed reflexes. While studies have found that only 8 percent to 14.5 percent of such cases are due to inadequate blood supply to the brain during delivery, the syndrome remains a leading cause of allegations of mismanagement by obstetricians.

The cases Dr. Muraskas examined included 18 newborns with an infection called chorioamnionitis and 14 newborns with severe anemia.

Chorioamnionitis occurs when bacteria infect the membranes that surround the fetus and the amniotic fluid in which the fetus floats. Anemia is due to an insufficient amount of blood in the baby after birth. Both conditions are difficult to detect prior to birth.

Medical records examined in the study showed that the gases in the umbilical cord blood of these newborns were normal, and there was little injury to the brains' deep gray matter. These and other indicators strongly suggest that the babies had not suffered brain damage before birth.

But once the babies were born, they were unable to cope on their own with the devastating effects of their infections or anemia. For example, babies infected by chorioamnionitis developed sepsis, an overwhelming immune response to

infection that can cause tissue damage and organ failure. Severe cases of chorioamnionitis and anemia can impede delivery of oxygen to the brain and other vital organs. In such cases, even the best resuscitation efforts are unable to prevent severe brain damage, Dr. Muraskas said. Despite appropriate obstetrical and pediatric-neonatal management, the presence of chorioamnionitis or fetal anemia can result in "devastating outcomes," Dr. Muraskas and colleagues wrote.

The study is titled 'The role of fetal inflammatory response syndrome and fetal anemia in nonpreventable term neonatal encephalopathy.'

Co-authors of the study are A.F. Kelly, MS Nash, Jean Goodman, MD, all of Loyola; and JC Morrison of the University of Mississippi Medical Center.

http://www.eurekalert.org/pub_releases/2016-01/uoc--zsn012116.php

Zebra stripes not for camouflage, new study finds

If you've always thought of a zebra's stripes as offering some type of camouflaging protection against predators, it's time to think again, suggest scientists at the University of Calgary and UC Davis.

"The most longstanding hypothesis for zebra striping is crypsis, or camouflaging, but until now the question has always been framed through human eyes," said the study's lead author Amanda Melin, an assistant professor of biological anthropology at the University of Calgary, Canada. Findings from their study will be published Friday, Jan. 22, 2016 in the journal PLOS ONE.

"We, instead, carried out a series of calculations through which we were able to estimate the distances at which lions and spotted hyenas, as well as zebras, can see zebra stripes under daylight, twilight, or during a moonless night.

Melin conducted the study with Tim Caro, a UC Davis professor of wildlife biology. In earlier studies, Caro and other colleagues have provided evidence suggesting that the zebra's stripes provide an evolutionary advantage by discouraging biting flies, which are natural pests of zebras.

A zebra grazing on the grassy plains gazes at the researchers' chart used for color-calibrating images. **Tim Caro/UC Davis**

In the new study, Melin, Caro and colleagues Donald Kline and Chihiro Hiramatsu found that stripes cannot be involved in allowing the zebras to blend in with the background of their environment or in breaking up the outline of the zebra, because at the point at which predators can see zebras stripes, they probably already have heard or smelled their zebra prey.

"The results from this new study provide no support at all for the idea that the zebra's stripes provide some type of anti-predator camouflaging effect," Caro said. "Instead, we reject this long-standing hypothesis that was debated by Charles Darwin and Alfred Russell Wallace."

New findings:

To test the hypothesis that stripes camouflage the zebras against the backdrop of their natural environment, the researchers passed digital images taken in the field in Tanzania through spatial and color filters that simulated how the zebras would appear to their main predators -- lions and spotted hyenas -- as well as to other zebras.

They also measured the stripes' widths and light contrast, or luminance, in order to estimate the maximum distance from which lions, spotted hyenas and zebras could detect stripes, using information about these animals' visual capabilities.

They found that beyond 50 meters (about 164 feet) in daylight or 30 meters (about 98 feet) at twilight, when most predators hunt, stripes can be seen by humans but are hard for zebra predators to distinguish. And on moonless nights, the stripes are particularly difficult for all species to distinguish beyond 9 meters (about 29 feet.) This suggests that the stripes don't provide camouflage in woodland areas, where it had earlier been theorized that black stripes mimicked tree trunks and white stripes blended in with shafts of light through the trees.

And in open, treeless habitats, where zebras tend to spend most of their time, the researchers found that lions could see the outline of striped zebras just as easily as they could see similar-sized, prey with fairly solid-colored hides, such as waterbuck and topi and the smaller impala. It had been earlier suggested that the striping might disrupt the outline of zebras on the plains, where they might otherwise be clearly visible to their predators.

Stripes also not for social purposes:

In addition to discrediting the camouflaging hypothesis, the study did not yield evidence suggesting that the striping provides some type of social advantage by allowing other zebras to recognize each other at a distance.

While zebras can see stripes over somewhat further distances than their predators can, the researchers also noted that other species of animals that are closely related to the zebra are highly social and able to recognize other individuals of their species, despite having no striping to distinguish them.

Collaborating with Melin and Caro were Donald W. Kline of the University of Calgary and Chihiro Hiramatsu of Kyushu University, Japan.

Funding for the study was provided by the Wenner Gren Foundation, the National Sciences and Research Council of Canada, the National Geographic Society and UC Davis.

http://bit.ly/1JwnKGa

Can Cannabis Treat Epileptic Seizures?

New evidence suggests that a chemical derived from marijuana may be an effective treatment for patients with drug-resistant forms of epilepsy

- **By Diana Kwon on January 22, 2016**

Charlotte Figi, an eight-year-old girl from Colorado with Dravet syndrome, a rare and debilitating form of epilepsy, came into the public eye in 2013 when news broke that medical marijuana was able to do what other drugs could not: dramatically reduce her seizures. Now, new scientific research provides evidence that cannabis may be an effective treatment for a third of epilepsy patients who, like Charlotte, have a treatment-resistant form of the disease.

Last month Orrin Devinsky, a neurologist at New York University Langone Medical Center, and his colleagues across multiple research centers published the results from the largest study to date of a cannabis-based drug for treatment-resistant epilepsy in *The Lancet Neurology*. The researchers treated 162 patients with an extract of 99 percent cannabidiol (CBD), a nonpsychoactive chemical in marijuana, and monitored them for 12 weeks. This treatment was given as an add-on to the patients' existing medications and the trial was open-label (everyone knew what they were getting).

The researchers reported the intervention reduced motor seizures at a rate similar to existing drugs (a median of 36.5 percent) and 2 percent of patients became completely seizure free. Additionally, 79 percent of patients reported adverse effects such as sleepiness, diarrhea and fatigue, although only 3 percent dropped out of the study due to adverse events. "I was a little surprised that the overall number of side effects was quite high but it seems like most of them were not enough that the patients had to come off the medication," says Kevin Chapman, a neurology and pediatric professor at the University of Colorado School of Medicine who was not involved in the study. "I think that [this study] provides some good data to show that it's relatively safe—the adverse effects were mostly mild and [although] there were serious adverse effects, it's always hard to know in such a refractory population whether that would have occurred anyway."

Stories of cannabis's abilities to alleviate seizures have been around for about 150 years but interest in medical marijuana has increased sharply in the last decade with the help of legalization campaigns. In particular, both patients and scientists have started to focus on the potential benefits of CBD, one of the main compounds in cannabis. Unlike tetrahydrocannabinol (THC), which is responsible for its euphoric effects, CBD does not cause a "high" or pose the same type of risks that researchers have identified for THC, such as addiction and cognitive impairment. Rather, studies have shown that it can act as an anticonvulsant and may even have antipsychotic effects.

The trial led by Devinsky is currently the most robust assessment of CBD's effect on epilepsy (prior studies included less than 20 patients) but many questions remain. In a subsequent commentary published this January, also in *The Lancet Neurology*, Kamil Detyniecki and Lawrence Hirsch, neurologists at the Yale University School of Medicine who were not involved in the research, outlined the study's major limitations, which include possible placebo effects and drug interactions.

Because the trial was open-label and without a control group, a main concern is the placebo effect, which previous studies have shown might be especially strong with marijuana-based products. For example, an earlier 2015 study carried out by Chapman and his group at the University of Colorado revealed that 47 percent of patients whose families had moved to Colorado for cannabis-based epilepsy treatment reported improvement, compared with 22 percent in people who already lived there.

The other major issue is the possibility of drug interactions—because CBD is a potent liver enzyme inhibitor it can increase the concentration of other drugs in the body. This means that when administered with other compounds, consequent effects on patients may be due to the increased exposure to those other drugs rather than the CBD itself.

Despite these limitations, both commentary authors agree the study is an important step in establishing CBD as a safe and effective epilepsy treatment. "This is a first step, and it's great," Detyniecki says. Despite the large number of adverse events, he says that overall "there were no surprising side effects—we can conclude that CBD appears to be safe in the short term."

Evidence suggesting that CBD is effective against treatment-resistant epilepsy may be growing but scientists still know very little about how it works—other than the likelihood that it is "completely different than any other seizure drug we know," as Devinsky puts it. That's a good thing, he notes: "One fear is that because of the way that the drugs are tested and screened, we've ended up with a lot of 'me-too' drugs that are all very similar."

Researchers, including those who were involved in the study published last December, hope to address these limitations in currently running blind and placebo-controlled clinical trials testing CBD on Dravet sufferers as well as Lennox–Gastaut syndrome, another drug-resistant form of epilepsy. In the meantime most clinicians and researchers, including those involved in the trial, advise "cautious optimism" when considering CBD as an epilepsy treatment.

“I think, based on the evidence that we have, if a child has tried multiple standard drugs and the epilepsy is still severe and impairing quality of life, then the risks of trying CBD are low to modest at best,” Devinksy says. “[But] I do feel it is critical for us as a scientific community to get [more] data.” Cannabis may be the much-needed treatment for a handful of people with epilepsy, but for now, patients should wait for scientists to clear the haze.

http://www.bbc.com/news/health-35381466

UK is 'vulnerable' to next Ebola outbreak

The UK is vulnerable to epidemics such as Ebola because of a gaping hole in the country's ability to manufacture vaccines, a group of MPs has warned.

By James Gallagher Health editor, BBC News website

The Science and Technology Committee said the UK "lacks the capacity" to produce enough to protect people. And they said the government's response to the Ebola outbreak was "undermined by systematic delay". More than 11,000 people died in West Africa since the start of the largest-ever outbreak of Ebola.

'Degraded' facilities

MPs praised the "heroic" efforts of the volunteers who often put their own lives on the line to tackle the epidemic. But their report warned: "We are also concerned that, in the unlikely but possible event of a domestic outbreak, the UK lacks the capability to go further and manufacture enough vaccines to vaccinate UK citizens in an emergency. "Existing facilities are degraded and new plants will take years to build, leaving the UK in a vulnerable position."

The concern is that should a disease such as Ebola spread around the world then countries would look after their own interests first, making it hard for the UK to get hold of vaccines. Those concerns were echoed by the chief medical officer, Prof Dame Sally Davies, who told the committee that "we are looking at how we can try and attract companies back".

Whereas Prof Adrian Hill, who was involved in trialling Ebola vaccines at Oxford University, described the lack of vaccine manufacturing as a "national security issue".

Slow and confusing

The report also said "delays were evident at every stage of our response" to the crisis. It pointed to research suggesting 12,500 cases of Ebola would have been prevented if treatment centres were set up just one month earlier.

And there was again criticism of the decision to set up screening at UK airports, contrary to recommendations from the World Health Organization.

Nicola Blackwood, the chairwoman of the committee, said: "The UK response to Ebola - like the international one - was undermined by systematic delay.

"The government's emergency response procedures were triggered far too late in the day, Ebola test kits were developed and trialled, but not deployed, and the initial response was ad hoc and uncoordinated.

"A combination of hard work and chance prevented Ebola spreading further than it did, but a future epidemic may be less containable and spread within the UK as well as overseas. "We must take the opportunity now to ensure that the UK is not caught unprepared when the next disease emergency strikes. Lives can be lost for every day of delay."