http://www.eurekalert.org/pub_releases/2016-05/uoo-ror052516.php

Remains of rice and mung beans help solve a Madagascan mystery

The first archaeological evidence that settlers from South Asia are likely to have colonised the island over a thousand years ago

Researchers have helped solve one of the enduring mysteries of the ancient world: why the inhabitants of Madagascar speak Malagasy, a language otherwise unique to Southeast Asia and the Pacific - a region located at least 6,000 km away. An international research team has identified that ancient crop remains excavated from sites in Madagascar consist of Asian species like rice and mung beans. This is thought to be the first archaeological evidence that settlers from South Asia are likely to have colonised the island over a thousand years ago. The findings are published in the journal, Proceedings of the National Academy of Sciences.

Genetic research has confirmed that the inhabitants of Madagascar do indeed share close ancestry with Malaysians, Polynesians, and other speakers of what is classed the Austronesian language family. To date, archaeological research has identified human settlements in Madagascar that belong to the first millennium. There are also findings suggesting that Madagascar may have been occupied by hunter-gatherers who probably arrived from Africa by the first or second millennium. Until now, however, archaeological evidence of the Austronesian colonisation has been missing. The team were able to identify the species of nearly 2,500 ancient plant remains obtained from their excavations at 18 ancient settlement sites in Madagascar, on neighbouring islands and on the eastern African coast. They examined residues obtained from sediments in the archaeological layers, using a system of sieves and water. They looked at whether the earliest crops grown on the sites were African crops or were crops introduced to Africa from elsewhere. They found both types, but noted a distinct pattern, with African crops primarily concentrated on the mainland and the islands closest to the mainland. In Madagascar, in contrast, early subsistence focused on Asian crops. The data suggested an introduction of these crops, both to Madagascar and the neighbouring Comoros Islands, by the 8th and 10th century.

Senior author Dr Nicole Boivin, from the School of Archaeology at the University of Oxford and Director of the Department of Archaeology at the Max Planck Institute for the Science of Human History, said: 'Southeast Asians clearly brought crops from their homeland and grew and subsisted on them when they reached Africa. This means that archaeologists can use crop remains as evidence to provide real material insights into the history of the island. There are a lot of things we still don't understand about Madagascar's past; it remains one of our big enigmas. But what is exciting is that we finally have a way of providing a window into the island's highly mysterious Southeast Asian settlement and distinguishing it from settlements by mainland Africans that we know also happened.'

The analyses also suggest that Southeast Asians colonised not only Madagascar but also the nearby islands of the Comoros, because again the crops that grew there were dominated by the same Asian species. By contrast, crops identified on the eastern African coast and near coastal islands like Mafia and Zanzibar were mainly African species like sorghum, pearl millet and baobab.

Commenting on the Southeast Asian influence in the Comoros, study lead author Dr Alison Crowther, from the University of Queensland, Australia, said: 'This took us by surprise. After all, people in the Comoros speak African languages and they don't look like they have Southeast Asian ancestry in the way that populations on Madagascar do. What was amazing to us was the stark contrast that emerged between the crops on the Eastern African coast and the offshore islands versus those on Madagascar, but also the Comoros.'

Dr Boivin added: 'When we started looking more closely into research that has been carried out on Comorian languages, we were able to find numerous esteemed linguists who had argued for the exact thing we seemed to seeing in the Comorian archaeological record: a settlement by people from Southeast Asia. So we've been able to not only to show for the first time an archaeological signature of Austronesians, we've also shown that it seems to extend beyond Madagascar. This is really exciting, and highlights how much we still have to learn about this fascinating migration.'

The paper, 'Ancient crops provide first archaeological signature of the westward Austronesian expansion', is published in the journal PNAS (Proceedings of the National Academy of Sciences) and embargoed until Monday 30 May, at 3pm US Eastern Time.

Funding was provided by the European Research Council (SEALINKS project); British Academy (Postdoctoral Grant); Natural Environment Research Council; and the (Oxford University) Fell Fund.

http://www.livescience.com/54912-did-t-rex-have-lips.html

T. Rex May Have Had Lips

T. rex may have had lips. Yes, you read that right. Lips.

By Mindy Weisberger, Senior Writer | May 31, 2016 06:13am ET

Robert Reisz, a paleontologist at the University of Toronto, is challenging the long-standing image of meat-eating theropod dinosaurs such as T. rex. Specifically, Reisz suggests that theropods' teeth were not bared all the time, extending outside their mouths and fully visible whether their jaws were open or closed. Rather, these teeth were kept hidden, covered by scaly lips, he said in a

presentation May 20 at the Canadian Society of Vertebrate Paleontology's annual meeting in Ontario.

Reisz told Live Science in an email that he had always been bothered by the typical "permanent smile" portrayal of theropod dinosaur teeth. He first looked to the closest living relatives of theropod dinosaurs — crocodiles — for clues about tooth exposure.

At first glance, it could seem like the expectation for large theropods to have exposed teeth was on the right track. Crocodiles' teeth are covered by gums for about one-quarter of their length, but lips are absent and the tooth crowns are permanently exposed, Reisz explained. However, if you look closer at tooth structure, a different story might emerge, he noted in his presentation.

The hard enamel of animals' teeth has low water content, and is typically kept hydrated by saliva. Without lips to keep moisture in and prevent the teeth from drying out, the tough enamel would become brittle and more prone to damage and wear, Reisz told Live Science.

Crocodiles live in watery environments and would rely on their habitat to keep exposed teeth hydrated. But land-dwelling theropods' large teeth — which are known to have enamel — could have been compromised by perpetual exposure, and likely needed to be covered by lips in order to stay moist, Reisz said in the presentation.

What about elephants?

But crocodiles aren't the only animals with exposed teeth — elephants, for instance, have exposed teeth as well, and many extinct saber-toothed predators had very long canines that were also exposed when their mouths were closed. Wouldn't their teeth have been vulnerable to serious drying out, too?

Not necessarily. A mammal's tooth structure is actually quite different from a reptile's, said Zhijie Jack Tseng, a paleontologist who studies bite-force biomechanics in extinct carnivores at the American Museum of Natural History in New York City.

"Mammalian teeth are prismatic — they have a crisscrossing structure," Tseng told Live Science. He explained that when mammal teeth grow, the enamel emerges from the root area and "races outward in all directions," creating a 3D shape that may be better at keeping water inside.

In reptile teeth, the enamel grows in one direction, creating a different type of structure that may not retain water as effectively — potentially making their teeth more likely to chip or crack, Tseng suggested.

But for reptiles — and theropod dinosaurs — damaging or losing a tooth simply isn't as big a deal as it would be for a mammal, Tseng added. Mammals typically grow a set of baby teeth followed by a set of adult teeth, whereas reptiles — and likely many, if not all, dinosaurs — replace individual teeth throughout their lifetimes, scientists have found. "Each tooth — relatively speaking — doesn't have as much value to the animal as in mammals," Tseng said. "T. rex could chip a tooth or get one stuck in prey, and just replace it. Evolving protection for teeth is not a critical component of how they eat."

The dinos, they are a-changin'

Reisz suggested in a statement that people may be reluctant to abandon the terrifying but familiar image of a "ferocious-looking" T. rex with bared teeth.

But now more than ever, scientists are challenging traditional ideas about how dinosaurs may have looked and behaved. New fossil evidence, computer modeling and comparisons with living creatures are helping scientists to paint a clearer picture of these extinct animals, overturning many historic conceptions of their postures, gaits, skin coverings and colors.

Long gone are the days when dinosaurs were almost uniformly pictured as grayish-green, ponderous reptiles with scaly skin. Contrary to their portrayal in popular films, dinosaurs are now widely accepted by scientists as having been covered in feathers, possibly in a range of colors, much like the colorful plumage of modern birds, which are a living dinosaur lineage.

Is it really so far-fetched to suggest that T. rex's toothy grin should also be relegated to the past? Time — and further research — will tell, Reisz said.

http://bit.ly/1WuGISw

The perfect heists that involve stealing nothing at all

In February, two artists, Nora al-Badri and Jan Nikolai Nelles – claimed to have scanned the bust of Nefertiti in a German history museum using a handheld Kinect Sensor. They then posted the digital files online.

By Geoff Manaugh

Their goal, they said, was to free the statue from its imprisonment inside the walls of Berlin’s Neues Museum by enabling anyone with access to a 3D printer to make their own near-perfect replica – a Nefertiti for all.

Al-Badri and Nelles saw their caper as an act of cultural liberation. It was a gesture against what they believe to be a legacy of colonial theft and appropriation, in which the goods of one nation or culture – in this case, Egypt – ended up in the museums and storerooms of another.

But the stunt illustrated another possibility: the indirect heist. Instead of stealing the thing itself, you can just pilfer the set of parameters – the metadata – that define it.

Why steal the actual bust of Nefertiti when you can instead easily nab the measurements to fabricate a new one? You would not have the original but you

would have the peculiar wealth that comes with possessing a potentially infinite number of exact copies.

Al-Badri and Nelles were not the first to release scans of unique artwork into the world. For some time Cosmo Wenman has been scanning and releasing digital files of artefacts housed in the British Museum – such as the head of the horse of Selene, one of the Parthenon sculptures. Like Al-Badri and Nelles, Wenman sees what he does as setting free the world's art. He also sells 3D-printed copies of ancient artefacts online.

Queen Nefertiti, at Egyptian Museum and Papyrus Collection in the Neues Museum Berlin
Ulrich Baumgarten via Getty Images

Nora Al-Badri and Jan Nikolai Nelles

Digital larceny

Of course, metadata has always been a target. The world of industrial espionage is filled with such tales. Stealing the plans for a nuclear reactor, a classified weapon, or a new computer chip have long been lucrative pursuits. What is intriguing about this new phase in the history of digital larceny is that meta-thievery is easier than ever.

For example, it turns out that just the acoustics of an industrial printing facility present a security issue for manufacturers. Accurate audio recordings made during the 3D-printing process can be used to reverse-engineer the objects being printed, allowing 3D-printed objects to be reproduced elsewhere based on the stolen acoustic metadata.

In this scenario, all that's needed for a sophisticated theft of intellectual property is a smartphone left near a 3D-printer to record the sound it makes. The acoustic signature carries enough information about the precise movements of the printer's nozzle. The recording can then be used to reverse engineer the object being printed and recreate it elsewhere. Steal the metadata, and you steal the object.

White noise

The researcher behind this discovery, Mohammad Al Faruque, director of the advanced integrated cyber-physical systems lab at UC Irvine later suggested that one way to counteract this kind of IP theft would be to introduce random noise into the printing facility. Any objects reverse-engineered from the resulting, imprecise sound data would be inaccurate. Acting as a kind of acoustic watermark, this would help to mask the sound of the printer, rendering any audio recordings useless.

Hidden within Al Faruque's observation is a key to how to guard against such heists in the first place. Preventing accurate audio recordings, or thwarting the production of laser scans, will require rethinking the basic tenets of physical security. Rather than only preclude direct human contact with a valuable object, for example, museums and factories might also invest in new forms of defence, such as acoustic cloaking, thermal camouflage, and even reflective surfaces used for their disruptive effects against laser scanning equipment.

The security systems of the future will be aimed at scrambling an object's metadata, deliberately introducing glitches, missteps, and errors into any attempted reproduction. If you can dazzle the devices that are being used to record or scan a given object, then you can effectively protect that object from illicit duplication.

Of course, as the work of Wenman, Al-Badri and Nelles so provocatively suggests, there is good reason to pause before sealing our cultural artefacts behind otherwise invisible walls of white noise or laser-jamming effects. But for those of us with new products to hide or valuable factories to run, the challenge of true security just got a lot stranger.

http://www.eurekalert.org/pub_releases/2016-05/pcc-emm052816.php

Ever-changing moods may be toxic to the brain of bipolar patients

The blood of bipolar patients is toxic to brain cells and affects the connectivity ability of neurons, a new study shows

Bipolar disorder (BD) is a severe and complex mental illness with a strong genetic component that affects 2% of the world population. The disorder is characterized by episodes of mania and depression that may alternate throughout life and usually first occur in the early 20s.

Most recently, physicians have started to group patients as early or late-stage. Early-stage BD patients are classified as those who have had fewer episodes of either mania or depression whereas late-stage patients have had more episodes with more severe effects and are less likely to respond to treatment.

This classification between early- and late-stage BD patients has more to do with episode recurrence and severity than the length of time the patient has had the disease. BD diagnosis may be difficult to establish and may take up to 10 years from the first episode. There is no cure for BD but psychotherapy and prescription medication such as antipsychotics, mood stabilizers and benzodiazepines may alleviate symptoms.

The brain of bipolar patients shows changes such as reduction in volume and neuroprogression. The latter is a pathological version of an otherwise normal mechanism by which the brain re-writes its neuronal connections, a process that is associated to learning, memory and even recovery from brain damage. In bipolar patients, the process is associated with loss of neuron connections and clinical and neurocognitive deterioration.

A previous study has shown that the blood levels of several markers related to inflammation, oxidative stress and neurotrophins (proteins that promote neuron growth and survival) in BD patients are associated to recurrent mood episodes. For instance, the brain-derived neurotrophic factor (BDNF), a protein that promotes neuron growth and survival and helps establishing neuron connections, is lower in BD patients, as is the early-growth response 3 (EGR3), a protein associated to helping the brain cope with environmental changes such as stressful stimuli. Besides these alterations, another study has shown that abnormally low levels of chemokines (which are proteins that send signals to other cell components) have also been observed in the blood of BD patients. If these blood markers can be associated to the severity and frequency of mood episodes in BD patients, is it possible that they are also associated to changes observed in the brain of BD patients?

To answer this intriguing question, a group led by Fabio Klamt at the Laboratory of Cellular Biochemistry at the Federal University of Rio Grande do Sul (UFRGS), and Flávio Kapczinski at the Laboratory of Molecular Psychiatry at Clinics Hospital of Porto Alegre (HCPA), in Brazil, exposed differentiated neurons to blood serum from either healthy normal individuals or bipolar patients. The group then observed that neurons exposed to serum from bipolar patients had a significant loss in the density of neurites, which is used to estimate the number of neuron connections, if compared to neurite density of neurons exposed to serum from healthy individuals. Interestingly, when serum from early-stage and late-stage BD patients was analyzed separately, no difference in neurite density was observed between neurons exposed to serum from early-stage patients and those exposed to healthy controls' serum. However, a significant difference remained in the neurite density between neurons exposed to serum from late-stage patients and from early-stage patients or healthy controls. The group also found that the number of neurons was not that different between samples, except for those exposed to serum from patients at very late stages of the disease.

"Our results indicate that the blood of BD patients is toxic to brain cells and affects the connectivity ability of neurons. Considering our previous knowledge on the association between mood episodes and blood toxicity, we believe that the more episodes a patient has, the more cellular components are produced that impair the brain's ability to deal with environmental changes, inflammation and stress," says Klamt.

This is the first study to show the toxic effects of BD serum on human neuronal cells and to present an in vitro study model for a disease for which no animal model has been yet developed. Future studies should focus on finding drugs that can protect BD brain cells from the toxic effects of their own blood.

The first draft of the study entitled "Reduced Neurite Density in Neuronal Cell Cultures Exposed to Serum of Patients with Bipolar Disorder" is available at the link below at the website of the International Journal of Neuropsychopharmacology

http://ijnp.oxfordjournals.org/content/ijnp/early/2016/05/13/ijnp.pyw051.full.pdf

GRANT: National Council for Scientific and Technological Development-CNPq/MS/SCTIE/DECIT - Research on Neurodegenerative Diseases (#466989/2014-8)

http://www.eurekalert.org/pub_releases/2016-05/lu-tbp053116.php

Theft behind Planet 9 in our solar system

Through a computer-simulated study, astronomers at Lund University in Sweden show that it is highly likely that the so-called Planet 9 is an exoplanet.

This would make it the first exoplanet to be discovered inside our own solar system. The theory is that our sun, in its youth some 4.5 billion years ago, stole Planet 9 from its original star.

An extrasolar planet, or exoplanet, is by definition a planet located outside our solar system. Now it appears that this definition is no longer viable. According to astronomers in Lund, there is a lot to indicate that Planet 9 was captured by the young sun and has been a part of our solar system completely undetected ever since.

"It is almost ironic that while astronomers often find exoplanets hundreds of light years away in other solar systems, there's probably one hiding in our own backyard", says Alexander Mustill, astronomer at Lund University.

Stars are born in clusters and often pass by one another. It is during these encounters that a star can "steal" one or more planets in orbit around another star. This is probably what happened when our own sun captured Planet 9.

In a computer-simulated model, Alexander together with astronomers in Lund and Bordeaux has shown that Planet 9 was probably captured by the sun when coming in close contact while orbiting another star.

"Planet 9 may very well have been 'shoved' by other planets, and when it ended up in an orbit that was too wide around its own star, our sun may have taken the opportunity to steal and capture Planet 9 from its original star. When the sun later departed from the stellar cluster in which it was born, Planet 9 was stuck in an orbit around the sun", says Alexander Mustill.

"There is still no image of Planet 9, not even a point of light. We don't know if it is made up of rock, ice, or gas. All we know is that its mass is probably around ten times the mass of earth."

It requires a lot more research before it can be ascertained that Planet 9 is the first exoplanet in our solar system. If the theory is correct, Alexander Mustill believes that the study of space and the understanding of the sun and the Earth will take a giant leap forward.

"This is the only exoplanet that we, realistically, would be able to reach using a space probe", he says. The article is published in Monthly Notices of the Royal Astronomical Society Letters, (MNRAS Letters).

Article: Mustill A, et al (2016) Is there an exoplanet in the Solar System?
http://mnrasl.oxfordjournals.org/content/early/2016/04/26/mnrasl.slw075.abstract

http://www.eurekalert.org/pub_releases/2016-05/qi-aad053116.php

Ancient anti-inflammatory drug salicylic acid has cancer-fighting properties

Diflunisal -- a cousin of aspirin -- blocks a key protein that causes tumor formation in leukemia

Scientists from the Gladstone Institutes have identified a new pathway by which salicylic acid--a key compound in the nonsteroidal anti-inflammatory drugs aspirin and diflunisal--stops inflammation and cancer.

In a study published in eLife, the researchers found that both salicylic acid and diflunisal suppress two key proteins that help control gene expression throughout the body. These sister proteins, p300 and CREB-binding protein (CBP), are epigenetic regulators that control the levels of proteins that cause inflammation or are involved in cell growth. By inhibiting p300 and CBP, salicylic acid and diflunisal block the activation of these proteins and prevent cellular damage caused by inflammation. This study provides the first concrete demonstration that both p300 and CBP can be targeted by drugs and may have important clinical implications.

"Salicylic acid is one of the oldest drugs on the planet, dating back to the Egyptians and the Greeks, but we're still discovering new things about it," said senior author Eric Verdin, MD, associate director of the Gladstone Institute of Virology and Immunology. "Uncovering this pathway of inflammation that salicylic acid acts upon opens up a host of new clinical possibilities for these drugs."

Earlier research conducted in the laboratory of co-author Stephen D. Nimer, MD, director of Sylvester Comprehensive Cancer Center at the University of Miami Miller School of Medicine, and a collaborator of Verdin's, established a link between p300 and the leukemia-promoting protein AML1-ETO. In the current study, scientists at Gladstone and Sylvester worked together to test whether suppressing p300 with diflunisal would suppress leukemia growth in mice. As predicted, diflunisal stopped cancer progression and shrunk the tumors in the mouse model of leukemia.

"The ability to repurpose drugs that are already FDA-approved to be part of novel therapies for cancer patients is incredibly exciting," said Nimer. "We have conducted a clinical trial of salicylic acid in patients with hematologic cancers and found it to be safe. Thus, this collaborative effort to develop novel epigenetic therapies is an important next step in our journey to find more effective treatment for leukemia patients."

The scientists are now pursuing a clinical trial that will test the ability of salicylic acid to treat patients with leukemia as part of novel combination therapies. Other possible clinical applications for salicylic acid include other forms of cancer, type 2 diabetes, inflammatory diseases, and even neurodegenerative disorders, such as Alzheimer's disease. Prior Gladstone research showed that another drug containing salicylic acid prevented the accumulation of tau in neurons and protected against cognitive decline in a mouse model of dementia.

Other Gladstone scientists on the studies include first author Kotaro Shirakawa, Hyung Lim, Intelly Lee, Tadahiro Shimazu, John Newman, Sebastian Schroder, and Melanie Ott. Researchers from the University of Miami, University of Pennsylvania, and the National Cancer Institute also took part in the study.

http://bit.ly/1P9QZM8

Building Blocks of Life Found in Comet's Atmosphere

Amino acid and many organic molecules in the atmosphere of a comet bolsters hypothesis that comets delivered some of life's ingredients to Earth

By Sarah Lewin, Space.com Staff Writer

For the first time, scientists have directly detected a crucial amino acid and a rich selection of organic molecules in the dusty atmosphere of a comet, further bolstering the hypothesis that these icy objects delivered some of life's ingredients to Earth.

The amino acid glycine, along with some of its precursor organic molecules and the essential element phosphorus, were spotted in the cloud of gas and dust surrounding Comet 67P/Churyumov-Gerasimenko by the Rosetta spacecraft, which has been orbiting the comet since 2014. While glycine had previously been extracted from cometary dust samples that were brought to Earth by NASA's Stardust mission, this is the first time that the compound has been detected in space, naturally vaporized.

The discovery of those building blocks around a comet supports the idea that comets could have played an essential role in the development of life on early

Earth, researchers said. The two-part Rosetta spacecraft is designed to orbit and land on the Comet 67P/Churyumov-Gerasimenko in November 2014.

"With all the organics, amino acid and phosphorus, we can say that the comet really contains everything to produce life — except energy," said Kathrin Altwegg of the University of Bern in Switzerland, the principal investigator for the Rosetta mission's ROSINA instrument.

"Energy is completely missing on the comet, so on the comet you cannot form life," Altwegg told Space.com. "But once you have the comet in a warm place — let's say it drops into the ocean — then these molecules get free, they get mobile, they can react, and maybe that's how life starts."

Getting a glimpse

Glycine, one of the simplest amino acids, is usually bound up as a solid, which means it's difficult to detect from afar, Altwegg said.

While scientists have searched for glycine through telescopes in star-forming regions of the sky, the newly reported detection marks the first sighting of the compound in space. In this case, the orbiting Rosetta was close enough to pick up the glycine released by the comet's dust grains as they heated up in the sun.

The study is a powerful confirmation of earlier, earth-bound detections of life's building blocks in comet and meteor material.

"We know the Earth was pretty heavily bombarded both with asteroidal material and cometary material," said Michael A'Hearn, a comet researcher at the University of Maryland who was not involved in the new study.

"There have been various claims of amino acids in meteorites, but all of them have suffered from this problem of contamination on Earth. The Stardust [samples] — which are from a comet, not an asteroid — are probably the least susceptible to the terrestrial contamination problem, but even there the problem is severe," A'Hearn told Space.com. "I think they [Stardust] really did have glycine, but this is a much cleaner detection in many ways."

Cooking up life

Amino acids form the basis of proteins, which are complexly folded molecules that are critical to life on Earth. Altwegg's team searched for other amino acids around the comet as well, but located only glycine — the only one that can form without liquid water (as in the frigid reaches of space).

The glycine probably didn't form on the comet itself, Altwegg said, but rather in the broad stretches of dust and debris that made up the solar system before planetary bodies formed.

"The solar system was made out of material which formed in a disk, in a solar nebula," Altwegg said. "In these clouds, it's pretty cold, so the chemistry you do there is catalytic chemistry on the dust surfaces. And these very small dust grains [1 micron in size] are very good to lead to organic chemistry. This is also done in the lab." Earth itself was far too hot for similar delicate amino acids to survive its formation, Altwegg said; only the smallest solar system bodies stayed cold.

So glycine formed during that time could have provided a boost to newly forming life if it was delivered to Earth by comets.

"It's not that it couldn't have formed on Earth — it certainly could — it's just that it didn't have to," A'Hearn said. "Basically, the Earth got a head start."

Other, more complex amino acids require liquid water, and so would have likely formed on Earth itself, Altwegg said. This idea is supported by the fact that Rosetta has not identified any amino acids other than glycine near Comet 67P.

Phosphorus is also vital to life as we know it. Among other things, the element is a key constituent of DNA and adenosine triphosphate (ATP), a molecule that stores the chemical energy used by cells.

Rosetta is the first spacecraft to bring the right kind of instrument up close to a comet; future probes could examine other comets or even bring frozen samples back for analysis, to see how representative 67P is of comets in general.

But in the meantime, the team is still working on understanding all the organics they found and analyzing them further. "And I think the next step goes to the biochemists, how to make something meaningful out of this," Altwegg said.

The discovery is also significant to researchers trying to understand the conditions of the early solar system, when the comet's nucleus first came together, not to mention conditions when the early Earth was bombarded by similar comets.

"For astrobiology, it's a very important measurement," Altwegg said. "And it's not only life on Earth; the material in comets has been formed in a protostellar cloud, and what could have happened here in our protostellar cloud could have happened everywhere in the universe." "Then you can ask yourself the question: How many Earths are there, how many evolved life or re-evolved life?" she added.

The new work was detailed in the journal Science Advances May 27.

http://bit.ly/1srIpne

Orcas are first non-humans whose evolution is driven by culture

Ready to pounce?

By Colin Barras

You could call it a culture shock. Many researchers accept that cultural experiences have helped shape human evolution – and evidence has now emerged that the same may be true of killer whales.

Human genomes have evolved in response to our cultural behaviours: a classic example is the way that some human populations gained genes for lactose tolerance following the onset of dairy farming.

But whether genomes and culture co-evolve in other animal species has been unclear. Andrew Foote at the University of Bern, Switzerland, and his colleagues suspected that killer whales might follow a similar pattern to humans.

Cosmopolitan whales

Killer whales, like people, are widely dispersed from the tropics to the poles. But many populations seem to remain in a single area where they have carved out a specialised niche, hunting a particular target through a sophisticated hunting strategy. Some eat fish by herding them into bait balls, for instance, whereas others target mammals such as seals by deliberately stranding themselves on beaches where the seals live.

Read about: Orcas seen in unique group ambush-and-kill attack on dolphins

Individuals live in stable groups for several decades, so juveniles have plenty of opportunity to learn these specialisms from the adults – biologists use the term "culture" to describe the learning of such striking behaviours.

But are these cultural groups of killer whales genetically distinct from one another? To find out, Foote and his colleagues looked at the genomes of 50 killer whales from five niches – two in the Pacific Ocean and three in the Antarctic Ocean.

The genomes fell into five distinct groups that exactly mirrored the five cultural niches. Some genes that may have specific functions in diet, for example, seemed to have diverged between the different cultural groups.

In other words, even though killer whales shared a common ancestor as recently as 200,000 years ago, individual cultural groups have become genetically distinct – so killer whale genomes and culture have co-evolved.

Founding fathers

The evidence even helps to explain how killer whales have gained their genetic diversity. The genomes indicate that all five groups began when a small founding population – numbering perhaps a few tens or hundreds of individuals – invaded each new niche and then expanded. Whenever a species passes through this sort of population bottleneck, it can rapidly gain a unique genetic identity.

"We suspect that the [invasion] event and subsequent bottleneck occur first and then the behavioural flexibility allows the founder group to adapt to local conditions," says Foote.

When juveniles learn social behaviours from adults, it helps solidify the group identity and gradually reinforce its distinct genetic signature.

Essentially, a few individuals can colonise new habitats and ecological niches thanks to their behavioural flexibility. Group culture then transmits the know-how of surviving on new resources and sets the group on a separate evolutionary track.

"This is an extremely important piece of research," says Hal Whitehead at Dalhousie University in Halifax, Canada. "The results are fascinating. We now see how in killer whales, as in humans, culture is not only an important factor in the lives of the whales, but also [helps drive] genetic evolution."

"One of the main conclusions is that variation within killer whales, humans and likely many other species arises from multiple interacting processes rather than being attributed to just culture, ecology or genetics," says Foote.

But Whitehead is not sure that the co-evolution of genomes and culture will turn out to be a common feature throughout the animal kingdom. After all, killer whales and humans share a number of unusual features, including their intelligence, longevity and social natures – which work together to create an ideal environment for social learning that can strengthen group identity and reinforce genetic distinction. "In both," says Whitehead, "culture is in the driving seat."

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http://www.livescience.com/54924-gadget-turns-human-ashes-into-trees.html

New Gadget Helps Turn Departed Loved Ones into Trees

The Bios Incube is an incubator that monitors and cultivates trees from human ashes.

By Elizabeth Goldbaum, Live Science Contributor

Instead of keeping a departed loved one's ashes in an urn over the fireplace, why not breathe new life into them, in the form of a tree that can sit in your living room or outside on your porch? A new gadget helps you nurture life from ashes, and regardless of how green your thumbs are, it offers a way to keep loved ones close after they die.

The Bios Incube, created by the company Bios Urn, is an incubator that monitors and cultivates trees from human ashes in people's homes. The company says the invention allows people to return the deceased to life through nature, creating a living reminder of that person.

"When someone dies, they physically die, but the people who are around the deceased person still remember," said Roger Moliné, co-founder of Bios Urn.

The Bios Incube is a sleek, white plant pot that measures 2.5 feet (76 centimeters) tall and about 1 foot (33 cm) in diameter. The Bios Incube works with the Bios Urn, a biodegradable urn, and an accompanying mobile application. Although the Bios Urn has been available for more than a year, the Bios Incube is a new product designed for people who want to keep their trees close instead of planting them in a forest, Moliné told Live Science.

The Bios Urn is a relatively small cylindrical package with the seed and soil sitting on top of the ashes. The entire Bios Urn sits in the upper half of the Bios Incube and is supported from the bottom and around by soil. The Bios Urn is

made of paper, carbon and cellulose. Once it decomposes, the ashes mix with the soil and roots of the tree, Moliné said.

The outer circumference of the Bios Incube, separated from the soil by a barrier, is a water tank that holds up to 3 gallons (11.4 liters) of water. There is a water pump on the bottom of the Bios Incube and a sensor and sprinkler at the top. Water enters through a slot toward the rim of the Bios Incube, according to the company.

The sensor and sprinkler sit on top of the soil. The sensor monitors soil moisture, to make sure the tree gets the right amount of water; soil conductivity, to make sure the tree has enough fertilizer; and soil temperature, to make sure the soil maintains a consistent temperature, Moliné said. The sensor also monitors environmental conditions, such as sunlight exposure, temperature and humidity, he added.

The sensor is preprogramed to know what type of tree it is monitoring — for instance, whether it's a pine or maple. This means the device knows the exact moment the tree needs to be watered, Moliné said. Over- and under-watering are typically the main issues that affect tree growth, Moliné said, so the Bios Incube combines collected data from its sensors to determine when to water the tree. When the device detects dryness, the water pump automatically works to hydrate the soil. The Bios Incube's storage capacity of 3 gallons of water lasts 20 days on average, according to the company.

The sensor wirelessly transmits all its collected data through Wi-Fi to an application that can be accessed on a smartphone. The sensor can also use the internet to retrieve weather data to determine whether the plant should or should not be left outside, Moliné said, or whether a plant should be moved from one room to another.

The tree can stay in its pot or be planted in a forest, Moliné said. "If we keep a tree in a flower pot, the tree doesn't grow indefinitely," he said. If the tree is removed from the Bios Incubator and planted in the forest, the Bios Incube can be reused to plant another tree, Moliné said, even if the seed and soil don't come from the Bios Urn. The Bios Incube uses an ordinary soil mixture of coco peat, made from coconut husks, and vermiculite, a mineral used to retain water, the company said.

Bios Urn has received positive feedback from its users and the company maintains close relationships with its customers, Moliné said. The Bios Incube ran a Kickstarter campaign that raised more than $83,000, about $15,000 over their goal of $68,000, to market the Bios Incube. The Bios Incube is expected to ship out to early backers of the crowdfunding campaign in November, with the rest of the shipments estimated for March 2017.

http://bit.ly/1TO5WW6

Bumblebees Detect a Flower's Electric Buzz With Their Fuzz

Using the tiny hairs that cover their bodies, bees can tap into the weak electric field in the atmosphere

By Maya Wei-Haas

The vibrant colors of a field of flowers can certainly be called electric, but this description isn't just poetic—it's also literal. A flower’s delicate form generates a weak electric field. Now, a new study shows how bumblebees can sense that electric buzz, reports Nell Greenfieldboyce for NPR. The secret is in their fuzz.

"There is, all the time, a background electric field in the atmosphere," the lead scientist of the research team, Gregory Sutton, tells Greenfieldboyce. "Any plant that's connected to the ground will generate its own electric field just by interactions with the atmosphere."

In 2013, Sutton and his colleagues first showed that bees could sense these minute charges by using electrically charged fake flowers. But until now, scientists didn’t know how bees could do it, writes Chelsea Harvey for Mashable.

This latest research, published this week in the Proceedings of the National Academy of Sciences, points to bees' tiny hairs. Using a sensitive laser, the researchers measured the minute motion of a bee’s hairs and antennae when exposed to a weak electric field like those of the flowers. The results suggest that the hairs are much more sensitive than the antennae to electric fields. Though the electric field caused both to move, the hairs—lighter and thinner than antennae—were both faster to respond and showed greater movement.

The researchers also detected nerve cell activity in anesthetized bees by inserting itty bitty electrode wires at the base of the hairs and antennae. When the hairs start waving in the electric field, the neurons at the base of the hairs increased firing. This was not true for the antennae, reports Harvey.

The phenomenon is similar to what happens to human hair when you rub a balloon on someone’s head—the hair stands out towards the balloon, Sutton describes in a press release. But for the bumblebees, the feeling of these bending hairs could perhaps help them tell the difference between flower types, Sutton tells NPR.

Bees are not the only creatures that scientists have found are sensitive to these slight electric fields. Creatures like sharks and rays have electrosensory organs that contain a conductive jelly that can detect electrical changes in the water, reports Mo Costandi for The Guardian.

But since air does not conduct electricity, the ability was thought to largely be limited to denizens of the watery or wet environments, where the water could help convey the buzz.

"I'm very excited by this because these little mechanically-sensitive hairs are common all over the insect world," he tells Greenfieldboyce. "I think this might be something we see in more insects than just bumblebees."

Even so, the why of detecting these electric fields remain less clear, Robert Gegear, biologist at Worcester Polytechnic Institute, tells NPR. The superpower may not necessarily be related to collecting pollen, he notes. Bees could be even be detecting electric fields for navigation or communication.

As bee populations plummet, scientists are swarming to learn more about these insects. From robo-bees even to vibrators, researchers are combing through the techniques that bees use to get the job done. Bees are amazing little creatures, electric field sensing fuzz adds to their buzz.

http://bit.ly/20Y6VHG

Perfect Storm: Pregnant Woman Gets Appendicitis During Blizzard

Diagnosed with appendicitis in the middle of a blizzard, hundreds of miles away from the nearest surgical center

By Laura Geggel, Senior Writer | May 31, 2016 06:10pm ET

A pregnant woman in remote Greenland faced a scary medical emergency after doctors diagnosed her with appendicitis in the middle of a blizzard, hundreds of miles away from the nearest surgical center, according to a new case report.

The woman lived in the northwest of Greenland, and needed to travel to Ilulissat Hospital to have her appendix removed. **Purch Creative Ops**

The 32-year-old Greenlandic Inuit woman came to the local health center when she was 12 weeks pregnant, after experiencing abdominal pain, nausea and vomiting in September 2015. At first, doctors thought she had a stomach bug, because she had just eaten raw meat, according to the case report, published online May 18 in the journal BMJ Case Reports.

But soon, the woman's pain moved to her lower right abdomen, suggesting she had appendicitis, the doctors said. Moreover, she had a fever, an elevated white blood cell count and high levels of a protein called C-reactive protein, which increases during times of inflammation. All of these signs indicated that the woman's body was mounting an immune response, said report co-author Dr. Trine Jensen, an internist in the obstetrics and gynecology department at Herning Hospital in Denmark.

To make matters worse, the weather was horrible and the woman was in the wilds of northwest Greenland, in Qaanaaq, about 730 miles (1,173 kilometers) from Ilulissat, the city with the closest regional hospital, said Jensen, who was working at Ilulissat Hospital at the time, and treated the woman.

Appendicitis can lead to a perforated, or burst, appendix, Jensen said. Moreover, appendicitis during pregnancy can lead to preterm birth and even fetal loss, she said. The doctors wanted to remove the woman's appendix, but there was no way to get her to Ilulissat Hospital for the operation, Jensen said.

"It was pretty far," Jensen told Live Science. "There are no roads, you can't just take a car or an ambulance and drive. You need to take airplanes."

Blizzard treatment

Because surgery wasn't an immediate option, the doctors in Qaanaaq started the woman on antibiotics.

According to a study published in the June issue of the journal JAMA, antibiotics can be an effective treatment for appendicitis. Of the more than 250 people in the study who received antibiotics for their appendicitis, 70 patients (about 27 percent) went on to need surgery to remove their appendicitis within the next year, the researchers found.

However, the Greenlandic woman's health did not improve after she took the antibiotics. So, once the weather got better, she was flown to Ilulissat Hospital. There, the doctors did an abdominal ultrasound to confirm that she had appendicitis, and 64 hours after the episode started, they removed her appendix.

"She actually woke up and she was singing, 'I can keep my baby,'" Jensen said. "She was so happy."

The woman later had the baby without any compilations, and both are doing well now, the report's other co-author, Dr. Luit Penninga, the head of Ilulissat Hospital, told Jensen.

Even if the antibiotics had helped the woman, it's likely that the doctors would have still removed her appendix, Jensen said. That's because, as the JAMA study found, some people who receive antibiotics for appendicitis still need surgery within a year. With pregnant women, the longer doctors wait to do the surgery, the riskier it is, she said.

"It's easier to do the surgery while they're early in pregnancy, because when they get bigger and further along, it might be even harder to diagnose the appendicitis," Jensen said. "Because the womb is filling up the entire abdomen, and the appendix can move around."

The report is a good example of how doctors can treat pregnant women with appendicitis who don't have immediate access to surgery, said Dr. Robert Glatter, an emergency physician at Lenox Hill Hospital in New York City, who was not

involved in the case report. "Antibiotics present a reasonable option for treatment," Glatter told Live Science. "If you're in a remote situation, that's a reasonable first choice. But at this time, it's generally recommended to have the appendix out because of the risk to the fetus, as well as the mom."

http://www.eurekalert.org/pub_releases/2016-06/tqso-dfi060116.php

Dietary fiber intake tied to successful aging, research reveals

Most people know that a diet high in fiber helps to keep us "regular." Now Australian researchers have uncovered a surprising benefit of this often-undervalued dietary component.

A new paper -- published in The Journals of Gerontology, Series A: Biological Sciences and Medical Sciences by scientists from The Westmead Institute for Medical Research -- reports that eating the right amount of fiber from breads, cereals, and fruits can help us avoid disease and disability into old age.

Using data compiled from the Blue Mountains Eye Study, a benchmark population-based study that examined a cohort of more than 1,600 adults aged 50 years and older for long-term sensory loss risk factors and systemic diseases, the researchers explored the relationship between carbohydrate nutrition and healthy aging.

They found that out of all the factors they examined -- which included a person's total carbohydrate intake, total fiber intake, glycemic index, glycemic load, and sugar intake -- it was the fiber that made the biggest difference to what the researchers termed "successful aging."

Successful aging was defined as including an absence of disability, depressive symptoms, cognitive impairment, respiratory symptoms, and chronic diseases including cancer, coronary artery disease, and stroke.

According to lead author of the paper, Associate Professor Bamini Gopinath, PhD, from the Institute's Centre for Vision Research, the study is the first to look at the relationship between carbohydrate intake and healthy aging, and the results were significant enough to warrant further investigation.

"Out of all the variables that we looked at, fiber intake -- which is a type of carbohydrate that the body can't digest -- had the strongest influence," she said. "Essentially, we found that those who had the highest intake of fiber or total fiber actually had an almost 80 percent greater likelihood of living a long and healthy life over a 10-year follow-up. That is, they were less likely to suffer from hypertension, diabetes, dementia, depression, and functional disability."

While it might have been expected that the level of sugar intake would make the biggest impact on successful aging, Gopinath pointed out that the particular group they examined were older adults whose intake of carbonated and sugary drinks was quite low.

Although it is too early to use the study results as a basis for dietary advice, Gopinath said the research has opened up a new avenue for exploration.

"There are a lot of other large cohort studies that could pursue this further and see if they can find similar associations. And it would also be interesting to tease out the mechanisms that are actually linking these variables," she said.

This study backs up similar recent findings by the researchers, which highlight the importance of the overall diet and healthy aging.

In another study published last year in The Journals of Gerontology, Westmead Institute researchers found that, in general, adults who closely adhered to recommended national dietary guidelines reached old age with an absence of chronic diseases and disability, and had good functional and mental health status.

http://bit.ly/1RTKdtQ

Britain's oldest writing found buried near London Tube station

Better smarten up if you want to get ahead in business. That's advice from the earliest writing ever discovered in the UK.

By Joshua Howgego

The message is part of a haul of 405 writing tablets unearthed in the heart of London, metres from Bank underground station. They date from as early as AD 43, the year the Romans started their conquest of Britain. The tablets reveal a rich cast of 1st-century Londoners, contain the first ever written reference to the city, and hint at Britain's very first school *(see "What the ancient texts say", below).*

"It's exceptional, really wonderful," says Michael Speidel, at the Mavors Institute for Ancient Military History in Basel, Switzerland. "Looking at things in the past is usually a bit like glaring into a fog and we can't really see beyond. With documents like this, the fog clears away a bit."

Before the Romans invaded, London didn't exist, says Roman historian Roger Tomlin at the University of Oxford. There were just "wild west, hillbilly-style settlements" scattered around the area.

The newly discovered documents written in Latin – which date from between AD 43 and AD 80 – show the city quickly became filled with a variety of characters, including soldiers, merchants, judges and even a brewer.

"I've been digging around in London for years and never quite imagined that in the late 1st century, there was a community of people who are very much like us," says Sophie Jackson, who manages the dig for the Museum of London Archaeology.

Stationery problems

Aside from a few scrawled pottery shards, the next-earliest known example of writing in Britain is the huge cache of inked wood scraps and wax tablets excavated from the Vindolanda fort near Hadrian's Wall in northern England.

The earliest of these is at least 40 years later than some of the new haul. The new find "pushes the written record almost back to the conquest", says Andrew Birley, director of excavations at Vindolanda.

Examples of Roman writing are rare because ancient stationery tends to degrade easily. These survived because of a quirk of fate. Back in the mid-1st century, the course of the Thames ran about 100 metres further north, and the area between modern sites of the Bank of England and St Paul's Cathedral where the dig is situated was a hilly area bisected by the river Walbrook.

The dig was started because a new office was being built on the site and it's a legal requirement to do an archaeological assessment before that happens.

During excavations between 2010 and 2014, Jackson's team found that the river is still there. "The Walbrook still runs – underground," she says. The waterlogged ground 6 metres down was free from oxygen, saving all sorts of artefacts from oxidation, which normally breaks them down.

The archaeologists found some 400 shoes and the leather backs from a set of six dining chairs. "It's fantastic stuff that you'd never normally see," says Jackson.

But the prize discovery was the wooden tablets. These were once filled with wax, which Romans would scratch messages into with an iron stylus. Sometimes the scratches would leave traces on the wood behind.

Oldest writing in Britain?

Tomlin had the job of deciphering these traces. It was particularly tough, he says, because the wax on tablets was often replaced, meaning there are often several sets of shallow scratches on top of each other.

He took pictures of the tablets illuminated from four directions and superimposed the images to get sharper resolutions of each edge. "If you're the sort of person who likes crossword puzzles, it's quite satisfying," he says.

What the ancient texts say

"(AD 62-65) "…I ask you by bread and salt that you send as soon as possible the 26 denarii in victoiriati and the 10 denarii of Paterio…"

"This sounds like a liquidity crisis," says Roger Tomlin of the University of Oxford, who deciphered the tablets. The appeal to bread and salt may have been a cliché at the time. Bread and salt represents hospitality in many cultures, so the expression might be appealing to recipient to be kind and offer a loan as a favour.

(AD 65-80) "…Classicus, prefect of the Sixth Cohort of Nervii."

A lot can de deduced from this fragment of text because the name "Classicus" is so rare. The only individual we know of by that name is famous for being the leader of a cavalry regiment that joined a revolt against Roman rule in what is now Germany in AD 70. In this older fragment he is leading a lesser regiment, which fits in with the known way in which Roman military careers progressed.

(AD 43-53) "…because they are boasting through the whole market that you have lent them money. Therefore, I ask you in your own interest to not appear shabby. You will not thus favour your own affairs…"

This seems to be passing on business advice. The word "market" probably refers to a forum, the centre of Roman public life. It's not clear whether the place referred to is in London, elsewhere, or even a metaphorical usage. Michael Speidel of the Mavors Institute in Basel, Switzerland, says it's not unreasonable to think London had a forum by then; the Romans often built town plazas very quickly after founding a town.

(AD57) "In the consulship of Nero Claudius Caesar Augustus Germanicus for the second time and of Lucius Calpurnius Piso, on the 6th day before the Ides of January. I, Tibullus the freedman of Venustus, have written and say that I owe Gratus the freedman of Spurius 105 denarii from the price of the merchandise which has been sold and delivered. This money I am due to repay him or the person whom the matter will concern…"

This might be Britain's earliest IOU. Romans had a cumbersome way of defining years – naming the two consulates elected for that year – but in this case it means the document effectively dates itself.

(AD60-62) "…ABCDIIFGHIKL, MNOPQRST…"

This looks like writing practice, so could be evidence of Britain's first school. We have evidence of a Roman general named Agricola encouraging his children to go to school in the 70s and 80s, but this would be much earlier.

The messages hold clues to what society was like at the time. At Vindolanda fort, the tablets typically see people addressing each other as dearest brother or sister. The London tablets, used for keeping records, as notebooks and for letters, will reveal how urban society was organised, says Birley.

MOLA

It's the earliest evidence of writing found in Britain so far. Whether the Celts who lived in Britain at the time of the Roman conquest were literate isn't known. No evidence of them writing has been found so far.

However, we do know that merchants operated in Britain before the conquest, and probably communicated with the Roman empire. "So it is still technically possible that somewhere in Britain we might get a collection of earlier material," says Birley. "But I have to say that's extremely unlikely."

http://www.eurekalert.org/pub_releases/2016-06/tau-swu060116.php

Shift work unwinds body clocks, leading to more severe strokes

Research finds living against our body clocks is detrimental to our health

Statistics show that some 15 million Americans don't work the typical nine-to-five. These employees (or shift workers), who punch in for graveyard or rotating shifts, are more prone to numerous health hazards, from heart attacks to obesity, and now, new research, published in Endocrinology, shows shift work may also have serious implications for the brain.

"The body is synchronized to night and day by circadian rhythms--24-hour cycles controlled by internal biological clocks that tell our bodies when to sleep, when to eat and when to perform numerous physiological processes," said David Earnest, Ph.D., professor in the Department of Neuroscience and Experimental Therapeutics at the Texas A&M Health Science Center College of Medicine. "A person on a shift work schedule, especially on rotating shifts, challenges, or confuses, their internal body clocks by having irregular sleep-wake patterns or meal times."

According to Earnest, it's not the longer hours--or the weird hours--necessarily that is the problem. Instead, it is the change in the timing of waking, sleeping and eating every few days that "unwinds" our body clocks and makes it difficult for them to maintain their natural, 24-hour cycle. When body clocks are disrupted, as they are when people go to bed and get up at radically different times every few days, there can be a major impact on health. Earnest and his colleagues have found that shift work can lead to more severe ischemic strokes, the leading cause of disability in the United States, which occur when blood flow is cut off to part of the brain.

Using an animal model, Earnest and his team, including colleague Farida Sohrabji, Ph.D., also a professor in the Department of Neuroscience and Experimental Therapeutics and director of the Women's Health in Neuroscience Program, found that subjects on shift work schedules had more severe stroke outcomes, in terms of both brain damage and loss of sensation and limb movement than controls on regular 24-hour cycles of day and night.

Of interest, their study--supported by the American Heart Association--found that males and females show major differences in the degree to which the stroke was exacerbated by circadian rhythm disruption; in males, the gravity of stroke outcomes in response to shift work schedules was much worse than in females.

"These sex differences might be related to reproductive hormones. Young women are less likely to suffer strokes, as compared with men of a similar age, and when they do, the stroke outcomes are likely to be less severe. In females, estrogen is thought to be responsible for this greater degree of neuroprotection," Sohrabji said. "Essentially, estrogen helps shield the brain in response to stroke." However, older women approaching menopause show increasing incidence of ischemic stroke and poor prognosis for recovery, compared with men at the same age.

Some of Earnest's previous work has shown that a high-fat diet can also alter the timing of internal body clocks, as well as dramatically increase inflammatory responses that can be a problem in cardio- and cerebrovascular disease (conditions caused by problems that affect the blood supply to the brain--which includes stroke).

"Next we would like to explore whether inflammation is a key link between circadian rhythm disruption and increased stroke severity," Earnest said. "With this information, we may be able to identify therapeutic interventions that limit damage after a stroke in patients with a history of shift work."

"This research has clear implications for shift workers with odd schedules, but probably extends to many of us who keep schedules that differ greatly from day-to-day, especially from weekdays to weekends," Earnest added. "These irregular schedules can produce what is known as 'social jet lag,' which similarly unwinds our body clocks so they no longer keep accurate time, and thus can lead to the same effects on human health as shift work."

An immediate impact of these studies on human health is that individuals in shift work-type professions should be monitored more closely and more frequently for cardio- and cerebrovascular disease and risk factors such as hypertension and obesity. In the meantime, Earnest suggests that those with irregular sleeping patterns should at least try to maintain regular mealtimes, in addition to avoiding the usual cardiovascular risk factors like a high-fat diet, inactivity and tobacco use.

http://bit.ly/24oQGnD

Prisoners' code word caught by software that eavesdrops on calls

Plug a machine-learning system in to prison phone lines and you can find out secrets a human monitor would never notice

voice recognition

By Hal Hodson

SAY it out loud and the machines will know. Search engines are moving beyond the web and into the messy real world. And they're finding some odd things.

Every call into or out of US prisons is recorded. It can be important to know what's being said, because some inmates use phones to conduct illegal business on the outside. But the recordings generate huge quantities of audio that are prohibitively expensive to monitor with human ears.

To help, one jail in the Midwest recently used a machine-learning system developed by London firm Intelligent Voice to listen in on the thousands of hours of recordings generated every month.

The software saw the phrase “three-way” cropping up again and again in the calls – it was one of the most common non-trivial words or phrases used. At first, prison officials were surprised by the overwhelming popularity of what they thought was a sexual reference.

Then they worked out it was code. Prisoners are allowed to call only a few previously agreed numbers. So if an inmate wanted to speak to someone on a number not on the list, they would call their friends or parents and ask for a “three-way” with the person they really wanted to talk to – code for dialling a third party into the call. No one running the phone surveillance at the prison spotted the code until the software started churning through the recordings.

This story illustrates the speed and scale of analysis that machine-learning algorithms are bringing to the world. Intelligent Voice originally developed the software for use by UK banks, which must record their calls to comply with industry regulations. As with prisons, this generates a vast amount of audio data that is hard to search through.

The company’s CEO Nigel Cannings says the breakthrough came when he decided to see what would happen if he pointed a machine-learning system at the waveform of the voice data – its pattern of spikes and troughs – rather than the audio recording directly. It worked brilliantly.

Training his system on this visual representation let him harness powerful existing techniques designed for image classification. “I built this dialect classification system based on pictures of the human voice,” he says.

The trick let his system create its own models for recognising speech patterns and accents that were as good as the best hand-coded ones around, models built by dialect and computer science experts. “In our first run we were getting something like 88 per cent accuracy,” says Intelligent Voice developer Neil Glackin.

The software then taught itself to transcribe speech by using recordings of US congressional hearings, matching up the audio with the transcripts.

Cheap as chips

The power of machines that can listen and watch is not that they can do better than human ears or eyes. In fact, they perform much worse – especially when confronted with data from the real world. Their power, like all applications of computation, lies in speed, scale and the relative cheapness of processing.

“The cost would work out at 4 pence per hour of audio,” says Cannings. Human transcription costs can be 1000 times that. An automated transcription service is something Intelligent Voice is considering, but for now they are focusing on search.

Most large tech companies are developing neural networks for understanding speech, opening up data sets that were previously difficult, or impossible, to search. Voice-activated virtual assistants like Google Now, Apple’s Siri, Amazon’s Echo and Microsoft’s Cortana must also make sense of the quirks of human speech.

And Facebook recently announced that it has repurposed its image-recognition software to draw maps based on satellite photos of Earth. These maps are of lower quality than those produced by humans but, again, the advantage is speed. Facebook’s system can map the entire land surface of the planet – every road and house – in just a few hours.

http://bit.ly/25DMUJN

Black-Death Survey Reveals Incredible Devastation Wrought by Plague

The devastation wrought by the Black Death plague pandemic in medieval England has been revealed in a uniquely detailed archaeological study carried out for more than a decade with the help of thousands of village volunteers.

By Tom Metcalfe, Live Science Contributor | June 1, 2016 12:28pm ET

Although some historians have played down the impact of the bubonic plague that struck Europe and Asia in the 1300s, new research shows that the Black Death was as deadly as described in writings that have survived from the time, with some villages suffering an almost 80 percent drop in population after the plague.

The study gathered and analyzed data about broken pieces of domestic pottery found in more than 2,000 test pits measuring 11 square feet (1 square meter) at the surface and up to 4 feet (1.2 meters) deep that were dug in 55 villages in eastern England.

The test pits were excavated from 2005 to 2014 by an estimated 10,000 volunteers, including students, homeowners and local community groups, under supervision by archaeologists and trained local team leaders. Each of the villages in the survey is known to have been occupied before the Black Death, which by some estimates killed more than 3 million people in England between 1346 and 1351.

In most of the surveyed villages, the quantities of pottery pieces indicate sharp long-term falls in population from the time of the Black Death. Many village populations did not recover until about 200 years later, in the 16th century.

Seeing the big picture

The new study has been able to map, for the first time, how different communities were affected by the plague. Overall, the population of the surveyed villages fell by an average of 45 percent after the Black Death. One of the worst-hit villages, Pirton in Hertfordshire, suffered a 76 percent drop in population. But a few villages seem to have survived almost unscathed.

According to the U.S. Centers for Disease Control and Prevention (CDC) in the United States, the Black Death killed between 75 million and 200 million people

in Europe and Asia after its appearance in central Asia early in the early 14th century, and reached its peak in Europe, where it killed up to 60 percent of the population.

Study leader Carenza Lewis, an archaeologist at the University of Lincoln in the United Kingdom, told Live Science that the quantity of dated pottery pieces found at different depths in each test pit served as an indicator, or proxy, for the human population of the sites at different times.

"Human communities in this part of the world are using pottery consistently through the medieval period," Lewis said. "Pottery is cheap to buy, so everyone has it. It's easy to break, and when it's broken, you throw it away rather than trying to mend it, because it's cheap. And when you've thrown it away, it doesn't rot, so it just sits there forever."

Pottery and population

Although gathering data about pottery from test pits had been done at single sites before, this study was the first time that so much data from so many sites were brought together to provide an overall picture of population changes.

The multiple test pits dug at each of the 55 villages in the study resulted in more accurate data, Lewis added. "This is a completely different approach — just scatter-gunning these villages with these test pits," she said. "Each pit is like one piece of a jigsaw puzzle that you can just put in place."

Lewis said the results clearly showed the "eye-watering" impact of the Black Death on the region, contrary to some recent studies that have suggested that historical accounts of the plague's devastation were exaggerated.

"There's been a prevailing view in the second half of the 20th century that these kinds of epidemic diseases were quite widespread, and that communities recovered pretty quickly," Lewis said. "I think it was just rather unfashionable to think that something as dramatic as the Black Death could have had such an impact."

The results of the latest study, however, clearly show otherwise.

"We can't identify whether these people died of the plague or whether they just moved away to a better place because someone else had died of the plague and a better place became available," Lewis said. But "what we definitely see is that the overall volume of pottery in use drops by 44 to 45 percent in a long-term, sustained drop, and we can see that some communities were much worst hit than others," she said.

Incredible devastation

Lewis said the findings support the emerging consensus that the population of England remained between 35 and 55 percent below its pre-Black Death levels well into the 16th century. She added that several villages in the county of Norfolk, in the northern part of the study area, had suffered up to an 80 percent decline in population, according to the analysis of the pottery.

Yet, a few villages in Suffolk, in the southern part of the study area, actually saw an increase in population over the same time.

"Now, we can see what the change is; we can now start to work out why it happened," Lewis said. "And it looks like agricultural villages were particularly badly hit because agriculture is labor-intensive, and when the population drops, the availability and cost of labor is high. So, what we see is the economic bottom line for agriculture becomes very unsustainable."

In the Suffolk villages where the population actually increased, though, these "seem to be villages that were tied into the cloth trade, which was very profitable," Lewis said.

"Today, these villages are just somewhere nice to live, but in the medieval period, they were like small businesses — they've got to be able to sustain themselves, and if they're not sustainable, they collapse," she added.

In the new study, Lewis noted the potential for the test-pit data technique to be extended to other areas.

"This new research suggests there is an almost unlimited reservoir of new evidence capable of revealing change in settlement and demography still surviving beneath today's rural parishes, towns and villages — anyone could excavate, anywhere in the U.K., Europe or even beyond, and discover how their community fared in the aftermath of the Black Death," she wrote in the study.

The new study was published online May 17 in the journal Antiquity.

http://www.eurekalert.org/pub_releases/2016-06/jj-dae053116.php

Detecting an early biomarker for pancreatic cancer in blood

New method for detecting a pancreatic cancer biomarker in patient serum

Pancreatic ductal adenocarcinoma is one of the most aggressive and deadliest forms of cancer. Treatment options are limited because symptoms typically do not appear until the disease is advanced and complete surgical resection of tumors is not possible. In this issue of JCI Insight, a group of researchers led by Motoyuki Otsuka at the University of Tokyo describe a pilot study of a new method for detecting a pancreatic cancer biomarker in patient serum. Previous work has shown that an RNA known as human satellite II (HSATII) RNA is highly enriched in human pancreatic cancer tissue. This RNA contains repetitive elements that make it difficult to detect with conventional methods. This study now reports a method to easily and specifically quantify HSATII in blood serum from pancreatic cancer patients. They show in an initial cohort of 20 cancer patients and 20 normal patients that HSATII levels are significantly higher in serum from individuals with pancreatic cancer. They validated these findings in a

second cohort of patients and showed that the test could detect patients with intraductal papillary mucinous neoplasm, a precancerous pancreatic lesion. These studies provide a promising early detection method for pancreatic cancer that can now be tested in a larger cohort of pancreatic cancer patients.

TITLE: Quantitation of circulating satellite RNAs in pancreatic cancer patients
View this article at: http://insight.jci.org/articles/view/86646?key=52a5cd934c740390968b

http://nyti.ms/1VFvHws

Where Did Dogs Come From? There May Be Two Answers.

Scientists have done well in scouring the DNA of humans to track our origins to the African continent.

By JAMES GORMAN JUNE 2, 2016

But the ancient origins of an animal that is an honorary member of many human families has remained in doubt: We still don't know where dogs came from. A group of scientists who are in the middle of a grand examination of canine fossils and modern DNA proposed Thursday to turn the whole conversation on its head.

Suppose dogs didn't evolve in one place, they suggested, but two. What if domestication of ancient wolves happened in both Asia and Europe — different wolves, different people?

Laurent Frantz and Greger Larson of Oxford University and an international team of scientists who are all part of a dog domestication project run out of Oxford, made the new argument in a paper published in the journal Science. They make clear that although they think their explanation best suits the available evidence, more evidence is needed to confirm it.

Scientists who were not part of the study agreed on the need for more evidence.

"It's an intriguing hypothesis," Adam Boyko, a canine geneticist at Cornell University, said.

John Novembre, a geneticist at the University of Chicago, described the idea as "very provocative"

"It's a hypothesis," was as far as Peter Savolainen, a geneticist at the Royal Institute of Technology in Stockholm, would go. Dr. Savolainen has argued strongly, with limited support from other researchers, that dogs originated in East Asia, which, he noted, fits with at least half of the paper's conclusion.

The notion of a dual origin of dogs is something new for geneticists, but Dr. Larson said archaeologists have long considered the possibility that dogs were domesticated more than once.

Separate domestications have occurred with other animals. Dr. Larson and Keith Dobney of Liverpool University found that wild boars were domesticated twice, once in China and once in Anatolia, part of modern Turkey.

For the new study, Dr. Larson and Dr. Frantz obtained DNA sequences from 59 ancient dogs and a complete genome from a 4,800-year-old-dog fossil found at Newgrange, a well-known archaeological site in County Meath, Ireland. They also analyzed other DNA evidence. They found a deep split between two groups — modern East Asian dogs and those from the Middle East and Europe.

They calculated mutation rates based on the known age of the Irish dog and considered archaeological evidence of migrations as well.

They said the overall picture could be explained two ways — by dogs originating in East Asia and then migrating west, or by dogs originating in Europe and Asia. They said there was a lack of archaeological evidence for an early, steady spread of dogs from an Eastern origin. And, they said, dog fossils from Europe dating to 15,000 years ago predated known migrations. So they concluded that dogs most likely originated both in Europe and in Asia. The Asian dogs then migrated with humans to Western Europe and the Middle East.

Although the new explanation may seem to complicate an already tangled discussion, Dr. Larson says it actually clears up confusion by explaining two competing ideas, the western and eastern origins of dogs.

Because of the dog domestication project and other current studies of ancient DNA, this is one scientific dispute that may well be solved.

"It's really an exciting moment," said Dr. Savolainen.

We may soon know where dogs come from. But not just yet.

http://www.eurekalert.org/pub_releases/2016-06/nsfc-nhf060216.php

NASA's Hubble finds universe is expanding faster than expected

Astronomers using NASA's Hubble Space Telescope have discovered that the universe is expanding 5 percent to 9 percent faster than expected.

"This surprising finding may be an important clue to understanding those mysterious parts of the universe that make up 95 percent of everything and don't emit light, such as dark energy, dark matter, and dark radiation," said study leader and Nobel Laureate Adam Riess of the Space Telescope Science Institute and The Johns Hopkins University, both in Baltimore, Maryland.

The results will appear in an upcoming issue of The Astrophysical Journal.

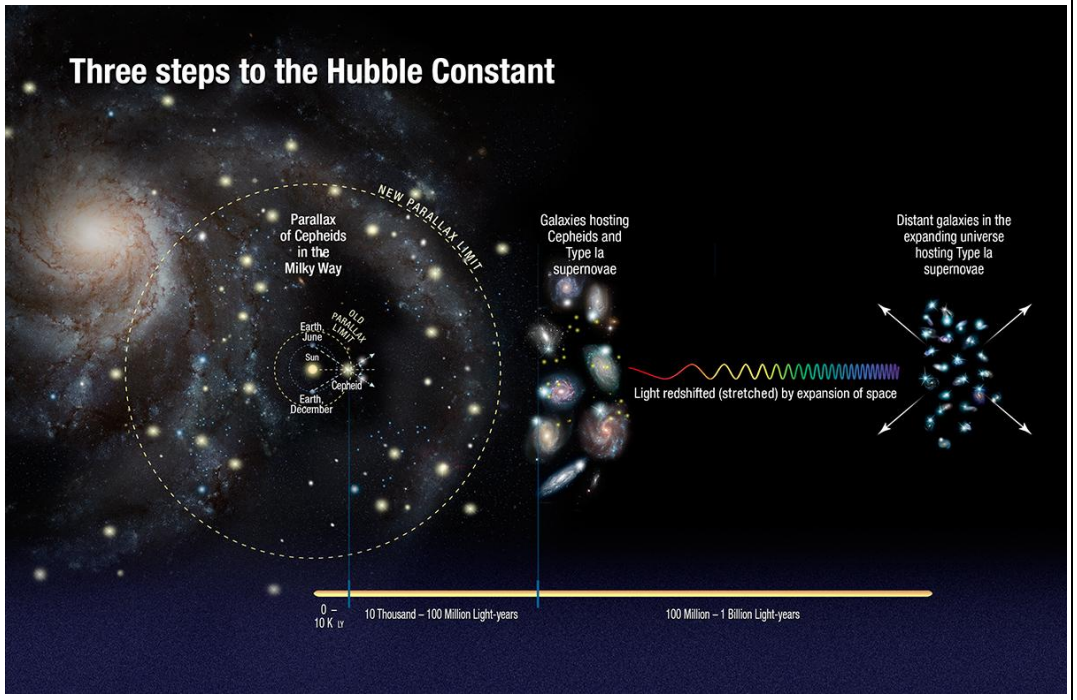
Riess' team made the discovery by refining the universe's current expansion rate to unprecedented accuracy, reducing the uncertainty to only 2.4 percent. The team made the refinements by developing innovative techniques that improved the precision of distance measurements to faraway galaxies.

The team looked for galaxies containing both Cepheid stars and Type Ia supernovae. Cepheid stars pulsate at rates that correspond to their true brightness, which can be compared with their apparent brightness as seen from Earth to accurately determine their distance. Type Ia supernovae, another commonly used

cosmic yardstick, are exploding stars that flare with the same brightness and are brilliant enough to be seen from relatively longer distances.

By measuring about 2,400 Cepheid stars in 19 galaxies and comparing the observed brightness of both types of stars, the accurately measured their true brightness and calculated distances to roughly 300 Type Ia supernovae in far-flung galaxies.

The team compared those distances with the expansion of space as measured by the stretching of light from receding galaxies. They used these two values to calculate how fast the universe expands with time, or the Hubble constant. The improved Hubble constant value is 73.2 kilometers per second per megaparsec. (A megaparsec equals 3.26 million light-years.) The new value means the distance between cosmic objects will double in another 9.8 billion years.



This refined calibration presents a puzzle, however, because it does not quite match the expansion rate predicted for the universe from its trajectory seen shortly after the Big Bang. Measurements of the afterglow from the Big Bang by NASA's Wilkinson Microwave Anisotropy Probe (WMAP) and the European Space Agency's Planck satellite mission yield predictions which are 5 percent and 9 percent smaller for the Hubble constant, respectively.

"If we know the initial amounts of stuff in the universe, such as dark energy and dark matter, and we have the physics correct, then you can go from a measurement at the time shortly after the big bang and use that understanding to predict how fast the universe should be expanding today," said Riess. "However, if this discrepancy holds up, it appears we may not have the right understanding, and it changes how big the Hubble constant should be today."

Comparing the universe's expansion rate with WMAP, Planck, and Hubble is like building a bridge, Riess explained. On the distant shore are the cosmic microwave background observations of the early universe. On the nearby shore are the measurements made by Riess' team using Hubble.

"You start at two ends, and you expect to meet in the middle if all of your drawings are right and your measurements are right," Riess said. "But now the ends are not quite meeting in the middle and we want to know why."

There are a few possible explanations for the universe's excessive speed. One possibility is that dark energy, already known to be accelerating the universe, may be shoving galaxies away from each other with even greater -- or growing -- strength.

Another idea is that the cosmos contained a new subatomic particle in its early history that traveled close to the speed of light. Such speedy particles are collectively referred to as "dark radiation" and include previously known particles like neutrinos. More energy from additional dark radiation could be throwing off the best efforts to predict today's expansion rate from its post-big bang trajectory.

The boost in acceleration could also mean that dark matter possesses some weird, unexpected characteristics. Dark matter is the backbone of the universe upon which galaxies built themselves up into the large-scale structures seen today.

And finally, the speedier universe may be telling astronomers that Einstein's theory of gravity is incomplete.

"We know so little about the dark parts of the universe, it's important to measure how they push and pull on space over cosmic history," said Lucas Macri of Texas A&M University in College Station, a key collaborator on the study.

The Hubble observations were made with Hubble's sharp-eyed Wide Field Camera 3 (WFC3), and were conducted by the Supernova H0 for the Equation of State (SH0ES) team, which works to refine the accuracy of the Hubble constant to a precision that allows for a better understanding of the universe's behavior.

The SH0ES Team is still using Hubble to reduce the uncertainty in the Hubble constant even more, with a goal to reach an accuracy of 1 percent. Current telescopes such as the European Space Agency's Gaia satellite, and future telescopes such as the James Webb Space Telescope (JWST), an infrared observatory, and the Wide Field Infrared Space Telescope (WFIRST), also could help astronomers make better measurements of the expansion rate.

Before Hubble was launched in 1990, the estimates of the Hubble constant varied by a factor of two. In the late 1990s the Hubble Space Telescope Key Project on the Extragalactic Distance Scale refined the value of the Hubble constant to within an error of only 10 percent, accomplishing one of the telescope's key goals. The SH0ES team has reduced the uncertainty in the Hubble constant value by 76 percent since beginning its quest in 2005.

The Hubble Space Telescope is a project of international cooperation between NASA and the European Space Agency. NASA's Goddard Space Flight Center in Greenbelt, Maryland, manages the telescope. The Space Telescope Science Institute (STScI) in Baltimore, Maryland, conducts Hubble science operations. STScI is operated for NASA by the Association of Universities for Research in Astronomy in Washington, D.C.

http://www.eurekalert.org/pub_releases/2016-06/rb-ord060216.php

Olfactory receptor discovered in pigment cells of the skin

Existence of an olfactory receptor in pigment-producing cells in human skin proven

Researchers at Ruhr-Universität Bochum were the first ones to prove the existence of an olfactory receptor in pigment-producing cells in human skin, the so-called melanocytes. The team headed by Prof Dr Dr Dr habil. Hanns Hatt demonstrated that the violet-like scent Beta-Ionone can activate the receptor.

Together with colleagues from Friedrich Schiller University Jena and the university hospital in Jena, the researchers at Bochum's Department for Cellphysiology reported their findings in the Journal of Biological Chemistry.

Cause of black skin cancer

The group identified the olfactory receptor 51E2 in cell cultures of melanocytes from human skin. Those cells produce the black melanin which renders the skin tan. Excessive growth of melanocytes may cause too much pigmentation and possibly trigger black skin cancer.

Signalling pathways in cells identified

The researchers identified the signalling pathway in detail that is activated by the 51E2 receptor. If a fitting odorant binds to the receptor, a reaction cascade is triggered similar to the one occurring in olfactory cells of the nose: the concentration of calcium ions increases.

This, in turn, activates the signalling pathways at the end of which phosphate groups are transferred to specific enzymes, such as MAP-kinases. The newly detected receptor uses this mechanism to regulate enzyme activity and, consequently, cell growth and melanin production.

Starting point for melanoma therapy

"The receptor and its activating odor molecule might constitute a new starting point for a melanoma therapy," says Hanns Hatt. If healthy melanocytes turn into tumour cells, they strongly increase the proliferation rate, but they focus less efficiently on their actual functions. The Beta-Ionone odorant appears to affect these properties using the relevant receptor. Hanns Hatt's team is currently analysing the causes and effects in melanoma cells gained through biopsies.

The scent researcher from Bochum expects the newly detected receptor to have other potential applications: "With its help, we might be able to treat pigmentation disorders of the skin, and they might also be used in tanning products," says Hatt.

The German Research Foundation funded the study under the umbrella of the Collaborative Research Centre 642. Additional funding came from Vogelsang Foundation.

http://www.medscape.com/viewarticle/863778

Fluoroquinolones Not First Line: FDA Advisory Reinforces Standard Practice in Ambulatory Care

Fluoroquinolones should not be used for routine infections unless there is no suitable alternative agent

Paul G. Auwaerter, MD

Hello. This is Paul Auwaerter, with Medscape Infectious Diseases and the Johns Hopkins University School of Medicine. The US Food and Drug Administration (FDA) recently announced[1] that it will upgrade its package warnings on fluoroquinolones to include instructions that they should not be used for routine respiratory tract infections or uncomplicated urinary tract infections unless there is no suitable alternative agent.

Why these warnings are being reinforced at this point rests on several foundational issues. When I was a medical student the late 1980s, fluoroquinolones were embraced as "wonder drugs." We had ciprofloxacin, which offered oral treatment for *Pseudomonas aeruginosa* and was thought to be effective for *Staphylococcus aureus*, even in deep bone infections. Over time, these drugs have been widely embraced with new additions, such as levofloxacin and moxifloxacin. But a number of other drugs (eg, trovafloxacin, lomefloxacin, and others) have fallen to the wayside, deservedly, because of serious toxicities.

It seems to be true, however, that the fluoroquinolones remain broadly prescribed both by primary care practitioners and in hospital settings and skilled nursing facilities.

Studies looking at the use of fluoroquinolones in ambulatory settings for uncomplicated urinary tract and respiratory infections show that over the past few years there has been little diminishment in the use of fluoroquinolones.[2]

Because of their wide use and adoption, we are experiencing problems such as pathogen resistance. The fluoroquinolones are no longer recommended for gonorrhea because of widespread resistance. They are no longer recommended for

routine first-line treatment of uncomplicated cystitis because of increased resistance of *Escherichia coli* to this class of drugs.[3]

Another issue is that, over the years, the remaining fluoroquinolones have been associated with adverse effects, including increased risk for *Clostridium difficile* infection (compared with many other antibiotics), tendinopathy, arthropathy, QT prolongation, retinal issues, and central and peripheral nervous system toxicities.[4] These adverse effects have been reported, although perhaps not thoroughly vetted through careful analysis. However, the FDA now feels that owing to potential irreversible or permanent side effects, these drugs should not be used for first-line treatment.

Many infectious diseases practitioners, out of concern about antibiotic resistance, have been broadly beating the drum for many years that these drugs should not be used in office settings and practices for mundane and pedestrian upper respiratory tract infections such as bronchitis or sinusitis, or for urinary tract infections.

So why are these drugs still so widely used?

There is a perception (and perhaps a reality) that the fluoroquinolones are still quite safe. I have never seen a case of peripheral neuropathy although I have certainly seen *C difficile* infection, tendinopathy, and arthropathy.

Obviously as drugs are getting more attention and being looked at in terms of adverse effects, it does not make sense to prescribe these drugs, which have quite broad-spectrum activity, to treat conditions that could be treated with a narrower-spectrum and more targeted drug.

The FDA is upgrading its warnings about these drugs in spite of what practitioners are seeing. The diminished use of these broad-spectrum antibiotics for certain conditions is a worthy goal and probably will benefit patient care, either by avoiding the use of antibiotics altogether if appropriate, or targeting antibiotics, as recommended in guidance on sinusitis, bronchitis, exacerbations of bronchitis, and urinary tract infections. Thanks very much for listening.

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Scientists Announce HGP-Write, Project to Synthesize the Human Genome

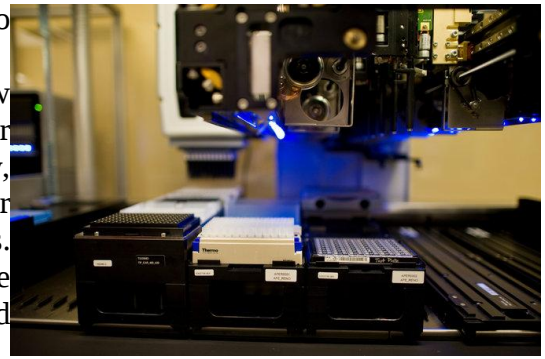
Scientists on Thursday formally announced the start of a 10-year project aimed at vastly improving the ability to chemically manufacture DNA, with one of the goals being to synthetically create an entire human genome.

By ANDREW POLLACK JUNE 2, 2016

Plans for the project, which leaked last month, have already set off an ethical debate, because the ability to chemically fabricate the complete set of human chromosomes could theoretically allow the creation of babies without biological parents.

Some critics also objected to the secrecy surrounding a meeting to discuss the project at Harvard Medical School in May. The organizers said they avoided publicity so as to not jeopardize publication of the proposal in a peer reviewed scientific journal. The publication occurred on Thursday by the journal Science.

The authors of the proposal said that the ability to fabricate huge stretches of DNA would allow for numerous scientific and medical advances. It might be possible to make organisms resistant to all viruses, for instance, or make pig organs suitable for transplant into people.



A DNA sequencing machine. Scientists have proposed a plan to synthesize human DNA. **Gregg Vigliotti for The New York Times**

The project, which will be run by a new nonprofit organization called the Center of Excellence for Engineering Biology, will seek to raise $100 million this year from various public and private sources. Organizers declined to state the ultimate cost of the project, though it could conceivably exceed $1 billion.

Whether the federal government will support the project is still unknown. Dr. Francis S. Collins, director of the National Institutes of Health, which is the main funder of medical research in the United States, had a tepid response Thursday.

Dr. Collins said in a statement that while N.I.H. was interested in encouraging advances in DNA synthesis, it “has not considered the time to be right for funding a large-scale production-oriented” project like the one being proposed.

He added that “whole-genome, whole-organism synthesis projects extend far beyond current scientific capabilities, and immediately raise numerous ethical and philosophical red flags.”

The effort is being called Human Genome Project – Write, because it is aimed at writing the DNA of life. The original Human Genome Project, which was completed more than a decade ago, aimed at reading the sequence of the three billion letters that make up the genetic code of humans.

The cost of sequencing DNA has fallen dramatically, so that it is now possible to sequence a person's complete DNA for about $1,000. As a result, DNA sequencing is now routinely used for medical diagnoses, crop breeding and scientific research.

The organizers of the HGP-Write project hope to do much the same with DNA synthesis, reducing the cost more than 1,000-fold in a decade. Still, even if such progress is made, it might cost several million dollars in 10 years to completely fabricate one human genome.

The authors of the paper in Science say they do not want to create babies but maintain that focusing on a grand challenge like synthesizing an entire human genome would be the best way to galvanize advances in DNA synthesis that could be used for more practical purposes, such as engineering plants, animals and microbes.

"By focusing on building the 3Gb of human DNA, HGP-write would push current conceptual and technical limits by orders of magnitude and deliver important scientific advances," they write, referring to three gigabases, the three billion letters in the human genome.

Scientists already can change DNA in organisms or add foreign genes, as is done to make medicines like insulin or genetically modified crops. New "genome editing" tools, like one called Crispr, are making it far easier to re-engineer an organism's DNA blueprint.

But George Church, a professor of genetics at Harvard Medical School and one of the organizers of the new project, said that if the changes desired are extensive, at some point it becomes easier to synthesize the needed DNA from scratch.

"Editing doesn't scale very well," he said. "When you have to make changes to every gene in the genome it may be more efficient to do it in large chunks."

Besides Dr. Church, the other organizers of the project are Jef Boeke, director of the Institute for Systems Genetics at NYU Langone Medical Center; Andrew Hessel, a futurist at the software company Autodesk; and Nancy J. Kelley, who works raising money for projects. The paper in Science lists a total of 25 authors, many of them involved in DNA engineering.

Autodesk, which has given $250,000 to the project, is interested in selling software to help biologists design DNA sequences to make organisms perform particular functions. Dr. Church is a founder of Gen9, a company that sells made-to-order strands of DNA.

Dr. Boeke of N.Y.U. is leading an international project to synthesize the complete genome of yeast, which has 12 million base pairs. It would be the largest genome synthesized to date, though still much smaller than the human genome.

Jason Kelly, chief executive of Ginkgo Bioworks, a Boston company that makes fragrances and flavorings in genetically modified yeast, said that even if it were possible to make DNA strands that were millions or billions of base pairs long, industry would not need such capability.

"We really don't know how to design anything that big today," he said.

Rather, he said, the emphasis should be on reducing the cost of making DNA strands up to 10,000 base pairs long. Such strands, long enough to encompass a few genes, are what companies like his use now. "There's a huge appetite for that," he said. "That's what everyone wants."

Two people who criticized the project, and the secrecy surrounding it last month, said Thursday that they were still not satisfied. While the paper in Science talks a lot about the need to consider ethical issues, they said that should have been done before starting the project.

"Before launching into such a momentous project, with such enormous ethical and theological implications, a basic ethical question still needs to be asked — starting with whether and under what circumstances we should make such technologies real," said a statement issued by Drew Endy, a bioengineer at Stanford, and Laurie Zoloth, a professor of religion at Northwestern University.

http://bit.ly/1ZoKVoG

In This Jurassic Boneyard, It's Not Size That Counts

A rich cache of fossils in Colorado is valuable not for the big dino bones but the relatively tiny fossils that are still being dug up.

By Brian Switek smithsonian.com

On the edge of Fruita, Colorado, scattered through a half square mile of red and gray rock, is one of the richest Jurassic boneyards anywhere. Over the years paleontologists have excavated the remains of a beautifully-preserved Ceratosaurus, the bones of at least six Allosaurus strewn together in death, and other Jurassic classics from this pocket of geological riches.

But the most magnificent fossils to come out of the Fruita Paleo Area aren't giants like Apatosaurus and Stegosaurus. What makes this 150-million-year old spot so special is that it contains an exquisite record of Jurassic life at a much smaller scale.

Even though paleontologists and amateur naturalists knew about fossils in the hills around Fruita since the 1890s, it wasn't until 1975 that the wonders of what would become the Fruita Paleo Area started to become known.

In that year, California State University paleontologist George Callison brought his students to exposures of the Morrison Formation, the rock layer where most Jurassic-era fossils in North America are found, in the deserts of western Colorado. Their mission: To look for the animals that scurried and slithered beneath the feet of Brachiosaurus and other Jurassic titans. While stopping to tie his boots, so the story goes, then-graduate student Jim Clark noticed black flecks in a piece of sandstone that turned out to be the bones of a three-foot-long crocodile that looks like a reptilian version of a small greyhound.

A reconstruction of Fruitachampsa, a Jurassic-era crocodile discovered in the Fruita Paleo Area and named in 2011. Small animals like Fruitachampsa help paleontologists reconstruct what life was really like in the Jurassic period. **Brian Switek**

Clark's crocodile was named Fruitachampsa in 2011. Exactly how this small saurian made its living is unclear, but its bones have turned up at another rarity in the Fruita Paleo Area – the nesting site of a small, herbivorous dinosaur called Dryosaurus, with preserved eggshell as well as the bones of young dinosaurs. The evidence is only circumstantial, simply placing Fruitachampsa at the scene, but the discovery of the odd croc's bones among the hatchlings might hint that this blunt-snouted carnivore had a taste for eggs and unwary infants.

Fruitachampsa wasn't the only small animal to turn up in Fruita. In 1987 Callison wrote that his team's scratchings at the Fruita Paleo Area rock had yielded some vertebrae that looked very much like they belonged to a snake. Other experts thought a lizard identification fit better, but, just last year, Callison's hunch turned out to be right – the tiny bones had once formed the spine of Diablophis, an early snake that would have still had limbs as it slithered through the forests and floodplains of the Jurassic world. Other discoveries in the area include Fruitadens – a dinosaur with tusk-like teeth and one of the smallest ever found – named in 2010, and the ant-eating mammal Fruitafossor announced by paleontologists in 2005.

An artists' rendering of Diablophis gilmorei, one of the many small animals discovered in the Fruita Paleo Area in Colorado. **Julius Cstonyi**

Such fossils come from pockets of delicate preservation called microsites, and they're quite rare in the Jurassic Morrison Formation, says Museums of Western Colorado paleontologist Julia McHugh. She and her crew continue to sift through the sites that Callison and his students identified back in the 70s, and this is because of the unprecedented view that small animals can provide of the habitat back when Allosaurus stalked this land. "Small animals give you a more detailed picture of an ecosystem," McHugh says, particularly because they "tend to have larger populations and are more sensitive to environmental changes." The small crocodiles, mammals, snakes, lizards, and other animals of the Fruita Paleo Area are more likely to provide insights about what the world was like at the time than the comparatively enormous dinosaurs that fill museum halls.

And it's not just animals. Just last year, McHugh says, a Jurassic pine cone was found in the Fruita Paleo Area that may allow experts to identify at least one of the conifer species that grew there.

"After decades of excavation, the FPA is still generating new discoveries of evolution," McHugh says.

There are likely still transformative tales to be drawn from the rocks on the outskirts of town. "Other Morrison microsites further north have produced amphibian fossils," McHugh says, but these delicate ecological indicators have yet to be found in Fruita. With luck, they'll soon peek out of this exceptional Jurassic graveyard.

http://bit.ly/1ZoMYcD

Stem cell brain injections let people walk again after stroke

People once dependent on wheelchairs after having a stroke are walking again since receiving injections of stem cells into their brains.

By Andy Coghlan

Participants in the small trial also saw improvements in their speech and arm movements.

"One 71-year-old woman could only move her left thumb at the start of the trial," says Gary Steinberg, a neurosurgeon at Stanford University who performed the procedure on some of the 18 participants. "She can now walk and lift her arm above her head."

Run by SanBio of Mountain View, California, this trial is the second to test whether stem cell injections into patients' brains can help ease disabilities resulting from stroke. Patients in the first, carried out by UK company ReNeuron, also showed measurable reductions in disability a year after receiving their injections and beyond.

All patients in the latest trial showed improvements. Their scores on a 100-point scale for evaluating mobility – with 100 being completely mobile – improved on

average by 11.4 points, a margin considered to be clinically meaningful for patients. “The most dramatic improvements were in strength, coordination, ability to walk, the ability to use hands and the ability to communicate, especially in those whose speech had been damaged by the stroke,” says Steinberg.

In both trials, improvements in patients’ mobility had plateaued since having had strokes between six months and three years previously.

“We used to think the affected brain circuits were dead,” says Steinberg. “Now, we have to rethink this, and I personally think the circuits are inhibited, and our treatment helps to disinhibit them.”

Baby steps

Steinberg injected the cells through a borehole in the skull into regions of the brain that control motor movements, and which had been damaged by the stroke. Each participant received either 2.5, 5 or 10 million cells.

The injected material consisted of mesenchymal stem cells taken from the bone marrow of two healthy donors. SanBio genetically engineered the cells to possess a gene called Notch1, which activates factors that help brain development in infants. Experiments in rats revealed that the engineered stem cells disappear within a month or so, but not before secreting several growth factors that build connections between brain cells and spawn the growth of new blood vessels to nourish growing brain tissue.

“We think the cells change the adult brain so that it’s more like a baby’s brain, which repairs very well,” says Steinberg. “They are secreting all sorts of growth factors, which aid repair, and which also alter the immune system to get rid of inflammation that otherwise obstructs repair.”

In the ReNeuron trial, patients received neural stem cells originally extracted from the brains of aborted fetuses, then multiplied to produce larger amounts.

“This is very encouraging news for the field of stem cell research and especially patients with established disability as a result of stroke, where this is no proven treatment to aid recovery,” says Julian Howell, chief medical officer at ReNeuron. “Both companies are at a similar stage of development, and while it’s great to hear stories of major improvements in some patients, controlled studies are absolutely necessary to establish the benefits and risks of stem cell therapy for stroke.”

Remarkable results

ReNeuron is preparing a second trial, while SanBio is in the process of performing the treatment on a further 156 patients. Steinberg says that this time, a third of the patients will receive a sham treatment – a hole in the head without the injection of stem cells – and the remainder will receive either 2.5 or 5-million cells.

There are around 30 similar trials in progress. These deliver stem cells to stroke patients by injecting them into the blood, but none have shown such remarkable results as the two trials that injected the cells into the brain, says Steinberg. “We still have much to learn, including the right cell for the job, the right dose and the right means of delivery,” he says.

The UK Stroke Association welcomed the results but also cautioned that further trials are essential to provide additional evidence the treatment works. “Although small, this latest trial suggests that the treatment is safe and may be able to restore movement to people previously lost after stroke,” says Shamim Quadir, a spokesman for the association. “The trial adds to a growing body of early clinical evidence suggesting stem cell treatment could promote recovery in people months, even years, after having a stroke, bringing hope to many living with a disability.”

Journal reference: Stroke, in press

http://www.eurekalert.org/pub_releases/2016-06/uops-ddm060316.php

Diabetes drug metformin holds promise for cancer treatment and prevention

Results show survival benefit for some breast cancer patients and potential treatment option for patients with endometrial hyperplasia

CHICAGO -- Use of Metformin - commonly used as the front-line treatment for type 2 diabetes - improves survival for some breast cancer patients, and shows promise as a treatment for patients diagnosed with endometrial hyperplasia, according to the results of two new studies presented by researchers from the Perelman School of Medicine at the University of Pennsylvania at the American Society of Clinical Oncology (ASCO) Annual Meeting.

In one study (abstract 1569), the first to examine the effect of metformin on survival rates for breast cancer patients, researchers examined clinical outcomes for 1,215 patients who were diagnosed and underwent surgical treatment for breast cancer between 1997 and 2013. Ninety-seven patients examined reported using metformin before their diagnosis, and 97 reported use of the drug after diagnosis.

Results of the study showed that patients who used metformin before being diagnosed with breast cancer were more than twice as likely to die than patients who never used the drug, while patients who began using metformin after their cancer diagnosis were almost 50 percent more likely to survive than non-users.

"Using metformin as a cancer prevention strategy has been controversial and results have been inconsistent, but our analysis reveals that use of the drug is time-dependent, which may explain the disparity. While use of the drug may have a survival benefit for some breast cancer patients, those who developed breast cancer while already using Metformin may have more aggressive cancer

subtypes," said lead author Yun Rose Li, MD, PhD, a clinical research fellow in the division of Endocrine and Oncologic Surgery at the Perelman School of Medicine at the University of Pennsylvania, who will present the results. "Our study also illustrates the complex interaction between underlying metabolic risks and breast cancer outcomes, and underscore the importance of a multi-system approach to cancer treatment."

Additional results of the study showed that patients who used metformin were more likely to be over the age of 50 at diagnosis and to be African-American. While tumor size and disease progression were similar across all groups, the patients who began using the drug after their diagnosis were more likely to have ER/PR positive tumors while the patients who used it prior to their diagnosis had higher rates of Her2+ and Triple Negative tumors.

Since this work is among the first to examine the effects of long-standing metformin use in the context of when patients start using it as it relates to breast cancer diagnosis, the authors say that further investigations are necessary to examine the impact of metformin use on cancer recurrence. Nonetheless, the authors say there is compelling biological evidence suggesting that the differences observed in breast cancer tumor markers may be due to mechanistic differences in cancer initiation in patients who develop cancer while taking metformin.

The results will be presented at the Cancer Prevention, Genetics, and Epidemiology poster session on Monday, June 6, from 8 a.m. to 11:30 a.m. CT in Hall A.

In the second study (abstract 5592), researchers examined the effectiveness of using metformin as a treatment for women newly diagnosed with endometrial hyperplasia, a condition that occurs when there is a hormonally related unbalanced overgrowth of the uterine lining. If left untreated, patients are at a significantly higher risk of developing uterine cancer.

Eighteen participants were enrolled in a multi-institutional trial and treated with metformin for three months. Results showed 56 percent of patients responded to treatment, defined as complete resolution of the hyperplasia. The effect was seen especially in women with simple hyperplasia without additional complications or irregularities.

Typically, women with endometrial hyperplasia are treated with progesterone-based therapies via depot injections, intrauterine devices, or oral medications. Progesterone works by counteracting the effects of estrogen and thinning the uterine lining. While effective in up to 80 percent of cases, progesterone therapies have been shown to cause significant side effects such as weight gain, mood changes, and gastrointestinal distress. Hysterectomy (surgical removal of the uterus) is also an alternative therapy for women who are post-menopausal, or have completed child-bearing.

"The results of our study may present an alternative treatment for particular forms of endometrial hyperplasia, in contrast to standard progesterone-based therapies or hysterectomy," said Emily Ko, MD, MSCR, an assistant professor of Obstetrics and Gynecology at the Perelman School of Medicine at the University of Pennsylvania, and lead author of the study. "Future prospective studies may better identify women for which metformin may be most beneficial, as well as the most effective dosing regimens."

http://www.eurekalert.org/pub_releases/2016-06/uomm-uso060316.php

UMMS scientists offer first look at how our cells can 'swallow up and quarantine' Zika

Research shows that the human protein, IFITM3, blocks Zika virus replication and prevents cell death

WORCESTER, MA - Eight weeks after receiving their first samples of Zika virus, scientists at the University of Massachusetts Medical School (UMMS) have shown that a very small protein we all have in our bodies, interferon-induced protein 3 (IFITM3), can dramatically reduce the ability of Zika virus to infect human and mouse cells. In some cases, IFITM3 can also prevent Zika virus from killing our cells. The findings, by senior author Abraham Brass, MD, PhD, assistant professor of microbiology & physiological systems, suggest that boosting the actions of IFITM3 may be useful for inhibiting Zika virus and other emerging viral infections. The study appears in the journal Cell Reports.

"This work represents the first look at how our cells defend themselves against Zika virus' attack," said Dr. Brass. "Our results show that Zika virus has a weakness that we could potentially exploit to prevent or stop infection."

Previous studies by Brass and Paul Kellam, PhD, professor from the Wellcome Trust Sanger Institute in the UK, have shown that people who have a genetic variant, or allele, of the IFITM3 gene are more susceptible to the development of severe influenza. While relatively rare in people of European decent, this IFITM3 variant is more common in Asia and Micronesia. The current study suggests that it will be important to test whether this allele might contribute to the risk of more severe Zika virus infections and birth defects, according to Brass.

An expert in flaviviruses, a family of viruses transmitted by mosquitos that includes Zika, yellow fever, dengue and West Nile, Brass has developed a suite of genomic tools to probe how human cells respond to pathogens and how these invaders exploit host cell factors and proteins to replicate.

"Having these tools allowed us to respond quickly when the Zika virus threat emerged," said Brass. "We simply adapted the technology we'd developed over the last four years working with dengue, influenza and other viruses to begin work on Zika virus."

The mosquito-transmitted Zika virus typically causes relatively mild symptoms in infected adults. Prior to outbreaks of the virus in Micronesia and Southeast Asia in 2007 relatively few human cases had been reported. An ongoing epidemic of Zika virus began in early 2015 in Brazil and with it new evidence emerged that Zika virus infection of mothers during early pregnancy can result in microcephaly, a severe brain defect in infants.

There is no treatment for Zika virus infection. The best way to prevent the infection is to limit potential exposure to the infected mosquitos that carry the disease. As summer heats up and mosquito season gets under way, the World Health Organization expects the virus to spread throughout much of the Americas including parts of the United States.

From their earlier research on dengue virus and other flaviviruses related to Zika virus, Brass and his group had a hunch that IFITM3 might reduce or block viral infection. Using the IFITM3 tools and assays they'd developed for studying dengue and influenza viruses, the Brass lab was able to rapidly test IFITM3's effect on Zika virus. "We just plugged Zika virus into our system and immediately began testing it," said Brass. "What might have taken many months or longer to build, we were able to turn around in just several weeks."

Found in nearly all human cells, IFITM3 works to alter the cell membrane, making it more difficult for viruses to penetrate this outer defense. The Brass lab found that when IFITM3 levels are low, Zika virus can more readily infiltrate into the cell interior and cause infection. Conversely, they discovered that when IFITM3 is abundant and on guard, it strongly prevents Zika virus from reaching the interior of the cell and so blocks its infection.

"In effect, we see that IFITM3 allows our cells to swallow up and quarantine the virus thereby stopping their own infection, and also the infection of neighboring cells" said George Savidis, a research associate in the Brass lab and the first author of the study. "We think this also reduces the levels of cell death caused by Zika virus.

"This work shows that IFITM3 acts as an early front line defender to prevent Zika virus from getting its hands on all of the resources in our cells that it needs to grow," said Savidis. "IFITM3 pretty much keeps Zika virus stuck in no man's land where it can't do anything to harm us."

The next step for Brass and his collaborators, including Sharone Green, MD, associate professor of medicine and a flavivirus expert at UMMS, is to test these findings in mice that are IFITM3-deficient to see whether these animals are more susceptible to the effects of Zika virus infection. The Brass lab is also searching for small molecules that can boost the levels, and hopefully the anti-viral actions, of IFITM3. Brass believes that such molecules could be developed into therapies to treat or protect us from Zika virus, as well as a growing list of other dangerous viruses.

"A lot of data by us and others in the field has shown that IFITM3 has a big impact on blocking many emerging viruses such as dengue, Zika, and Ebola" said Brass. "Given our recent results with Zika virus, it's now even more important that we work to find out how IFITM3 is blocking these viruses, and use that knowledge to prevent and treat infections."

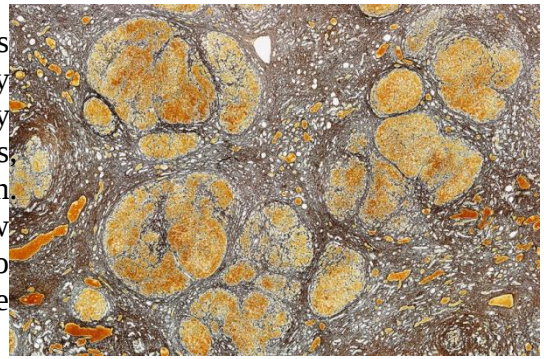
http://bit.ly/1X5pdYS

Failing livers transformed into healthy organs by virus therapy

From sinner to saint. A modified virus can repair diseased livers by turning bad cells into good. The treatment could one day offer a lifeline to thousands of people with liver failure.

By Andy Coghlan

More than 35,000 people in the US die of liver disease each year. The new viral treatment targets liver fibrosis, the progressive scarring of the liver that leads to organ failure.



Spot the bad cells and turn them good **Microscape/Science Photo Library**

Liver failure occurs when healthy cells called hepatocytes are damaged by alcohol and disease. The gaps left by these cells are filled with myofibroblasts, which generate scar tissue from collagen. Eventually the liver cannot generate new hepatocytes quickly enough to counteract the damage caused by the scar tissue and the organ fails.

Gene cocktail

Holger Willenbring of the University of California, San Francisco, and his colleagues worked out a way to transform myofibroblasts into healthy hepatocytes using a cocktail of liver gene switches called transcription factors.

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The problem was getting these transcription factors into a scarred liver. That's where the virus comes in. They packed a cold-related virus called an adeno-associated virus, or AAV, with their transcription factors and used it to infect

myofibroblasts in liver-damaged mice. Once inside the myofibroblasts, the virus downloads the transcription factors, which transform the cells into hepatocytes.

The treatment increased the number of healthy liver cells in the mice, as well as reducing the collagen content of their livers by a third on average. "We think the combination of making more hepatocytes and reducing collagen is the most promising approach to treating liver fibrosis," says Willenbring.

More treatments ahead

This new piece of research has encouraging and exciting implications for the future, says Vanessa Hebditch, director of communications and policy at the British Liver Trust. "The vector used in these studies is one that has already been used in the treatment of other human diseases so this is a promising approach."

"These are remarkable data," says Amit Nathwani at University College London, who is using AAVs in potential treatments for a blood disorder called haemophilia B. "Liver fibrosis is a major clinical problem and if these data can be reproduced clinically, the National Health Service would save billions and patients would be given a new lease of life."

Willenbring says that more work is needed to optimise the liver treatment, so it may be five years before it can be tried out in people.

Other treatments that regenerate livers are also in development, some rely on stem cells, others are aimed at building replacement organs from scratch.

Journal reference: Cell Stem Cell, *DOI: 10.1016/j.stem.2016.05.005*

http://nyti.ms/1Pd4ACq

Scientists Find Form of Crispr Gene Editing With New Capabilities

Just a few years ago, Crispr was a cipher — something that sounded to most ears like a device for keeping lettuce fresh. Today, Crispr-Cas9 is widely known as a powerful way to edit genes.

Carl Zimmer

Scientists are deploying it in promising experiments, and a number of companies are already using it to develop drugs to treat conditions ranging from cancer to sickle-cell anemia.

Yet there is still a lot of misunderstanding around it. Crispr describes a series of DNA sequences discovered in microbes, part of a system to defend against attacking viruses. Microbes make thousands of forms of Crispr, most of which are just starting to be investigated by scientists. If they can be harnessed, some may bring changes to medicine that we can barely imagine.

On Thursday, in the journal Science, researchers demonstrated just how much is left to discover. They found that an ordinary mouth bacterium makes a form of Crispr that breaks apart not DNA, but RNA — the molecular messenger used by cells to turn genes into proteins. If scientists can get this process to work in human cells, they may open up a new front in gene engineering, gaining the ability to precisely adjust the proteins in cells, for instance, or to target cancer cells.

"The groundbreaking thing about this work is that it now opens up the RNA world to Crispr," said Oliver Rackham, a synthetic biologist at the University of Western Australia who was not involved in the study.

Crispr was first discovered in 1987, but it took decades for scientists to figure out that microbes needed the system to recognize DNA from invading viruses and to chop it into pieces, stopping the infection.

In 2012, a team of scientists led by Jennifer Doudna of the University of California, Berkeley, and Emmanuelle Charpentier, then at Umea University in Sweden, discovered how to use this microbial defense as a gene-editing tool that could potentially alter any piece of DNA.

Most of that early work was carried out with Crispr molecules from a species of bacteria that lives in human skin called Streptococcus pyogenes. Once those molecules proved effective at reassembling human DNA, a number of scientists began looking at other species for Crispr systems that might be even better.

Some researchers investigated familiar species that have been studied in labs for decades. But Eugene V. Koonin and his colleagues at the National Center for Biotechnology Information instead scoured databases containing hundreds of millions of genetic sequences for those that resembled Crispr genes.

Once they discovered some candidates, they joined forces with Feng Zhang of M.I.T., who published one of the first studies on using Crispr to edit human DNA.

One of the first candidates they looked at came from a species of bacteria that lives in the mouth, known as Leptotrichia shahii. It had a group of genes that looked like Crispr genes in some ways, but with stark differences. When the researchers equipped bacteria with these genes, which they called C2c2, they found that the organisms gained a defense that had never been seen.

Many viruses do not contain DNA. Instead, their genetic information is encoded in RNA, DNA's single-stranded cousin, which they use to hijack the genes of their hosts and cause them to make new viruses. Some of these RNA viruses, such as H.I.V. and poliovirus, attack our species. Many others attack bacteria.

Previously discovered Crispr molecules are very good at whacking apart DNA but don't protect bacteria from an RNA virus. Dr. Zhang and his colleagues discovered that bacteria with C2c2 make molecules that can attack RNA and chop it up, destroying the invaders.

The researchers also found that they could tailor these genes to cut any RNA molecule they wanted. Now they are tinkering with the process to try to get it to work in human cells.

"There could be a lot of cool applications," Dr. Zhang said. He hopes, for example, that C2c2 molecules could be trained to destroy RNA made only in cancer cells. Those cells would be unable to make essential proteins and die.

While it remains to be seen if these will become useful tools, Dr. Koonin said, the discovery has already revealed something important about the evolutionary history of these microbial defenses.

Some parts of C2c2 genes share a common evolutionary origin with the defense systems seen in other bacterial species. Over billions of years, Dr. Koonin said, evolution has blindly tinkered with these genes in order to generate new ways to protect against viruses. Exploring this evolution is more productive for now than trying to design gene-editing technology from scratch, Dr. Zhang said. "We're not quite smart enough yet," he added.

In fact, some future advances in gene editing may even not be based on Crispr. Microbes have evolved several different lines of defense against viruses, some of which are only now coming to light. In recent years, for example, scientists have discovered that microbes can use another group of proteins, called Argonautes, to chop up viral DNA. Last month, a team of Chinese researchers announced that they were able to use Argonaute proteins to edit DNA in human cells.

Paul S. Knoepfler, a cell biologist at the University of California, Davis, is taking a wait-and-see attitude about Argonaute proteins, but he said he would not be surprised if they quickly turned out to be yet another powerful gene-editing tool.

"This field seems to move in dog years," he said. "It feels like seven times faster than real time."

http://www.eurekalert.org/pub_releases/2016-06/cru-npt060216.php

New pre-surgery technique may make colostomy bags redundant for emergency bowel cancer patients

AN expandable tube that unblocks the bowel before surgery could lead to fewer cancer patients -- diagnosed as emergencies -- needing a colostomy bag.

The Cancer Research UK-funded CReST trial presented at the 2016 American Society of Clinical Oncology (ASCO) Annual Meeting in Chicago today (Sunday)* found that less than half (45 per cent) of those who had their bowel unblocked by the tube, which uses body heat to expand, needed a colostomy bag.

But more than two-thirds (69 per cent) of those who had emergency surgery to remove the tumour and the blockage were fitted with bags. Around 41,100 people are diagnosed with bowel cancer each year in the UK with up to 20 per cent diagnosed as emergencies -- with some of these patients having their bowel blocked by the tumour.

One in six of those diagnosed need emergency surgery to relieve the blockage, but this is more likely than planned surgery to lead to complications such as needing a colostomy bag or spending time in intensive care after the surgery. The risk of death is also higher for emergency surgery -- around 12 per cent compared with two per cent for planned surgery.

In the study almost 250 bowel cancer patients who were diagnosed as emergencies with blocked bowels were divided into two groups and either had emergency surgery or the expanding tube -- also known as a stent -- followed by surgery between one to four weeks later.

The expanding tube worked in 82 per cent of cases and patients who had it survived as long as those who didn't.

Doctors insert an endoscope -- a small camera -- into the bowel which guides the tube to the tumour and helps place it through any remaining gap in the blocked bowel.

When inserted the tube is just three millimetres wide but expands in response to the heat of the body over 48 hours to become two and a half centimetres wide -- about eight times larger. This pushes the bowel open and allows the contents of the bowel to pass.

Trial lead Professor James Hill, from the Central Manchester University Hospitals, said: "Traditionally doctors have worried that unblocking the bowel in this way could increase the chance of cancer spreading, but our early results don't show this. We're also pleased to see that this could be a way of reducing the risk of patients needing a colostomy bag after their surgery - which is a huge improvement to patients' day-to-day lives.

"These are early results and we'll need to follow-up our work for three years in full to find out if this technique affects survival and end-of-life care for bowel cancer patients."

Martin Ledwick, Cancer Research UK's head information nurse, said: "This treatment isn't suitable for everyone, but for those who are it could have a huge impact on their lives after surgery. Not needing a colostomy bag is likely to significantly improve the quality of life of patients. If longer term follow up and larger studies confirm these results it is great news for bowel cancer patients who come to A&E with bowel blockages."

More information about the CReST trial available here: http://www.cancerresearchuk.org/about-cancer/find-a-clinical-trial/a-trial-looking-at-relieving-a-blockage-caused-by-suspected-bowel-cancer-with-a-tube-inside-the-bowel and here: http://abstract.asco.org/176/AbstView_176_169602.html

http://www.bbc.com/news/uk-36455719

Breast cancer: Taking hormonal drugs for up to 15 years can reduce risk - study

Taking hormonal drugs for up to 15 years reduces the risk of breast cancers coming back, a landmark study suggests.

By James Gallagher Health editor, BBC News website in Chicago

The trial, involving 1,918 patients, which had top billing at the world's largest cancer conference, showed the risk was cut by a third. Experts described it as a "big deal" that will change treatment for millions of women. But they warned there were risks, including osteoporosis. Globally, 1.7 million women are diagnosed with breast cancer around the world each year.

Double dose

Around 80% of the tumours are fuelled by the female sex hormone, oestrogen. Such cancers have a low but persistent risk of returning that lasts for years. It is why women already take drugs such as tamoxifen, to prevent oestrogen getting into breast cells, or aromatase inhibitors, which stop the body making oestrogen, for years after the lump is removed.

The trial, carried out on post-menopausal women, doubled aromatase inhibitor treatment from five to 10 years. The data, presented to the American Society of Clinical Oncology (ASCO), showed that cancer recurrence was cut by 34%.

But many women on the trial had already taken other hormonal drugs before starting on aromatase inhibitors and benefited from 15 years of treatment.

Prof Paul Goss, one of the researchers from Massachusetts General Hospital, said: "[The study] will have an enormous impact, a reduction in recurrences is a very important finding. "Aromatase inhibitors are now readily available around the world and therefore our results will further improve the outcome of women with breast cancer globally."

At the end of the study, 95% of women were still cancer-free if they had taken the extra medication, compared with 91% without.

The study did not show an improvement in survival rates, as patients had not been followed for long enough, but scientists expect this to come as "night follows day". The results, which have also been published in the New England Journal of Medicine, have been widely praised as significant.

'Substantial number'

Dr Nick Turner, a breast cancer specialist from the Institute of Cancer Research in London, told the BBC News website: "It is a big deal, it's going to be a change of treatment for a lot women. "Extended letrozole [an aromatase inhibitor] in years 10-15 has benefit in preventing a new breast cancer diagnosis. "But this won't be for everyone, many will be low risk and can probably safely stop at five years [of aromatase inhibitors], but then we're talking about a substantial number of women keeping going from five to 10 years [of aromatase inhibitors]."

There were side effects to treatment including loss of libido, hot flushes and vaginal dryness. The treatment also increased the risk of osteoporosis and bone fractures. Experts said it should be a decision between doctor and patient whether to continue.

'Compelling'

Dr Harold Burstein, from ASCO and the Dana Farber Cancer Institute, said: "I think you can say fairly that for millions of women around the world these data will support longer durations of anti-oestrogen therapy."

But he said the balance of risks and benefits meant the drugs would likely be targeted at those whose tumours were most likely to come back. He said: "In general, I would imagine that women who had riskier cancers will look to these data and think they are compelling for continuing on longer durations of treatment out to 10 or 15 years. "But we're certainly not at the point of saying women should be on these drugs for the rest of their lives."

In the UK, more than 40,000 women are diagnosed with an oestrogen-positive breast cancer each year. Up to three years of tamoxifen, followed by five years of aromatase inhibitors is a common practice.

Baroness Delyth Morgan, the chief executive at the charity Breast Cancer Now, said: "This a really important study that could one day have a major impact on how we use anti-hormone breast cancer treatments."

Prof Arnie Purushotham, from Cancer Research UK, said it was an "important" finding but called for more long-term studies.

http://theconversation.com/rip-e-t-most-aliens-will-die-young-60243

RIP E.T. – most aliens will die young

Astronomers have found a plethora of planets around nearby stars. And it appears that Earth-sized planets in habitable zones are probably common.

So, with tens or even hundreds of billions of potentially habitable planets within our galaxy, the question becomes: are we alone?

Indeed, the search for alien life has become the holy grail for the next generation of telescopes and space missions to Mars and beyond. But could our search for E.T. be naively optimistic?

Many scientists and commentators equate “more planets” with “more E.T.s”. However, the violence and instability of the early formation and evolution of rocky planets suggests that most aliens will be extinct fossil microbes.

Just as dead dinosaurs don’t walk, talk or breathe, microbes that have been fossilised for billions of years are not easy to detect by the remote sampling of exoplanetary atmospheres.

Gaian Bottleneck

In research published in the journal Astrobiology, we argue that early extinction could be the cosmic default for life in the universe. This is because the earliest habitable conditions may be unstable.

In our "Gaian Bottleneck" model, planets need to be inhabited in order to remain habitable. So even if the emergence of life is common, its persistence may be rare.

Mars, Venus and Earth were more similar to each other in their first billion years than they are today. Even if only one of the planets saw the emergence of life, this era coincided with heavy bombardment from asteroids, which could have spread life between the planets.

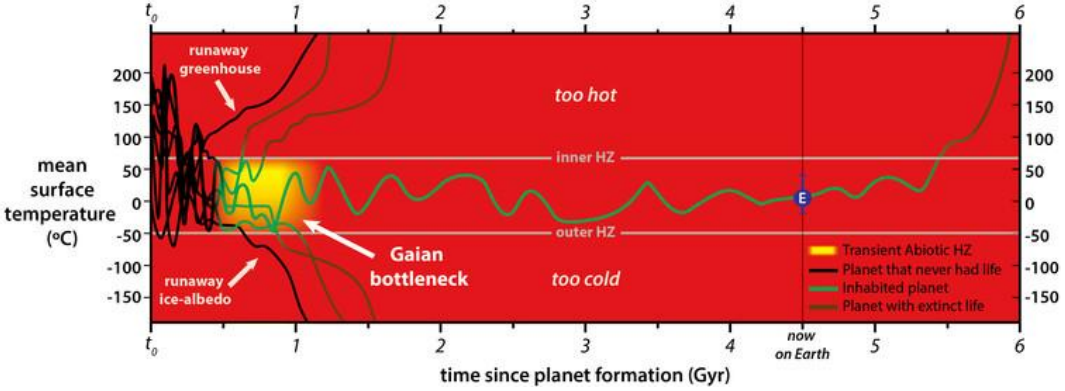
But about 1.5 billion years after formation, Venus started to experience runaway heating and Mars experienced runaway cooling. If Mars and Venus once harboured life, that life quickly went extinct.

Even if wet rocky Earth-like planets are in the "Goldilocks Zone" of their host stars, it seems that runaway freezing or heating may be their default fate.

Large impactors and huge variation in the amounts of water and greenhouse gases can induce positive feedbacks cycles that push planets away from habitable conditions.

The carbonate-silicate weathering cycle, which provides the major negative feedback to stabilise Earth's climate today, was probably inoperative, or at least inefficient, until about 3 billion years ago.

However, life on Earth may have had the fortuitous ability to create stability by suppressing the positive runaway feedback loops and enhancing the negative feedback loops.



How did Earth manage to remain habitable for almost 4 billion years while one sibling turned into a hot hell-house and the other a frozen ice-box? JAXA/NASA/ESA

We should probably thank the unpredictable evolution of microbial communities our planet hosted early in its history for saving us from runaway conditions that would make Earth too hot or too cold for us to live.

As soon as life became widespread on Earth, the earliest metabolisms began to modulate the greenhouse gas composition of the atmosphere. It is no coincidence that methane, carbon dioxide, hydrogen and water are all potent greenhouse gases and also the reactants and products of metabolic reactions of the earliest microbial mats and biofilms.

We postulate a habitable zone (yellow) that is unstable and lasts only from ~0.5 to ~1 billion years after the planet forms. Then, in the next ~0.5 billion years, surface temperatures drift or run away from habitability. **Chopra & Lineweaver (2016), Author provided**

The emergence of life's ability to regulate initially non-biological feedback mechanisms (what we call "Gaian regulation") could be the most significant factor responsible for life's persistence on Earth.

Abiotic habitable zones are transient

The Earth is not the only planet in our galaxy with liquid water on its surface and energy sources and nutrients to enable life to form.

Although the universe is filled with stars and planets conducive to life, the absence of any evidence for alien life suggests that even if the emergence of life is easy, its persistence may be difficult.

Our work challenges conventional views that physics-based habitable zones provide stable conditions for life for many billions of years.

Although, the cottage industry of habitable zone modellers can turn various knobs that control atmospheric and geophysical properties to stabilise planets over short-

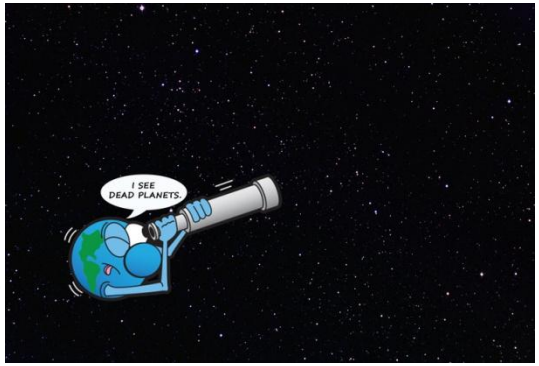
timescales, they have mostly ignored the role of biology in keeping planets habitable over billions of years.

This is in part because the complexities of interactions between microbial communities that keep ecosystems stable are not sufficiently understood.

We hypothesise that even if life does emerge on a planet, it rarely evolves quickly enough to regulate greenhouse gases, and thereby keep surface temperatures compatible with liquid water and habitability.

Maintaining life on an initially wet rocky planet in the habitable zone may be like trying to ride a wild bull. Most riders falls off. So inhabited planets may be rare in the universe, not because emergent life is rare, but because habitable environments are difficult to maintain during the first billion years.

Most life dies young



Our suggestion that the universe is filled with dead aliens might disappoint some, but the universe is under no obligation to prevent disappointment.

We should not expect technological or spacefaring civilisations because there is no evidence that biological evolution converges to human-like intelligence.

And subjective philosophical notions of life in the universe should not inform our estimates of the probability of life beyond Earth.

Our search for extant extraterrestrial life may be thwarted by planetary instability snuffing out incipient life. **Author provided**

Superficially, these ideas seem to undermine the motivation for SETI and the recently announced Breakthrough Listen project.

Nevertheless, we support SETI because when we explore new regions of parameter space, we often find the unexpected.

In his book Pale Blue Dot, Carl Sagan reminded us that “in our obscurity, in all this vastness, there is no hint that help will come from elsewhere to save us from ourselves”.

In the two decades since it was published, we’ve learnt that our cosmic backyard is littered with pale dots, probably in many colours of the rainbow. As we embark on the adventure of exploring our galactic neighbourhood with bigger and better telescopes, we may find only spooky planets haunted by long dead microbial E.T.s.

http://www.bbc.com/news/health-36437428

Scientists grow human organs for transplant inside pigs

Scientists in the United States are trying to grow human organs inside pigs.

By Fergus Walsh Medical correspondent

They have injected human stem cells into pig embryos to produce human-pig embryos known as chimeras. The embryos are part of research aimed at overcoming the worldwide shortage of transplant organs.

The team from University of California, Davis says they should look and behave like normal pigs except that one organ will be composed of human cells.

The human-pig chimeric embryos are being allowed to develop in the sows for 28 days before the pregnancies are terminated and the tissue removed for analysis.

The BBC's Panorama was given exclusive access to the research for Medicine's Big Breakthrough: Editing Your Genes.

Creating a chimera

Creating the chimeric embryos takes two stages. First, a technique known as CRISPR gene editing is used to remove DNA from a newly fertilised pig embryo that would enable the resulting foetus to grow a pancreas. This creates a genetic "niche" or void. Then, human induced pluripotent (iPS) stem cells are injected into the embryo. The iPS cells were derived from adult cells and "dialled back" to become stem cells capable of developing into any tissue in the body. The team at UC Davis hopes the human stem cells will take advantage of the genetic niche in the pig embryo and the resulting foetus will grow a human pancreas.

Pablo Ross, a reproductive biologist who is leading the research told me: "Our hope is that this pig embryo will develop normally but the pancreas will be made almost exclusively out of human cells and could be compatible with a patient for transplantation."

But the work is controversial. Last year, the main US medical research agency, the National Institutes of Health, imposed a moratorium on funding such experiments. The main concern is that the human cells might migrate to the developing pig's brain and make it, in some way, more human.

Pablo Ross says this is unlikely but is a key reason why the research is proceeding with such caution: "We think there is very low potential for a human brain to grow, but this is something we will be investigating."

Biological incubator

His team has previously injected human stem cells into pig embryos but without first creating the genetic niche. Prof Ross said although they later found human cells in several parts of the developing foetus, they "struggled to compete" with the pig cells. By deleting a key gene involved in the creation of the pig pancreas, they hope the human cells will have more success creating a human-like pancreas.

Other teams in the United States have created human-pig chimeric embryos but none has allowed the foetuses to be born.

Walter Low, professor in the department of neurosurgery, University of Minnesota, said pigs were an ideal "biological incubator" for growing human organs, and could potentially be used to create not just a pancreas but hearts, livers, kidneys, lungs and corneas.

He said if the iPS cells were taken from a patient needing a transplant then these could be injected in a pig embryo which had the key genes deleted for creating the required organ, such as the liver: "The organ would be an exact genetic copy of your liver but a much younger and healthier version and you would not need to take immunosuppressive drugs which carry side-effects."

But Prof Low stressed that the research, using another form of gene editing called TALENs, was still at the preliminary stages, trying to identify the target genes which must be removed in order to prevent the pig from developing a particular organ. His team is also trying to create dopamine-producing human neurons from chimeric embryos to treat patients with Parkinson's disease. These embryos have been allowed to develop for up to 62 days - the normal gestation period is around 114 days.

Like the team in California, Prof Low said they were monitoring the effects on the pig brain: "With every organ we will look at what's happening in the brain and if we find that it's too human like, then we won't let those foetuses be born".

Animal viruses

Gene editing has revitalised research into xenotransplantation, and the concept of using animal organs for humans. In the mid-90s there were hopes that genetically modified pigs might provide an endless supply of organs for patients, and that cross-species transplants were not far off. But clinical trials stalled because of fears that humans might be infected with animal viruses.

Last year, a team at Harvard Medical School used CRISPR gene editing to remove more than 60 copies of a pig retrovirus.

Prof George Church, who led the research, told me: "It opens up the possibility of not just transplantation from pigs to humans but the whole idea that a pig organ is perfectible. "Gene editing could ensure the organs are very clean, available on demand and healthy, so they could be superior to human donor organs."

Animal suffering

But organisations campaigning for an end to factory farming are dismayed at the thought of organ farms.

Peter Stevenson, from Compassion in World Farming, told me: "I'm nervous about opening up a new source of animal suffering. Let's first get many more people to donate organs. If there is still a shortage after that, we can consider using pigs, but on the basis that we eat less meat so that there is no overall increase in the number of pigs being used for human purposes."

In Greek mythology, chimeras were fire-breathing monsters composed of several animals - part lion, goat and snake. The scientific teams believe human-pig chimeras should look and behave like normal pigs except that one organ will be composed of human cells.

Scott Fahrenkrug, whose Minnesota-based company Recombinetics is teaming up on the chimera research with Prof Low, told me: "Perhaps the term chimera is going to take on a new meaning and it will be one that's much more affectionate: chimeras will be seen to be what they are which is a saviour, given that they will provide, life-saving, sustaining organs for our patients."

Seven thousand people in the UK are on the transplant waiting list and hundreds die each year before a donor can be found.