http://www.eurekalert.org/pub_releases/2016-04/ku-mrs_1042416.php

Mammal-like reptile survived much longer than thought

Fossils in Japan overturn widely accepted theory about tritylodontid extinction

Kyoto, Japan -- Teeth can reveal a lot, such as how the earliest mammals lived with their neighbors. Researchers have uncovered dozens of fossilized teeth in Kuwajima, Japan and identified this as a new species of tritylodontid, an animal family that links the evolution of mammals from reptiles. This finding suggests that tritylodontids co-existed with some of the earliest mammal species for millions of years, overturning beliefs that mammals wiped out mammal-like reptiles soon after they emerged.

Tritylodontids are the last known family of near-mammalian reptiles, before mammals with features such as advanced hearing evolved. Researchers have uncovered dozens of fossilized teeth in Kuwajima, Japan and identified this as a new species of tritylodontid. This suggests that tritylodontids co-existed with some of the earliest mammal species for millions of years. **Seishi Yamamoto/Hiroshige Matsuoka**

Tritylodontids are the last known family of near-mammalian reptiles, before mammals with features such as advanced hearing evolved.

"Tritylodontids were herbivores with unique sets of teeth which intersect when they bite," explains study author Hiroshige Matsuoka, based at Kyoto University. "They had pretty much the same features as mammals -- for instance they were most likely warm-blooded -- but taxonomically speaking they were reptiles, because in their jaws they still had a bone that in mammals is used for hearing."

While excavating a geologic layer from the Cretaceous era in Kuwajima, researchers found fossils of dinosaurs, turtles, lizards, fish, many types of plants, and Mesozoic mammals. Among these were more than 250 tritylodontid teeth, the first to be found in Japan.

Tritylodontids lived in the Jurassic era and proliferated worldwide, but were thought to have died out as herbivorous mammals took over their ecological role in the late Jurassic. "This made sense, because otherwise tritylodontids and the herbivorous mammals would have competed for the same niche," says Matsuoka.

But according to the team's finding, tritylodontids seem to have survived at least 30 million years longer than what paleontologists had believed.

"This raises new questions about how tritylodontids and their mammalian neighbors shared or separated ecological roles," says Matsuoka. The study is also the first of its kind to depend solely on details from teeth to determine whether the species is new, and also where it sits on the evolutionary tree.

"Usually fossils are identified as a new species only when a relatively complete set of structures like a jaw bone are found. In these cases, characteristics of teeth tend to be described only briefly," adds Matsuoka. "Tritylodontid teeth have three rows of 2-3 cusps. This time we paid attention to fine details like the size and shape of each cusp. By using this method it should be possible to characterize other species on the evolutionary tree as well."

"Because fossils of so many diverse families of animals are to be found in Kuwajima, we'd like to keep investigating the site to uncover things not just about individual species, but also about entire ecological dynamics."

The paper "A new Early Cretaceous tritylodontid (Synapsida, Cynodontia, Mammaliamorpha) from the Kuwajima Formation (Tetori Group) of central Japan" appeared 22 March 2016 in Journal of Vertebrate Paleontology, with doi: 10.1080/02724634.2016.1112289

http://www.eurekalert.org/pub_releases/2016-04/esoa-dbb041816.php

Do bed bugs have favorite colors?

Bed bugs strongly prefer some colors, and seem to avoid green and yellow

Researchers from the University of Florida and Union College in Lincoln, NE wondered whether bed bugs preferred certain colors for their hiding places, so they did some testing in the lab. The tests consisted of using small tent-like harborages that were made from colored cardstock and placed in Petri dishes. A bed bug was then placed in the middle of the Petri dish and given ten minutes to choose one of the colored harborages. A few variations of the test were also conducted, such as testing bed bugs in different life stages, of different sexes, individual bugs versus groups of bugs, and fed bugs versus hungry bugs.

The results, which are published in the Journal of Medical Entomology, showed that the bed bugs strongly preferred red and black, and they seemed to avoid colors like green and yellow.

"It was speculated that a bed bug would go to any harborage in an attempt to hide," wrote the authors. "However, these color experiments show that bed bugs do not hide in just any harborage; rather, they will select a harborage based on its color when moving in the light."

"We originally thought the bed bugs might prefer red because blood is red and that's what they feed on," said Dr. Corraine McNeill, one of the co-authors. "However, after doing the study, the main reason we think they preferred red colors is because bed bugs themselves appear red, so they go to these harborages

because they want to be with other bed bugs, as they are known to exist in aggregations."

While this is a plausible explanation, many factors influenced which color the bed bugs chose. For example, the bugs' color preferences changed as they grew older, and they chose different colors when they were in groups than when they were alone. They also chose different colors depending on whether they were hungry or fed. Furthermore, males and females seemed to prefer different colors. The authors suggest that a possible explanation for why bed bugs avoided yellow and green colors is because those colors resemble brightly-lit areas. These findings are important because they may have implications for controlling the pests.

"We are thinking about how you can enhance bed bug traps by using monitoring tools that act as a harborage and are a specific color that is attractive to the bug," said Dr. McNeill. "However, the point isn't to use the color traps in isolation, but to use color preference as something in your toolkit to be paired with other things such as pheromones or carbon dioxide to potentially increase the number of bed bugs in a trap."

In light of these results, people might be tempted to throw out their red and black sheets in place of yellow and green ones. However, Dr. McNeill warns that they might not want to replace the contents of their linen closets just yet.

"I always joke with people, 'Make sure you get yellow sheets!'" said Dr. McNeill. "But to be very honest, I think that would be stretching the results a little too much. I think using colors to monitor and prevent bed bugs would have to be specifically applied to some sort of trap, and it would have to be used along with another strategy for control. I don't know how far I would go to say don't get a red suitcase or red sheets, but the research hasn't been done yet, so we can't really rule that out completely."

Interestingly, this study almost never happened in the first place.

"We were trying to think of a new avenue to control bed bugs," said Dr. McNeill. "My advisor at the time, Dr. Phil Koehler, said to me, 'You know, I don't think we have any recent studies regarding bed bug vision or how they respond to colors if they're looking for a harborage.' At first I laughed at him and said, 'Oh Dr. Koehler, bed bugs can't see color or use color in that way! That's ridiculous.' However, he encouraged me to not push the idea out the door until we had tried some preliminary tests. So, we did some preliminary testing and found that the bed bugs were specifically going to certain colors over others, especially as it pertained to harborages. From there, we took the idea and ran with it."

The full article, "Behavioral Responses of Nymph and Adult Cimex lectularius (Hemiptera: Cimicidae) to Colored Harborages," is available at http://jme.oxfordjournals.org/lookup/doi/10.1093/jme/tjw033.

http://www.eurekalert.org/pub_releases/2016-04/uol-naa042516.php

New advance announced in fight against Parkinson's and Alzheimer's

Lab-based study led by University of Leicester discovers way of 'reversing' symptoms

A five-year study by an international team led from the University of Leicester has found a way of 'reversing' symptoms of neurodegenerative diseases such as Parkinson's and Alzheimer's - using fruit flies as test subjects.

The researchers have demonstrated that genetic and pharmacological approaches can be used to lower levels of toxic metabolites in the nervous system and thereby alleviate several symptoms of neurodegeneration.

The study, led by Dr Carlo Breda who works in the laboratory of Professor Flaviano Giorgini at the University of Leicester, is published in the Proceedings of the National Academy of Sciences of the USA. The research was performed in close collaboration with the University of Maryland School of Medicine (USA), led by Prof Robert Schwarcz, with Dr Korrapati Sathyasaikumar and Dr Francesca Notarangelo contributing. Other University of Leicester colleagues that contributed are Prof Charalambos Kyriacou, Shama Idrissi, Jasper Estanero, Gareth Moore, and Dr Edward Green.

Professor Giorgini, of the internationally acclaimed Department of Genetics at Leicester, said: "Our research is focused on better understanding the mechanisms that contribute to onset and progression of disease symptoms in neurodegenerative disorders. These are diseases in which specific populations of nerve cells within the brain die, leading to severe problems in movement and cognitive deficits in patients.

"The two most common neurodegenerative disorders worldwide are Alzheimer's and Parkinson's disease. The treatment options for these diseases are limited, and to date no cures exist. Our hope is that by improving our knowledge of how these nerve cells become sick and die in the brain, we can help devise ways to interfere with these processes, and thereby either delay disease onset or prevent disease altogether."

The newly published research utilized the common laboratory fruit fly Drosophila melanogaster in order to explore the role of specific metabolites in the kynurenine pathway that cause loss of nerve cells in models of Alzheimer's, Parkinson's, and Huntington's diseases.

Past studies by the Leicester team and others have shown some of these metabolites are toxic to nerve cells, and their levels are increased in these diseases. In the past the researchers have found that they can use genetic approaches to

inhibit (or "mute") the activity of two critical enzymes in this pathway - TDO and KMO - which lowers levels of the toxic metabolites and reduces nerve cell loss in a fruit fly model of Huntington's disease.

In the current study they have uncovered how inhibiting these two enzymes improves "symptoms" in flies because of increased levels of a "protective" kynurenine pathway metabolite known as kynurenic acid which counteracts the effects of the toxic metabolites.

Professor Giorgini said: "There is a fine balance between levels of "good" and "bad" metabolites that occurs in the kynurenine pathway. In disease, it shifts towards the "bad", and by inhibiting TDO or KMO, we shift it back to "good". For example, we find that if we inhibit either TDO or KMO in Huntington's flies we reduce loss of neurons. In Alzheimer's or Parkinson's flies we see extension of the shortened lifespan exhibited by these flies, and we also reverse the defects they have in movement. We have even used a drug-like chemical to inhibit TDO and found that this also alleviates 'symptoms'."

Dr Breda said: "There is considerable interest in developing drugs that 'turn down' these enzymes, so our hope is that our work could lead to drugs to treat these devastating disorders in the future. Neurodegenerative disorders are devastating diseases with limited treatment options. The major risk factor for these diseases is aging - and as our society is becoming longer lived, we are facing dramatic increases in the number of individuals suffering from these disorders."

Professor Giorgini added: "We are excited by these results, as they suggest that TDO and KMO inhibition could be a general strategy employed to improve symptoms in a myriad of neurodegenerative disorders, not just Parkinson's and Alzheimer's. Indeed, five years ago we first showed that these manipulations could improve "symptoms" in Huntington's disease model flies, so our next step is to validate our work in mammalian models and ultimately to see if such drugs could be helpful to patients in clinical trials"

Aspects of this work were supported by CHDI Foundation, NIH, and Parkinson's UK.

Commenting on the research Claire Bale, Head of Research Communications at Parkinson's UK, says: "Parkinson's is a progressive neurological brain condition, with symptoms emerging when 70% of nerve cells in the brain have been lost.

"Unfortunately current treatments are only able to tackle the symptoms of the condition, but cannot slow or stop the degeneration of these cells.

"This research which focuses on protecting brain cells, such as those lost in Parkinson's, by targeting proteins in the kynurenine pathway, could provide a turning point in the fight against this condition - which currently has no cure.

"There is a lot of potential in harnessing the power of protective proteins to prevent brain cell loss, and Parkinson's UK is exploring this by investing in a clinical trial of GDNF, a protein which may also support the survival of brain cells. "Research such as this continues to help open doors to further discoveries into treatments, which one day could tackle the underlying cause of the condition which affects 127,000 people in the UK."

http://www.eurekalert.org/pub_releases/2016-04/cp-cmb041816.php

Can mountain-climbing bears rescue cherry trees from global warming?

As the planet warms, one way for plants and animals to find their way to cooler territory is to move up higher into the mountains.

Now, researchers reporting in the Cell Press journal Current Biology on April 25 have found that cherry trees are indeed making their way to the mountaintops with help from an unexpected source: mountain-climbing bears. "The most important implication of our study on a warming planet is that seed dispersal direction can be asymmetric," says Shoji Naoe of the Forestry and Forest Products Research Institute in Ibaraki, Japan.

This photograph shows wild cherry (Prunus verecunda) in full bloom in Okutama, Japan. **Toshio Katsuki**

"Most previous studies have predicted future plant distributions under global warming based on the simple relationships between present plant distribution and environmental factors there, assuming that there are no seed dispersal limitations and no bias in dispersal direction. However, our study indicates that predicting future plant distributions can be very uncertain without considering the seed dispersal process that determines plant movement."

In the case of cherry trees, it's all about the bears.

If the goal is to seek cooler temperatures, then moving to higher altitudes is a rather useful strategy, the researchers explain. That's because the temperature change with increasing altitude is about 100 to 1,000 times greater than can be obtained by moving the same distance to the north or south.

The researchers spent 3 years, from 2010 to 2013, studying the movement of wild cherry tree seeds in the dung of Asiatic black bears and small mammals known as Japanese martens. The bears accounted for the bulk of seed movement by mammals, according to their study.

To determine how the seeds moved in space, the researchers relied on the ratio of stable oxygen isotopes in the seeds, which correspond to the temperatures in the place where the plant grew. Their studies show that bears often move seeds over several hundred meters, almost always toward the mountaintops.

"We show that bears disperse seeds toward mountaintops, probably because bears climb mountains following the spring plant phenology, proceeding from the foot to the top of mountains," Naoe says.

The dispersal distance of the seeds was considered to be sufficient for the cherries to cope with global warming. The distance that the bears and martens moved the seeds corresponded to a drop in temperature of about 1.0°C or 2.0°C, enough to offset the projected global temperature rise of almost 5°C by the year 2100.

While the findings come as good news for cherry trees, they are a reminder that the movement patterns of individual plants in nature will be hard to accurately predict without careful consideration of their complex interactions with seed-dispersing animals, the researchers say. Estimates suggest that more than one-third of plants depend on animals to disperse their seeds.

Naoe and colleagues will continue to explore the ability of various plants to travel up into the mountains by various routes, including birds, wind, and water. They suspect that the story won't be as hopeful for autumn-fruiting plants dispersed by mammals as they come down from the mountains.

"Seed dispersal toward the base of the mountain is a tragedy under global warming," Naoe says.

This work was funded by the Japan Society for the Promotion of Science and the Ministry of the Environment. The present study was conducted using Joint Usage/Research Grant of Center for Ecological Research, Kyoto University.

Current Biology, Naoe et al.: "Mountain-climbing bears protect cherry species from global warming through vertical seed dispersal" http://www.cell.com/current-biology/fulltext/S0960-9822(16)30170-1

http://www.eurekalert.org/pub_releases/2016-04/wtsi-mdr042216.php

Modern DNA reveals ancient male population explosions linked to migration and technology

The largest ever study of global genetic variation in the human Y chromosome has uncovered the hidden history of men.

Research published today (25 April) in Nature Genetics reveals explosions in male population numbers in five continents, occurring at times between 55 thousand and four thousand years ago.

The study, led by Dr Chris Tyler-Smith of the Wellcome Trust Sanger Institute, analysed sequence differences between the Y chromosomes of more than 1200 men from 26 populations around the world using data generated by the 1000 Genomes Project.

The work involved 42 scientists from four continents.

Dr David Poznik, from Stanford University, California, first author on the paper, said: "We identified more than 60,000 positions where one DNA letter was replaced by another in a man with modern descendants, and we discovered thousands of more complex DNA variants. These data constitute a rich and publicly available resource for further genealogical, historical and forensic studies."

Analysing the Y chromosomes of modern men can tell us about the lives of our ancestors. The Y chromosome is only passed from father to son and so is wholly linked to male characteristics and behaviours. The team used the data to build a tree of these 1200 Y chromosomes; it shows how they are all related to one another. As expected, they all descend from a single man who lived approximately 190,000 years ago.

The most intriguing and novel finding was that some parts of the tree were more like a bush than a tree, with many branches originating at the same point.

Dr Yali Xue, lead author from the Wellcome Trust Sanger Institute, explained: "This pattern tells us that there was an explosive increase in the number of men carrying a certain type of Y chromosome, within just a few generations. We only observed this phenomenon in males, and only in a few groups of men."

The earliest explosive increases of male numbers occurred 50,000-55,000 years ago, across Asia and Europe, and 15,000 years ago in the Americas.

There were also later expansions in sub-Saharan Africa, Western Europe, South Asia and East Asia, at times between 4,000 and 8,000 years ago.

The team believes the earlier population increases resulted from the first peopling by modern humans of vast continents, where plenty of resources were available.

The later expansions are more enigmatic.

Dr Chris Tyler-Smith, from the Sanger Institute, added: "The best explanation is that they may have resulted from advances in technology that could be controlled by small groups of men. Wheeled transport, metal working and organised warfare are all candidate explanations that can now be investigated further."

All of the samples and data from the 1000 Genomes Project are freely available for use by other scientists and interested investigators.

Poznik GD et al. Punctuated bursts in human male demography inferred from 1,244 worldwide Y-chromosome sequences is published in Nature Genetics 25 April 2016 DOI: 10.1038/ng.3559

http://bit.ly/1N4tYyH

Plants may form memories using mad cow disease proteins

Prions – those infamous proteins linked to mad cow disease -may be responsible for memory in plants.

By Anil Ananthaswamy

The proteins may help plants change their activity based on past events, helping them decide when to flower, for instance.

A mustard remembers **Kumiko Shimizu/EyeEm/Getty**

That plants have memory is well known. For instance, certain plants flower after a prolonged exposure to cold. But if the conditions are not right following the cold, the plant will delay flowering until temperature and light are just right. This suggests that plants "remember" the exposure to cold.

You can even take tissue from such plants and grow a new plant, and it, too, will remember the encounter with the cold, and flower accordingly. The biological state is somehow perpetuated in both the original and new plants.

"Plants have lots of states that they self-perpetuate," says Susan Lindquist of the Massachusetts Institute of Technology. "They have memory in some ways."

A prion protein can fold in two ways: it has a normal form and a prion form. Once it folds into a prion, it can then cause similar proteins to change their folding, turning them into prions too.

Lindquist's team already knew that yeasts use prions as a form of memory, and suspected that plants might too. Unlike in Creuzfeldt-Jakob disease, the human equivalent of BSE or "mad cow disease", where prions multiply in the human brain with terrible consequences, prions in yeast are beneficial. They can help the organism use different nutrients and grow in new places. Crucially, this ability persists over generations. "It could be a state that only lasts for 50 generations, or it could last for thousands and thousands of generations," says Lindquist.

The team applied techniques developed for finding prions in yeast to Arabidopsis thaliana, a flowering mustard plant. Their method involves using specialised algorithms to search the full complement of proteins expressed by the plant.

The researchers found four proteins involved in flowering that had portions that resembled prion-specific sequences in yeast. Next, the team replaced the prions in yeast cells with the prion-like protein sequences from Arabidopsis, and confirmed that the three of the four plant protein fragments did indeed behave like prions.

This is the first time a prion-like protein sequence has been found in plants. "We don't know what it's actually doing in the plant, so we are trying to be cautious," says Lindquist. "That's why we call it prion-like."

The finding is "very significant", says Frantisek Baluska at the University of Bonn, Germany, an expert on plant intelligence. "In fact, I was expecting the discovery of prions in plants."

"Prions, we think, are responsible for some really broad, really interesting biology," says Lindquist. "We have only seen the tip of the iceberg so far."

Journal reference: PNAS, DOI: 10.1073/pnas.1604478113

http://www.eurekalert.org/pub_releases/2016-04/lu-dts042616.php

Despite their small brains -- ravens are just as clever as chimps

Ravens are as clever as chimpanzees, despite having much smaller brains

A study led by researchers at Lund University in Sweden shows that ravens are as clever as chimpanzees, despite having much smaller brains, indicating that rather than the size of the brain, the neuronal density and the structure of the birds' brains play an important role in terms of their intelligence.

"Absolute brain size is not the whole story. We found that corvid birds performed as well as great apes, despite having much smaller brains", says Can Kabadayi, doctoral student in Cognitive Science.

Intelligence is difficult to test, but one aspect of being clever is inhibitory control, and the ability to override animal impulses and choose a more rational behaviour. Researchers at Duke University, USA, conducted a large-scale study in 2014, where they compared the inhibitory control of 36 different animal species, mainly primates and apes. The team used the established cylinder test, where food is placed in a transparent tube with openings on both sides. The challenge for the animal is to retrieve the food using the side openings, instead of trying to reach for it directly. To succeed, the animal has to show constraint and choose a more efficient strategy for obtaining the food.

The large-scale study concluded that great apes performed the best, and that absolute brain size appeared to be key when it comes to intelligence. However, they didn't conduct the cylinder test on corvid birds.

Can Kabadayi, together with researchers from the University of Oxford, UK and the Max Planck Institute for Ornithology in Germany, therefore had ravens, jackdaws and New Caledonian crows perform the same cylinder test to better understand their inhibitory control.

The team first trained the birds to obtain a treat in an opaque tube with a hole at each end. Then they repeated the test with a transparent tube. The animal impulse would naturally be to go straight for the tube as they saw the food. However, all of the ravens chose to enter the tube from the ends in every try. The performance of the jackdaws and the crows came very close to 100%, comparable to a performance by bonobos and gorillas.

"This shows that bird brains are quite efficient, despite having a smaller absolute brain size. As indicated by the study, there might be other factors apart from absolute brain size that are important for intelligence, such as neuronal density", says Can Kabadayi, and continues:

"There is still so much we need to understand and learn about the relationship between intelligence and brain size, as well as the structure of a bird's brain, but this study clearly shows that bird brains are not simply birdbrains after all!"

The research article published in the journal Royal Society Open Science: http://rsos.royalsocietypublishing.org/content/3/4/160104

http://www.eurekalert.org/pub_releases/2016-04/uoct-drb042616.php

Danish researchers behind vaccine breakthrough

Completely new and simple method which sets new standards for the development of vaccines

The next generation of vaccines may soon see the light of day, because Danish researchers have discovered a completely new and simple method which sets new standards for the development of vaccines.

"The major research breakthrough is that we have created a general and user-friendly platform for the development of a special type of effective and safe vaccines. The highly effective method opens a new door for controlling diseases such as cancer, asthma, allergies and cardiovascular diseases by means of vaccines. We are therefore already now able to initiate strategies to combat some of the biggest killers in the western world," says Postdoc Adam Sander, Department of Immunology and Microbiology, University of Copenhagen.

How the new vaccines work

The idea behind the new technique is to mimic the structure of a virus. When you have made the virus structure, it is used as a platform onto which are glued harmless parts of the disease which you want to vaccinate against. This creates an overall virus-like structure, which constitutes an important danger signal for the body. The immune system will therefore produce antibodies against the disease - a mechanism which has been difficult to activate by traditional vaccines.

The Danish research team's technology is also so effective that it can trick the immune system into attacking the body's own cells, which may be used in the treatment of a number of serious diseases, e.g. cancer, which are not caused by foreign organisms.

"We can see from our experiments that the method works. The method is generic, which means that we can glue, for example, different parts of pathogenic organisms onto the surface of the virus-like platform. Previously, it was a major problem to activate the immune system and get an adequate response. We have lacked the possibility to easily create a vaccine which mimics something that will trigger a natural response from the body, but the new virus-like platform now allows us to do so. In other words, we now have a unique technique that enables us to develop vaccines against diseases that we have so far been unable to fight," says PhD student Susan Thrane.

The vaccine breakthrough also means that previous research in vaccines can get a new life. For many years, researchers have tried to find vaccines against, for example, malaria, cancer and allergies, but the vaccines have either been too ineffective or dangerous. However, the new research provides the 'structural' building blocks that were needed to make the vaccines effective. This means that new vaccine research can proceed directly to the development and testing of new vaccines against, for example, breast cancer and allergies.

Huge potential for development of inexpensive vaccines in low-income countries

The technique for the development of the new type of vaccines is very simple. Where vaccines have so far been complicated to develop and produce, it will now be possible for laboratories all over the world to employ and implement the technique.

"It has always been an important mission for us to make the platform available for researchers all over the world. With our research, we offer a very simple tool that allows health professionals to produce complex vaccines in an effective, safe and cost-effective manner. It will be a game changer for low-income countries, which can now make vaccines targeted at widespread diseases such as tuberculosis and malaria. There is no doubt that the new results will have a significant impact on tomorrow's vaccines and public health," says Professor Ali Salanti.

http://www.eurekalert.org/pub_releases/2016-04/uow-rid042616.php

Rare ice data collected by early 'citizen scientists' confirms warming

Oldest inland water ice records in human history are contributing to modern understanding of climate change

MADISON, Wis. -- In 1442, 50 years before Columbus "sailed the ocean blue," Shinto priests in Japan began keeping records of the annual freeze dates of a nearby lake. Along a Finnish river, starting in 1693, local merchants recorded the date the ice broke up each spring. These observations are among the oldest inland water ice records in human history, and now they are contributing to modern understanding of climate change.

According to a new study published in Nature Scientific Reports, the meticulous record keeping of these historical "citizen scientists" reveals increasing trends toward later ice cover formation and earlier spring breakup since the start of the Industrial Revolution.

"These data are unique," says John Magnuson, a researcher and emeritus professor at the University of Wisconsin-Madison's Center for Limnology. "They were collected by humans viewing and recording the ice event year after year for centuries, well before climate change was even a topic of discussion."

Magnuson and Sapna Sharma, a York University biologist, co-led the study, which involved an international team of scientists from Canada, the United States, Finland and Japan.

The records from Lake Suwa, in the Japanese Alps, were collected by Shinto priests observing a legend about a male god who crossed the frozen lake to visit a female god at her shrine, says Magnuson. On Finland's Torne River, a local merchant began collecting data because the river -- and its frozen-or-thawed status -- was important to trade, transportation and food acquisition.

Ice seasonality, or when a lake or river freezes over in winter or thaws again in spring, is a variable strongly related to climate, says Magnuson. While such a long-term, human-collected dataset is remarkable in and of itself, the climate trends the data reveals are equally notable.

"Even though the two waters are half a world apart and differ greatly from one another," he says, "the general patterns of ice seasonality are similar for both systems."

For example, the study found that from 1443 to 1683, Lake Suwa's annual freeze date was moving almost imperceptibly to later in the year -- at a rate of 0.19 days per decade. From the start of the Industrial Revolution, however, that trend grew 24 times faster, pushing the lake's "ice on" date back 4.6 days per decade. On the Torne River, there was a corresponding trend for earlier ice break-up in the spring, as the rate with which the river moved toward earlier thaw dates doubled. These findings strongly indicate more rapid climate change during the last two centuries, the researchers report.

"Although there are local factors that are influencing both systems," says Sharma, "climate changes associated with increasing carbon dioxide emissions and air temperatures are important, perhaps overarching factors explaining the trends."

In recent years, she notes, both waters have exhibited more extreme ice dates corresponding with increased warming. For Lake Suwa, that means more years where full ice cover never occurs. Before the Industrial Revolution, Lake Suwa froze over 99 percent of the time, but beginning more recently, it does so only half the time. A similar trend is seen with extremely early ice breakup on the Torne. Extreme cases once occurred in early May or later 95 percent of the time, but they are now primarily in late April and early May.

"Our findings not only bolster what scientists have been saying for decades, but they also bring to the forefront the implications of reduced ice cover," says Sharma -- with consequences for ecology, culture and economy.

For example, she says, "decreasing ice cover erodes the 'sense of place' that winter provides to many cultures, with potential loss of winter activities such as ice fishing, skiing and transportation." In addition, less ice cover can lead to more evaporation and lower water levels while warmer water contributes to more algal blooms and impaired water quality, she says.

The team of researchers say their findings also suggest that the fluctuations of large-scale climate drivers have changed, leading to more frequent events associated with El Niño or La Niña. They plan follow-up studies to better understand how lake and river ecosystems are affected, as the number of days they spend "on ice" continues to melt away.

http://bit.ly/1pOqe9s

It Takes Effort to be Selfish

Altruism, it seems, takes less energy than being selfish, researchers have found.

by Victoria Sayo Turner

Selflessness can be sexy. Generosity has been shown to pique the fancy of people seeking long term partners. It seems understandable that generosity to others might promise generosity in a relationship, but beyond identifying love interests, helping others seems to strengthen all human relations. Without selflessness, the logic goes, we as a society would devolve into chaos. Those who do not share at the metaphorical sandbox are not invited back to play.

So where does selflessness come from? This question, sustaining centuries of philosophical debate, is whether selflessness is an effort or a default. Recent research hints at the neural answer, locating specific areas of the brain which seem to rein in our better nature. This suggests that selflessness is the default option. Your conscience aside, surrendering your seat on the train for someone else might be a little less effort for your brain.

People participating in the experiment received transcranial magnetic stimulation (TMS) to one of two wedges of the prefrontal cortex, the dorsomedial or dorsolateral, and decided how to split ten dollars with recipients pictured on a screen. A TMS coil forms alternating magnetic fields, like a wireless phone charger, to stir up electrical currents nearby. Rather than charging our brains, of course, researchers use TMS to alter brain activity. In this case, the TMS temporarily disrupted the prefrontal cortex. By throwing this wrench in the works, the researchers could test if people acted more or less generous without this area’s contribution.

The prefrontal cortex, famous for maturing last in the brain, is believed to help us resist temptations and make complex judgments, but this was a first direct test of its role in altruistic generosity. If disruption of the brain area led to less giving, then the undisturbed prefrontal cortex might restrain self-serving urges. If TMS disruption led to more giving, that would suggest that it restrains our natural generosity.

The second possibility proved true. Disruption of prefrontal cortex by TMS led to greater giving, on average, than disruption of unrelated motor areas. This region seemed to act like a control valve for generosity, aligning with its other roles in impulse control. But the impulse here looked to be selfless, not selfish.

Another puzzle emerged, though, when researchers noticed where people gave the additional money. During the experiment, the participants saw an annual income next to each recipient's face. Disrupting the dorsomedial prefrontal cortex led participants to give more to poorer recipients, while disrupting the adjacent dorsolateral part produced greater giving to wealthy recipients. What kind of brain regulates generosity so specifically? The researchers proposed that one region might act as a "contextual" control, holding back generosity towards higher earning recipients, while the other region might act as a baseline control of generosity. In this interpretation, the brain has subcomittees on whether we should give and where the gifts should go. The contextual control area seems more analytic, active during tough logical decisions, while the baseline control area activates while sensing others' states of mind, perhaps distinguishing ourselves versus others.

Some research on TMS has reported side effects like headaches or odd sensations. These symptoms could conceivably have confused the participants or made them perform in a haze during the experiment. Leonardo Christov-Moore, lead author of the study, states there were no obvious side effects in people participating. And, he said, "if the default is to be selfish, why would making you confused make you less selfish?"

Studies like these can have trouble pinning down exactly when people are acting thoughtful or selfish. Research from 2006 concluded that TMS disruption of prefrontal cortex caused participants to act more self-interested, which doesn't square with a role holding back generosity. However, the 2006 experiment involved a complex task in which people could either accept or reject money after someone split ten dollars with them. (Rejecting an offer punished both people, because neither received money from the round.) People who received TMS to disrupt the prefrontal cortex accepted more stingy offers, but at least two interpretations are possible. They could have sacrificed their sense of fairness in order to grab any money they could. Or, Christov-Moore suggests, they could have been accepting a raw deal as an act of generosity. The underlying cognitive brain is no less complex. Numerous cognitive tasks rely on any given region, and the latest human studies point to the vigorous multitasking of brain space. We still have much to understand about how fairness or altruism arise, not to mention how to use what we do know.

Charity is often described as an effort one should make. We should donate. We should be humanitarians. We should volunteer. This study suggests that in some ways, selflessness is actually less demanding than selfishness. While we logically decide to look after ourselves, an undercurrent of empathy might push us to be generous. For Christov-Moore, what stays with him is that altruism is "not something that's very abstract and rational. It's actually a very emotional impulse."

http://www.eurekalert.org/pub_releases/2016-04/osu-wlm042716.php

Working longer may lead to a longer life, new OSU research shows

Working past age 65 could lead to longer life, while retiring early may be a risk factor for dying earlier, a new study from Oregon State University indicates.

CORVALLIS, Ore. - The researchers found that healthy adults who retired one year past age 65 had an 11 percent lower risk of death from all causes, even when taking into account demographic, lifestyle and health issues. Adults who described themselves as unhealthy were also likely to live longer if they kept working, the findings showed, which indicates that factors beyond health may affect post-retirement mortality.

"It may not apply to everybody, but we think work brings people a lot of economic and social benefits that could impact the length of their lives," said Chenkai Wu, the lead author of the study. He conducted the research as part of his master's thesis at OSU, where he is now a doctoral student in the College of Public Health and Human Sciences.

The findings were published recently in the Journal of Epidemiology and Community Health. Co-authors include Associate Professor Robert Stawski and Assistant Professor Michelle Odden of OSU and Gwenith Fisher of Colorado State University. The research was supported by a grant from the National Institute on Aging.

The research was the basis for Wu's master's thesis in human development and family science; he's now pursuing a doctorate in epidemiology.

Wu took an interest in the effects of retirement on health in part because of China's mandatory laws, which are often debated. Retirement age is also an issue for debate elsewhere around the world, including the United States, he said.

"Most research in this area has focused on the economic impacts of delaying retirement. I thought it might be good to look at the health impacts," Wu said. "People in the U.S. have more flexibility about when they retire compared to other countries, so it made sense to look at data from the U.S."

Wu examined data collected from 1992 through 2010 through the Healthy Retirement Study, a long-term study of U.S. adults led by the University of Michigan and funded by the National Institute on Aging. Of the more than 12,000 initial participants in the study, Wu narrowed his focus to 2,956 people who began the study in 1992 and had retired by the end of the study period in 2010.

Poor health is one reason people retire early and also can lead to earlier death, so researchers wanted to find a way to mitigate a potential bias in that regard.

To do so, they divided the group into unhealthy retirees, or those who indicated that health was a factor in their decision to retire - and healthy retirees, who indicated health was not a factor. About two-thirds of the group fell into the healthy category, while a third were in the unhealthy category.

During the study period, about 12 percent of the healthy and 25.6 percent of the unhealthy retirees died. Healthy retirees who worked a year longer had an 11 percent lower risk of mortality, while unhealthy retirees who worked a year longer had a 9 percent lower mortality risk. Working a year longer had a positive impact on the study participants' mortality rate regardless of their health status.

"The healthy group is generally more advantaged in terms of education, wealth, health behaviors and lifestyle, but taking all of those issues into account, the pattern still remained," said Stawski, senior author of the paper. "The findings seem to indicate that people who remain active and engaged gain a benefit from that."

Additional research is needed to better understand the links between work and health, the researchers said. As people get older their physical health and cognitive function are likely to decline, which could affect both their ability to work and their longevity.

"This is just the tip of the iceberg," Stawski said. "We see the relationship between work and longevity, but we don't know everything about people's lives, health and well-being after retirement that could be influencing their longevity."

http://www.eurekalert.org/pub_releases/2016-04/aaft-cac042516.php

Could a cancer drug be repurposed for fragile X syndrome?

An experimental cancer drug can improve learning and memory in mice with fragile X syndrome, according to a new study.

Unlike other potential treatments for this disorder that target neurons, the cancer drug coaxes neural stem cells to generate neurons potentially critical to cognitive function. The findings offer new hope to patients with fragile X syndrome, the most common cause of inherited intellectual disability and autism spectrum disorder, which currently lacks an effective treatment. Mutations in the fragile X mental retardation (FMR1) gene lead to loss of FMRP, a protein that regulates the expression of many genes in neurons. FMRP deficiency is known to impair neural stem cells' ability to generate new neurons in the adult brain, but how this occurs is not fully understood. Studying a mouse model of fragile X syndrome, Yue Li and colleagues found that loss of FMRP led to greater activation of neural stem cells, enhancing their differentiation into astrocytes, but not neurons. The researchers identified the enzyme MDM2 as a key target of FMRP in neural stem cells. FMRP deficiency led to greater MDM2 activity, resulting in enhanced neural stem cell proliferation but reduced differentiation. A specific MDM2 inhibitor known as Nutlin, currently in an early clinical trial for retinoblastoma, seemed to correct this imbalance between neural stem cell proliferation and differentiation. Low doses of Nutlin restored spatial memory and learning in FMRP-deficient mice, opening the door to repurposing the drug as a potential treatment for fragile X syndrome.

http://www.eurekalert.org/pub_releases/2016-04/bps-rac042716.php

Rosemary aroma can help older adults to remember to do things

The aroma of rosemary essential oil may improve ability of people over 65 to remember events and to remember to complete tasks at particular times in the future.

This is the finding of a study by post-graduate student Lauren Bussey, Lucy Moss and Dr Mark Moss of Northumbria University who will present their research today, Wednesday 27 April 2016, at the British Psychological Society's Annual Conference in Nottingham.

Lauren Bussey said: "In this study we focused on prospective memory. This involves the ability to remember events that will occur in the future and to remember to complete tasks at particular times. It's critical for everyday functioning. For example: when someone needs to remember to post a letter or to take medication at a particular time."

Rosemary and lavender essential oil were diffused in a testing room by placing four drops on an aroma stream fan diffuser and switching this on five minutes before the participants entered the room. A total of 150 people aged over 65 took part in the study and were randomly allocated to either the rosemary/lavender-scented room or another room with no scent.

Once in the room they undertook tests designed to assess their prospective memory functions. These included remembering to pass on a message at a given time during the procedure, and switching tasks when a specific event occurred. These tasks represent the two components of prospective memory: time-based

(remembering to do something at a specific time such as watch a TV show) and event-based (remembering to do something due to an environmental cue such as posting a letter after seeing a post box). Participants also completed mood assessment before and after undertaking tests in the scented or non-scented rooms. Analysis of the results showed that the rosemary aroma significantly enhanced prospective memory compared to the room with no aroma. In terms of mood, rosemary significantly increased alertness and lavender significantly increased calmness and contentedness compared to the no aroma control condition

Lauren Bussey said: "These findings support previous research indicating that the aroma of rosemary essential oil can enhance cognitive functioning in healthy adults. This is the first time that similar effects have been demonstrated in the healthy over 65's. Further investigation is required to understand the potential beneifts of these aromas throughout the life span."

http://www.eurekalert.org/pub_releases/2016-04/mu-ntt042716.php

No time to get fit? Think again -- just 1 minute of intense exercise produces health benefits

Researchers at McMaster University have found that a single minute of very intense exercise produces health benefits similar to longer, traditional endurance training.

The findings put to rest the common excuse for not getting in shape: there is not enough time. "This is a very time-efficient workout strategy," says Martin Gibala, a professor of kinesiology at McMaster and lead author on the study. "Brief bursts of intense exercise are remarkably effective."

Scientists set out to determine how sprint interval training (SIT) compared to moderate-intensity continuous training (MICT), as recommended in public health guidelines. They examined key health indicators including cardiorespiratory fitness and insulin sensitivity, a measure of how the body regulates blood sugar.

A total of 27 sedentary men were recruited and assigned to perform three weekly sessions of either intense or moderate training for 12 weeks, or to a control group that did not exercise).

The McMaster team has previously shown that the SIT protocol, which involved three 20-second 'all-out' cycle sprints, was effective for boosting fitness. The workout totaled just 10 minutes, including a 2-minute warm-up and 3-minute cool down, and two minutes of easy cycling for recovery between the hard sprints.

The new study compared the SIT protocol with a group who performed 45 minutes of continuous cycling at a moderate pace, plus the same warm-up and cool down. After 12 weeks of training, the results were remarkably similar, even though the MICT protocol involved five times as much exercise and a five-fold greater time commitment.

"Most people cite 'lack of time' as the main reason for not being active", according to Gibala. "Our study shows that an interval-based approach can be more efficient -- you can get health and fitness benefits comparable to the traditional approach, in less time."

Gibala, who has studied has been studying interval training for more than a decade. O, was the first researcher to show that a few minutes per week of intense exercise produced benefits similar to longer, continuous workouts. Over time, his team has experimented with different protocols in an effort to identify the most time-efficient exercise strategies.

"The basic principles apply to many forms of exercise," he says. "Climbing a few flights of stairs on your lunch hour can provide a quick and effective workout. The health benefits are significant." The findings are published online in the journal PLOS ONE.

The study can be found at http://dx.plos.org/10.1371/journal.pone.0154075

http://bit.ly/1SP3yAk

Map of the brain's word filing system could help us read minds

Most English dictionaries list words alphabetically, but how do we store them in our head?

By Aviva Rutkin

Finding out could have an unexpected pay-off: being able to tell what someone is thinking from their brain activity.

Although neuroscientists can already do this to a limited extent, the brain's internal filing system for words and concepts – an important step towards accurately reading a person's thoughts – remains murky.

Now Jack Gallant at the University of California, Berkeley, and his team have charted the "semantic system" of the human brain. The resulting map reveals that we organise words according to their deeper meaning, in subcategories based around numbers, places, and other common themes.

Previous "mind-reading" studies have shown that certain parts of the brain respond to particular words. Gallant's own lab had already found that the brain sorts visual information by meaningful categories like animals or buildings.

In their latest experiment, the team wanted to see if they could build a more complete map of meaning across the cerebral cortex, the folded outer layer of grey matter.

Story time

To do this, they asked seven people to listen to two hours of The Moth Radio Hour, a show which features individuals telling stories. As this happened, they

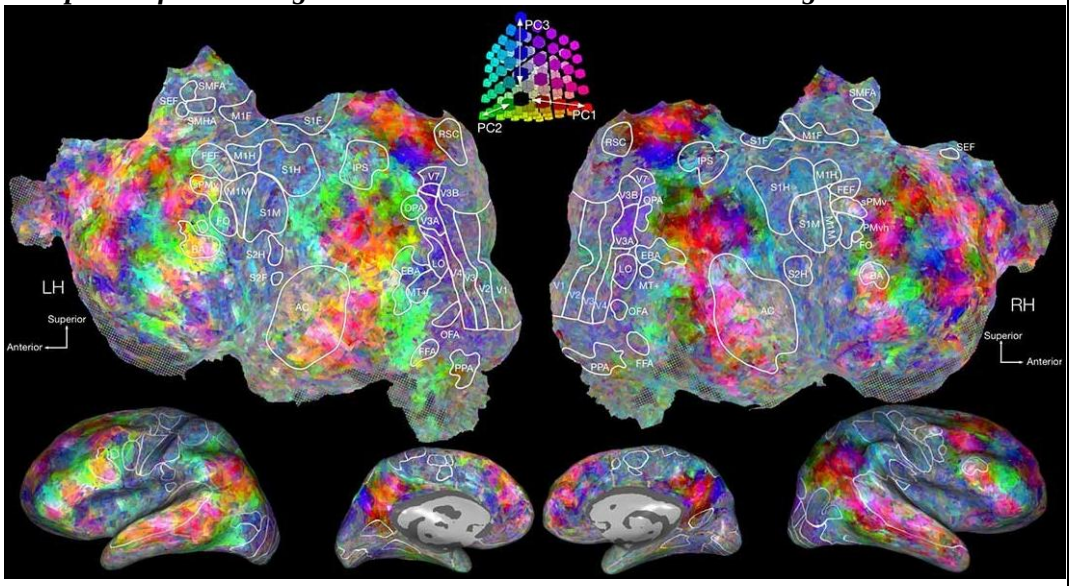
used an fMRI scanner to log changes in blood oxygen levels across the brain – a sign of neural activity.

The team then compared the meanings of the words in the show against the activity in small subregions of the brain. They identified 12 clusters in the brain, each of which filed words corresponding to a particular concept such as time, emotion, social relevance and location.

Other categories included visual words (for example "yellow"), work concepts ("meetings"), tactile words ("fingers"), and abstract ideas ("nature").

The team then used software to plot clustering data from six people on a single brain map, pictured below. It charts a complex pattern of activity across more than 100 areas spanning both brain hemispheres. This is a surprise as the brain's left side is generally considered to be responsible for language.

Composite of brain images broken down into multicoloured subregions **Alexander Huth**



/ The Regents of the University of California

The map suggests that patterns of word meaning are consistent between different people's brains, but the team say this might be because they studied a small number of people with a culturally similar upbringing and education.

With a map like this, the team also suggest it may be possible to build a "general-purpose language decoder", a device that can infer what someone hears or says using fMRI data alone.

Scientists have long suspected that words are organised into clouds of meaning in the brain, says Richard Wise, a neurologist at Imperial College London. "The results won't really surprise anybody," he says.

But by studying people while they listened to stories, rather than isolated words or sentences, the team has assembled a useful picture of how the brain responds to the kind of language we hear every day, says Swathi Kiran of Boston University. "They've essentially put it all together."

The map may help us understand language deficits in Alzheimer's disease or in aphasia, a condition which can involve using the wrong words or sounds in speech. "We're struggling with brains that are not this nice and neat and have got damage," says Kiran. "This paper tells us what normal could look like."

To explore the map, check out the team's interactive version.

Nature, DOI: 10.1038/nature17637

http://nyti.ms/249viYF

SpaceX Says It Plans to Send a Probe to Mars

Next stop: Mars?

By KENNETH CHANG APRIL 27, 2016

In December, Space Exploration Technologies Corporation of Hawthorne, Calif., better known as SpaceX, landed a rocket on Earth, flying a booster stage of one of its Falcon 9 rockets back to Cape Canaveral. This month, the company repeated the feat even more impressively, setting the booster down on a floating platform in the Atlantic.

Now SpaceX, Elon Musk's rocket company, has its sights set farther away: It aims to land one of its capsules on the surface of Mars in May 2018, the company announced in a Twitter message on Wednesday.

Mr. Musk has said that SpaceX's long-term goal is to colonize Mars, and he has talked of an ambitious schedule to get people there in the mid-2020s.

But before that happens, Mr. Musk, not to mention any would-be colonists, have to make sure that the technology for getting to Mars in one piece actually works.

In an announcement on Wednesday, SpaceX said it planned to send an unmanned Dragon capsule to Mars in 2018 and land it on the surface about six months later. (Mars and Earth line up only once every 26 months.)

NASA also plans to send people to Mars, although not as quickly, aiming for the mid-2030s. On Wednesday afternoon, a couple of hours after the SpaceX Twitter message, Dava J. Newman, NASA's deputy administrator, wrote: "We are closer than ever before to sending American astronauts to Mars than anyone, anywhere, at any time has ever been. A new consensus is emerging around NASA's plan and timetable for sending astronauts to the Red Planet in the 2030s."

NASA has emphasized that — unlike the Apollo missions to the moon — it is not working alone, but is enlisting the help of other countries and endeavors. Almost in passing, Dr. Newman mentioned the SpaceX Mars effort.

"Among the many exciting things we're doing with American businesses, we're particularly excited about an upcoming SpaceX project that would build upon a current 'no exchange of funds' agreement we have with the company," she wrote.
"In exchange for Martian entry, descent and landing data from SpaceX," she continued, "NASA will offer technical support for the firm's plan to attempt to land an uncrewed Dragon 2 spacecraft on Mars."
Landing on Mars is tricky. The atmosphere is thick enough that the energy of the arriving spacecraft slamming into the air molecules heats its outside to thousands of degrees, but it is too thin for parachutes to provide a gentle landing.
NASA has turned to innovative devices like airbags, used to cushion the landings of the Spirit and Opportunity rovers in 2004, and a Rube Goldberg-esque "sky crane" system to set down the larger and heavier Curiosity rover in 2012.
A team at NASA's Ames Research Center in California proposed SpaceX's Dragon capsule as a cheaper way to land on Mars, using rocket engines. SpaceX liked the idea enough to start working on it as well, signing an agreement to tap into NASA expertise.
The Dragon capsule would be launched on SpaceX's larger Falcon Heavy rocket, which has yet to have its first flight. "These missions will help demonstrate the technologies needed to land large payloads propulsively on Mars," said Philip Larson, a SpaceX spokesman.
But even with SpaceX's recent technological tours de force, getting to Mars in 2018 would be a huge, quick leap for a company that has yet to leave Earth's neighborhood.

http://www.eurekalert.org/pub_releases/2016-04/epfd-avt042716.php

A vitamin that stops the aging process of organs

Nicotinamide riboside rejuvenates stem cells, allowing better regeneration processes in aged mice

Nicotinamide riboside (NR) is pretty amazing. It has already been shown in several studies to be effective in boosting metabolism. And now a team of researchers at EPFL's Laboratory of Integrated Systems Physiology (LISP), headed by Johan Auwerx, has unveiled even more of its secrets. An article written by Hongbo Zhang, a PhD student on the team, was published today in Science and describes the positive effects of NR on the functioning of stem cells. These effects can only be described as restorative.
As mice, like all mammals, age, the regenerative capacity of certain organs (such as the liver and kidneys) and muscles (including the heart) diminishes. Their ability to repair them following an injury is also affected. This leads to many of the disorders typical of aging.

Mitochondria: also useful in stem cells

Hongbo Zhang wanted to understand how the regeneration process deteriorated with age. To do so, he teamed up with colleagues from ETH Zurich, the University of Zurich and universities in Canada and Brazil. Through the use of several markers, he was able to identify the molecular chain that regulates how mitochondria - the "powerhouse" of the cell - function and how they change with age.
The role that mitochondria play in metabolism has already been amply demonstrated, "but we were able to show for the first time that their ability to function properly was important for stem cells," said Auwerx.
Under normal conditions, these stem cells, reacting to signals sent by the body, regenerate damaged organs by producing new specific cells. At least in young bodies. "We demonstrated that fatigue in stem cells was one of the main causes of poor regeneration or even degeneration in certain tissues or organs," said Hongbo Zhang.
This is why the researchers wanted to "revitalize" stem cells in the muscles of elderly mice. And they did so by precisely targeting the molecules that help the mitochondria to function properly. "We gave nicotinamide riboside to 2-year-old mice, which is an advanced age for them," said the researcher. "This substance, which is close to vitamin B3, is a precursor of NAD+, a molecule that plays a key role in mitochondrial activity. And our results are extremely promising: muscular regeneration is much better in mice that received NR, and they lived longer than the mice that didn't get it."

A breakthrough for regenerative medicine

Parallel studies have revealed a comparable effect on stem cells of the brain and skin. "This work could have very important implications in the field of regenerative medicine," said Auwerx. "We are not talking about introducing foreign substances into the body but rather restoring the body's ability to repair itself with a product that can be taken with food."
This work on the aging process also has potential for treating diseases that can affect - and be fatal - in young people, like muscular dystrophy (myopathy).
So far, no negative side effects have been observed following the use of NR, even at high doses. But caution remains the byword when it comes to this elixir of youth: it appears to boost the functioning of all cells, which could include pathological ones. Further in-depth studies are required.
This paper will be published online by the journal Science on Thursday, 28 April, 2016. It is titled: "NAD+ repletion improves mitochondrial and stem cell function and enhances lifespan in mice"

http://www.eurekalert.org/pub_releases/2016-04/gi-sts042616.php

Scientists turn skin cells into heart cells and brain cells using drugs

Studies represent first purely chemical cellular reprogramming, changing a cell's identity without adding external genes

In a major breakthrough, scientists at the Gladstone Institutes transformed skin cells into heart cells and brain cells using a combination of chemicals. All previous work on cellular reprogramming required adding external genes to the cells, making this accomplishment an unprecedented feat. The research lays the groundwork for one day being able to regenerate lost or damaged cells with pharmaceutical drugs.

In two studies published in Science and Cell Stem Cell, the team of scientists, who were led by Gladstone senior investigator Sheng Ding, PhD, and are part of the Roddenberry Center for Stem Cell Biology and Medicine at Gladstone, used chemical cocktails to gradually coax skin cells to change into organ-specific stem cell-like cells and, ultimately, into heart or brain cells.

This discovery offers a more efficient and reliable method to reprogram cells and avoids medical concerns surrounding genetic engineering.

"This method brings us closer to being able to generate new cells at the site of injury in patients," said Ding, the senior author on both studies.

"Our hope is to one day treat diseases like heart failure or Parkinson's disease with drugs that help the heart and brain regenerate damaged areas from their own existing tissue cells. This process is much closer to the natural regeneration that happens in animals like newts and salamanders, which has long fascinated us."

Chemically Repaired Hearts

Adult hearts have a very limited ability to generate new cells, so scientists have searched for a way to replace cells lost after a heart attack, such as transplanting adult heart cells or stem cells into the damaged heart. However, these efforts have been largely ineffective, as most transplanted adult cells do not survive or integrate properly into the heart, and few stem cells can be coaxed into becoming heart cells.

An alternative approach pioneered by Deepak Srivastava, MD, director of cardiovascular and stem cell research at Gladstone, used genes to convert scar-forming cells in the heart of animals into new muscle that improved the function of the heart.

A chemical reprogramming approach to do the same may offer an easier way to provide the cues that induce heart muscle to regenerate locally.

In the Science study, the researchers used a cocktail of nine chemicals to change human skin cells into beating heart cells. By trial and error, they found the best combination of chemicals to begin the process by changing the cells into a state resembling multi-potent stem cells, which can turn into many different types of cells in a particular organ. A second cocktail of chemicals and growth factors helped transition the cells to become heart muscle cells.

With this method, more than 97% of the cells began beating, a characteristic of fully developed, healthy heart cells.

The cells also responded appropriately to hormones, and molecularly, they resembled heart muscle cells, not skin cells. What's more, when the cells were transplanted into a mouse heart early in the process, they developed into healthy-looking heart muscle cells within the organ.

"The ultimate goal in treating heart failure is a robust, reliable way for the heart to create new muscle cells," said Srivastava, co-senior author on the Science paper. "Reprogramming a patient's own cells could provide the safest and most efficient way to regenerate dying or diseased heart muscle."

Rejuvenating the Brain with Neural Stem Cells

In the second study, published in Cell Stem Cell, the scientists created neural stem cells from mouse skin cells using a similar approach.

The chemical cocktail again consisted of nine molecules, some of which overlapped with those used in the first study. Over ten days, the cocktail changed the identity of the cells, until all of the skin cell genes were turned off and the neural stem cell genes were gradually turned on.

When transplanted into mice, the neural stem cells spontaneously developed into the three basic types of brain cells: neurons, oligodendrocytes, and astrocytes. The neural stem cells were also able to self-replicate, making them ideal for treating neurodegenerative diseases or brain injury.

"With their improved safety, these neural stem cells could one day be used for cell replacement therapy in neurodegenerative diseases like Parkinson's disease and Alzheimer's disease," said co-senior author Yadong Huang, MD, PhD, a senior investigator at Gladstone.

"In the future, we could even imagine treating patients with a drug cocktail that acts on the brain or spinal cord, rejuvenating cells in the brain in real time."

Nan Cao and Mingliang Zhang, both postdoctoral scholars at Gladstone, were the first authors on the Science and Cell Stem Cell papers, respectively. Other Gladstone scientists on the studies include Yu Huang, Ian Spencer, Yu Zhang, Baoming Nie, Min Xie, Haixia Wang, Tianhua Ma, Tao Xu, Guilai Shi, Saiyong Zhu, Kai Liu, and Ke Li. Researchers from the University of California, San Francisco and Case Western Reserve University also took part in the research.

http://www.eurekalert.org/pub_releases/2016-04/uonc-cfo042616.php

Costs for orally administered cancer drugs skyrocket

Patients may increasingly take on cost burden

New cancer drugs, taken in pill form, have become dramatically more expensive in their first year on the market compared with drugs launched 15 years ago, calling into question the sustainability of a system that sets high prices at market entry in addition to rapidly increasing those prices over time.

The findings, reported today in JAMA Oncology, show that a month of treatment with the newest cancer drugs, introduced in 2014, were on average six times more expensive at launch than cancer drugs introduced in 2000, after adjusting for inflation. In other words, orally-administered drugs approved in 2000 cost an average of $1,869 per month compared to $11,325 for those approved in 2014.

"The major trend here is that these products are just getting more expensive over time," said study author Stacie Dusetzina, Ph.D., at the University of North Carolina at Chapel Hill. She is also a UNC Lineberger Comprehensive Cancer Center member, and an assistant professor in the UNC Eshelman School of Pharmacy and UNC Gillings School of Global Public Health.

In the past 10 years, there has been a push toward developing orally-administered drugs for cancer patients, but the high prices may increasingly be passed along to the patient, potentially affecting a patient's access to the drug and their ability to use it, Dusetzina said.

The drug imatinib, also known as Gleevec, was among the drugs with large increases in monthly spending. From the time it launched, in 2001, to 2014, the price increased from $3,346 to $8,479, reflecting an average annual change of 7.5 percent.

Dusetzina also explains that the amount that patients pay for these drugs depends on their health care benefits. However, patients are increasingly taking on the financial burden of paying for these high-cost specialty drugs, despite the fact that commercially insured health plans have historically had generous coverage for orally-administered cancer drugs.

"Patients are increasingly taking on the burden of paying for these high-cost specialty drugs as plans move toward use of higher deductibles and co-insurance - where a patient will pay a percentage of the drug cost rather than a flat copay," Dusetzina said.

In her work, Dusetzina analyzed what commercial health insurance companies and patients paid for prescription fills before rebates and discounts for orally-administered cancer drugs from 2000 to 2014. The data came from the TruvenHealth MarketScan Commercial Claims and Encounters database.

Dusetzina noted that while the study did account for payments by commercial health plans, it did not account for spending by Medicaid and Medicare, which may differ. In addition, only the products that were dispensed and reimbursed by commercial health plans were included, which may have excluded rarely used or recently approved products.

http://www.eurekalert.org/pub_releases/2016-04/acs-slr042816.php

Study links residential radon exposure to hematologic cancers in women

First population-based study to make connection; requires replication

ATLANTA - A new report finds a statistically-significant, positive association between high levels of residential radon and the risk of hematologic cancer (lymphoma, myeloma, and leukemia) in women. The study is the first prospective, population-based study of residential radon exposure and hematologic cancer risk, leading the authors to caution that it requires replication to better understand the association and whether it truly differs by sex. It appears early online in Environmental Research.

Radon is a naturally occurring byproduct of the decay of radium, and is a known human lung carcinogen, the second-leading cause of lung cancer in the United States. Modeling studies show that radon delivers a non-negligible dose of alpha radiation to the bone marrow and therefore could be related to risk of hematologic cancers. Studies to date, however, have produced inconsistent results.

More than 171,000 new cases of hematologic cancer and more than 58,000 deaths are expected in the United States in 2016. Hematologic cancers are the most expensive cancers to treat per quality-adjusted life year gained.

For the current study, researchers led by Lauren Teras, Ph.D. of the American Cancer Society used data from the American Cancer Society Cancer Prevention Study-II Nutrition Cohort established in 1992, to examine the association between county-level residential radon exposure and risk of hematologic cancer. The analysis included 140,652 participants among whom there were 3,019 hematologic cancers during 19 years of follow-up.

They found women living in counties with the highest mean radon concentration had a statistically significant 63% higher risk of hematologic cancer compared to those living in counties with the lowest radon levels. They also found evidence of a dose-response relationship. There was no such association among men.

The authors say men may have a higher baseline risk, possibly because of more exposure to occupational or other risk factors for hematologic cancer, reducing the impact of any additional risk from residential radon. In women, who have a smaller baseline risk, residential radon exposure might be a larger contributor to

overall risk. Another reason may be that the women of this generation spent more time in their homes, so had more residential exposure than men.

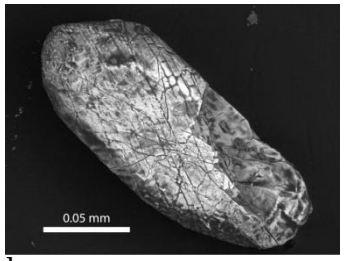
"The overall lifetime risk of hematological cancers in the United States is about 2%, so even a 60% relative increase would still mean a relatively small absolute risk," said Dr. Teras. "Nonetheless, radon is already associated with lung cancer, and if other studies confirm the link to blood cancers, we think it would warrant strengthened public health efforts to mitigate residential radon risks."

Residential radon exposure and risk of incident hematologic malignancies in the Cancer Prevention Study-II Nutrition Cohort, Environmental Research, July 2016 doi:10.1016/j.envres.2016.03.002

http://www.eurekalert.org/pub_releases/2016-04/tcd-tsr042816.php

Trinity scientists reveal origin of Earth's oldest crystals

The tiny crystals probably formed in huge impact craters not long after Earth formed, some 4 billion years ago



Dublin, Ireland - New research suggests that the very oldest pieces of rock on Earth -- zircon crystals -- are likely to have formed in the craters left by violent asteroid impacts that peppered our nascent planet, rather than via plate tectonics as was previously believed.

Scanning electron microscope picture of a zircon crystal from the Sudbury crater. **Gavin Kenny, Trinity College Dublin.**

Rocks that formed over the course of Earth's history allow geologists to infer things such as when water first appeared on the planet, how our climate has varied, and even where life came from.

However, we can only go back in time so far, as the only material we have from the very early Earth comes in the form of tiny, naturally occurring zircon crystals.

Naturally then, the origin of these crystals, which are approximately the width of a human hair and more than four billion years old (the Earth being just over four and a half billion years old), has become a matter of major debate.

Fifteen years ago these crystals first made headlines when they revealed the presence of water on the surface of the Earth (thought to be a key ingredient for the origin of life) when they were forming.

Ten years ago, a team of researchers in the US1 argued that the ancient zircon crystals probably formed when tectonic plates moving around on the Earth's surface collided with each other in a similar fashion to the disruption taking place in the Andes Mountains today, where the ocean floor under the Pacific Ocean is plunging under South America.

However, current evidence suggests that plate tectonics -- as we know it today -- was not occurring on the early Earth. So, the question remained: Where did the crystals come from?

Recently, geologists suggested these grains may have formed in huge impact craters produced as chunks of rock from space, up to several kilometres in diameter, slammed into a young Earth.

To test this idea, researchers from Trinity College Dublin decided to study a much younger impact crater to see if zircon crystals similar to the very old ones could possibly have formed in these violent settings.

In the summer of 2014, with the support of the Irish Reseach Council (IRC) and Science Foundation Ireland (SFI), the team collected thousands of zircons from the Sudbury impact crater, Ontario, Canada - the best preserved large impact crater on Earth and the planet's second oldest confirmed crater at almost two billion years old.

After analysing these crystals at the Swedish Museum of Natural History in Stockholm, they discovered that the crystal compositions were indistinguishable from the ancient set.

PhD Researcher in Trinity's School of Natural Sciences, Gavin Kenny, is first author of the article which explains these findings, and which has just been published in leading international journal, Geology.

He said: "What we found was quite surprising. Many people thought the very ancient zircon crystals couldn't have formed in impact craters, but we now know they could have. There's a lot we still don't fully understand about these little guys but it looks like we may now be able to form a more coherent story of Earth's early years -- one which fits with the idea that our planet suffered far more frequent bombardment from asteroids early on than it has in relatively recent times."

Gavin Kenny recently travelled to the annual Lunar and Planetary Science Conference (LPSC) in Houston, Texas, to present these findings to the space science community.

He added: "There was a lot of enthusiasm for our findings. Just two years ago a group2 had studied the likely timing of impacts on the early Earth and they suggested that these impacts might explain the ages of the ancient zircons. They were understandably very happy to see that the chemistry of the zircons from the Canadian impact crater matched the oldest crystals known to man."

Kenny GG, Whitehouse MJ, Kamber BS. Differentiated impact melt sheets may be a potential source of Hadean detrital zircon. Geology. 2016; DOI: 10.1130/G37898.1

http://www.eurekalert.org/pub_releases/2016-04/b-mhr042616.php

Metal hip replacements implanted since 2006 more prone to failure

Higher rate of issues in manufacturing process since this date may be to blame, say researchers

Metal on metal hip replacements implanted since 2006 are more prone to failure and the need for further surgery, finds research looking at revision rates at one hospital trust for the DePuy Pinnacle device, and published in the online journal BMJ Open.

A higher rate of manufacturing issues since 2006, with more than a third of hips manufactured outside the stated specifications, may be to blame, suggest the researchers.

They looked specifically at the long term performance of the 36 mm Pinnacle metal on metal hip--the most commonly implanted metal hip in the world--in a bid to uncover the risk factors associated with early failure and the need for further surgery.

The use of metal on metal hips has plummeted over the past five years, but "hundreds of thousands" remain in place.

A better understanding of the factors associated with a higher risk of failure would not only help those patients fitted with them, but could also inform the design of future products, say the researchers.

They reviewed the progress of 434 patients (243 women and 191 men) fitted with 489 metal on metal total hip replacements at one hospital trust in northern England, and monitored for an average of 7.5 years after the procedure.

In all, 71 metal hips required surgical removal and replacement, adding up to a revision rate of 16.4%, which the researchers describe as "unacceptably high."

A metal on metal hip consists of a metal 'ball,' which acts as the top of the thigh bone (femoral head). This fits inside a metal liner, which acts as the replacement socket.

Total replacement of both (bilateral) hip joints and thinner liners were risk factors for failure at nine years. But implantation from 2006 onwards also carried a significantly higher risk of revision, possibly because of the increasing tendency from this date to manufacture devices outside of their intended product specification, say the researchers.

Before 2006, only five out of 43 hips (12%) failed to meet the manufacturer's product specification. But after 2006 more than a third (36%; 43 out of 118) failed to comply.

Furthermore, in over 40% of cases examined the taper surface was defective. The taper surface describes the inside of the femoral head that is attached to the femoral stem--the part that anchors the implant in the thigh bone. This defect was significantly associated with excessive metal particle release.

Abundant metal staining of tissues visible to the naked eye (metallosis) had occurred in around one in five (19%) cases. .

Metal hips implanted into women were also more likely to fail, but the researchers caution that twice as many women as men had bilateral hip replacements, and when the findings were analysed according to sex and liner thickness, thinner liners had the greater impact.

Data from the National Joint Registry for England and Wales for 2014 indicate that 11,871 metal on metal Pinnacle hips have been implanted, prompting the researchers to calculate that 180,000 people around the world are now walking around with these hips. These patients might be at risk of early revision surgery, they suggest.

http://www.eurekalert.org/pub_releases/2016-04/bps-ptc042816.php

Peppermint tea can help improve your memory

Peppermint tea can improve long-term and working memory and in healthy adults

Peppermint tea can improve long-term and working memory and in healthy adults. This is the finding of a study by Dr Mark Moss, Robert Jones and Lucy Moss of Northumbria University who presented their research thist at the British Psychological Society's Annual Conference in Nottingham.

A total of 180 participants were randomly allocated to receive a drink of peppermint tea, chamomile tea or hot water. Before they consumed their drink they completed questionnaires relating to their mood. After a twenty minute rest the participants completed tests that assessed their memory and a range of other cognitive functions. Following the tests participants completed another mood questionnaire.

Analysis of the results showed that peppermint tea significantly improved long term memory, working memory and alertness compared to both chamomile and hot water. Chamomile tea significantly slowed memory and attention speed compared to both peppermint and hot water.

Dr Mark Moss said: "It's interesting to see the contrasting effects on mood and cognition of the two different herbal teas. The enhancing and arousing effects of peppermint and the calming/sedative effects of chamomile observed in this study are in keeping with the claimed properties of these herbs and suggest beneficial effects can be drawn from their use."

http://bit.ly/1QHjqZD

This Drug Ad Is Not Right for You

Peddling pharmaceuticals on TV is a lousy form of health education, and it can also drive up medical costs

By THE EDITORS on May 1, 2016

Television ads for erectile dysfunction, stroke or toenail fungus treatments have been called both a boon and a curse. Drugmakers assert that promoting their products makes patients aware of conditions they can then flag for their doctor.

Yet every developed country except the U.S. and New Zealand prohibits such direct-to-consumer prescription drug ads. It is hard to see educational value in commercials on American TV that show radiant models relaxing before a tryst, accompanied by voice-overs that warn of possible side effects, including difficulty breathing and an unsafe drop in blood pressure.

An ad that conflates an aura of glowing health and the prospect of an amorous liaison with a list of dire cardiovascular symptoms is a paradigm of confused messaging because it does not provide the viewer with a clear guide to weighing both benefits and costs entailed in using a prescription medicine. Absent further interpretation, the underlying message reduces to: Sex or death—which will it be? Of course, the ads always end with an admonition to "ask your doctor...."

Now, finally, the doctors are giving an answer. In November 2015 the American Medical Association asked for a ban on these ads, saying that they are partially responsible for the skyrocketing costs of drugs. The World Health Organization and other groups have previously endorsed such restrictions.

In 2014 pharmaceutical companies spent $4.5 billion on consumer ads, mostly for television, a 30 percent rise from two years before. The pitches can drum up sales on higher-priced medications that can drive up drug costs when less expensive alternatives are sometimes available.

Many of the newest ads are for premium drugs for life-threatening diseases or rare conditions that can cost tens of thousands of dollars and require large, out-of-pocket patient co-payments. After seeing an ad, patients may press physicians for a prescription without understanding the complex criteria needed to determine eligibility for treatment.

Despite industry rhetoric about educating the consumer, the ads do what ads do—promote the advertiser's product while failing to note these complexities or alternative options. Last October a Kaiser Family Foundation survey found that 28 percent of people who viewed a drug ad subsequently asked a physician about the medicine and that 12 percent walked out with a prescription.

A ban would be a welcome step toward trimming the nation's lofty drug bills—and it would rid the airwaves of purported health messages that baffle more than they inform. It is unclear, though, whether any prohibition passed by Congress would pass muster in the courts. Pharma would undoubtedly mount a legal challenge, claiming that the law violates First Amendment protections for commercial speech.

Steps, however, can be taken short of outright prohibition. Presidential candidate Hillary Clinton, who has highlighted inflated drug prices as a campaign issue, wants to eliminate the industry's ad-based tax deduction. There are other options as well. Because drug companies contend that the ads are an educational tool, the Food and Drug Administration might hold them to their word. They could be required to focus consumer ads on the benefits of a particular class of drugs rather than a specific product. The patient could then follow up with a physician who might recommend, say, the best diabetes medicine.

Another constructive move would be for Congress to pass the Responsibility in Drug Advertising Act, introduced in February by Representative Rosa DeLauro of Connecticut. The bill would require a three-year moratorium on ads for new prescription drugs approved by the FDA.

The proposed legislation also could be flexible in its implementation. The bill recognizes that a new approval by the FDA can have substantial public health benefits, and so it provides for the waiving of the restriction case by case. And it would permit extending the ban beyond the three years if concern over a side-effect profile persisted. A break from the up to 30 hours of prescription drug ads that the average TV viewer is exposed to every year—be it temporary or permanent—would be a refreshing relief.

http://bit.ly/1SDkdrH

Coma brain scans predict if a person will ever recover awareness

Are you there? Detecting brain circuits that switch back-and-forth between internal awareness and external awareness could help doctors work out if a person in a coma is ever likely to regain consciousness.

By Anil Ananthaswamy

The test involves scanning the brains of people who are minimally conscious or in a coma. Other tests for consciousness have used beeps, music or electromagnetic pulses to stimulate the patient – but the latest one needs no active input, simply watching resting brain activity is enough.

Massive brain injuries and other trauma can disrupt conscious awareness, leading to states ranging from minimal consciousness, in which people show some signs of conscious awareness, to comas, in which people are neither awake nor aware, and are less likely to wake up or recover consciousness. But some people in a coma can progress to a state called unresponsive wakefulness, in which people

can sometimes open their eyes spontaneously, but show no signs of other conscious activity.

“The challenge is to disentangle this condition from what we call minimally conscious,” says Steven Laureys of the University of Liege in Belgium.

Switching circuits

Minimally conscious patients can at times follow commands with their eyes, or make small movements, but relying on these as indicators of consciousness is problematic – if a person has damage to the motor areas of their brain, such movements may be impossible.

So Laureys’s team have designed tests for awareness that don’t require an active sign from a patient. These concentrate on the brain’s default mode network (DMN), which is active in healthy people when they rest or are doing nothing. The tests exploit the fact that our brains can’t help but think, says Laureys.

The DMN is mainly involved in processes of internal awareness: thinking about oneself, daydreaming, mind-wandering, and awareness of one’s body. In healthy people, activity in this network reduces when awareness shifts to external events and stimuli – a shift that can be detected by brain scans. If external awareness goes up, then internal awareness goes down, and vice-versa.

Expressing consciousness

To see if this so-called anti-correlation also happens in people with disrupted consciousness, Laureys’s team studied 58 patients from across Europe. Of these, 24 were minimally consciousness, 13 had recovered from minimal consciousness, and 21 were in unresponsive wakefulness.

Comparing these patients with 35 healthy people, the team found that the extent of anti-correlation between external and internal awareness networks was related to the level of consciousness. “The better patients got and the more they evolved towards healthy controls, the stronger these anti-correlations became,” says Laureys.

But brains that showed activity in both forms of awareness at the same time were in a worse state. “The anti-correlations seem to somehow be important for you to express your consciousness or have higher level cognition,” says Laureys.

Laureys thinks that such tests could one day become a tool for diagnosis, but cautions that their sample of patients was too small to draw definitive conclusions.

Melanie Boly at the University of Wisconsin in Madison agrees that tests like these could be used alongside other techniques for measuring the levels of awareness in non-communicative patients. “This will need further validation in other states like sleep-induced unconsciousness and loss of consciousness induced by various anaesthetics,” says Boly.

Journal reference: The Lancet Neurology, DOI: 10.1016/S1474-4422(16)00111-3

http://www.bbc.com/news/health-36133475

'Secret' of youthful looks in ginger gene

Scientists say they have made a leap in knowing why some people retain their youthful looks while others age badly.

By James Gallagher Health editor, BBC News website

They found the first part of human DNA - the genetic code - that seems to affect how old people look to others. The mutations, reported in the journal Current Biology, were in the genetic instructions for protecting the body from UV radiation. But these can also lead to red hair, and experts caution the findings may be confused by eye, skin or hair colour.

The study into "perceived age" was organised by the Erasmus University Medical Centre in the Netherlands and Unilever. Dr David Gunn, a senior scientist at the company, said perceived age was a phenomenon everyone was familiar with.

He told the BBC News website: "You meet two people you haven't seen for 10 years, and you happen to notice one doesn't look a day older than you remember and then the other person you think 'Wow what happened to them?'."

How old?

Images of the make-up free "naked-face" of 2,693 people were independently assessed to see what age people thought they looked. This was compared with their true age. The next stage of the research was to scour the 2,693 people's DNA to find any differences or mutations that were more common in those who looked younger than they really were.

All the evidence pointed to the MC1R gene - it is critical for making melanin, which affects skin pigmentation and protects against UV radiation from the Sun.

But the gene comes in many different forms, or variants, many of which cause red hair - hence the nickname "the ginger gene". The study suggested some variants of the gene led to people looking, on average, two years younger than those with other forms of MC1R.

Prof Manfred Kayser, from Erasmus, told the BBC News website: "The exciting part is we actually found the gene, and that we did find the first means we will be able to find more. "It is exciting because this is a well known phenomenon that so far cannot be explained - why do some people look so much younger?"

However, the researchers cannot explain why MC1R has such an effect - they tested ideas that the different variants might alter skin damage from the sun, but this did not appear to be the case.

Does 'gingerism' really exist?

Prof Ian Jackson, from the UK Medical Research Council's Human Genetics Unit, said the study was interesting, but had not found the fountain of youth. He said: "MC1R is the major gene involved in red hair and pale skin, and what they're

trying to say is it's got an impact on making you look slightly younger that isn't to do with paler skin, but I'm not so sure."

The researchers say they adjusted their data to account for different skin tones. But Prof Jackson said: "The question is how well are they adjusting for that - what about hair colour and eye colour - my gut reaction is what they're looking at is an aspect of pigmentation. "I would suspect people who have paler pigmentation would look younger and that might be paler skin or bluer eyes or blonde or red hair."

More research is planned, but Dr Gunn hopes the findings will eventually lead to a product to make people look younger. "This is the first genetic study ever of perceived age, ideally we'd want something to boost this gene for everybody," he said. However, it is far from clear whether it will be possible to lower someone's "perceived age".

Also commenting on the study, Prof Tim Frayling, from the University of Exeter, said: "This is an interesting finding that shows how genetics can influence the ageing process independently of developing disease. "However, whilst interesting, the authors admit that they need to find more genetic variation to have any chance of predicting someone's appearance from DNA alone."

http://www.eurekalert.org/pub_releases/2016-04/e-uff042816.php

Unique fragment from Earth's formation returns after billions of years in cold storage

Tailless Manx comet from Oort Cloud brings clues about the origin of the solar system

In a paper to be published today in the journal Science Advances, lead author Karen Meech of the University of Hawai`i's Institute for Astronomy and her colleagues conclude that C/2014 S3 (PANSTARRS) formed in the inner Solar System at the same time as the Earth itself, but was ejected at a very early stage.

Their observations indicate that it is an ancient rocky body, rather than a contemporary asteroid that strayed out. As such, it is one of the potential building blocks of the rocky planets, such as the Earth, that was expelled from the inner Solar System and preserved in the deep freeze of the Oort Cloud for billions of years .

Karen Meech explains the unexpected observation: "We already knew of many asteroids, but they have all been baked by billions of years near the Sun. This one is the first uncooked asteroid we could observe: it has been preserved in the best freezer there is." C/2014 S3 (PANSTARRS) was originally identified by the Pan-STARRS1 telescope as a weakly active comet a little over twice as far from the Sun as the Earth. Its current long orbital period (around 860 years) suggests that its source is in the Oort Cloud, and it was nudged comparatively recently into an orbit that brings it closer to the Sun.

The team immediately noticed that C/2014 S3 (PANSTARRS) was unusual, as it does not have the characteristic tail that most long-period comets have when they approach so close to the Sun. As a result, it has been dubbed a Manx comet, after the [tailless cat]. Within weeks of its discovery, the team obtained spectra of the very faint object with ESO's Very Large Telescope in Chile.

Careful study of the light reflected by C/2014 S3 (PANSTARRS) indicates that it is typical of asteroids known as S-type, which are usually found in the inner asteroid main belt. It does not look like a typical comet, which are believed to form in the outer Solar System and are icy, rather than rocky. It appears that the material has undergone very little processing, indicating that it has been deep frozen for a very long time. The very weak comet-like activity associated with C/2014 S3 (PANSTARRS), which is consistent with the sublimation of water ice, is about a million times lower than active long-period comets at a similar distance from the Sun. The authors conclude that this object is probably made of fresh inner Solar System material that has been stored in the Oort Cloud and is now making its way back into the inner Solar System.

A number of theoretical models are able to reproduce much of the structure we see in the Solar System. An important difference between these models is what they predict about the objects that make up the Oort Cloud. Different models predict significantly different ratios of icy to rocky objects. This first discovery of a rocky object from the Oort Cloud is therefore an important test of the different predictions of the models. The authors estimate that observations of 50-100 of these Manx comets are needed to distinguish between the current models, opening up another rich vein in the study of the origins of the Solar System.

Co-author Olivier Hainaut (ESO, Garching, Germany), concludes: "We've found the first rocky comet, and we are looking for others. Depending how many we find, we will know whether the giant planets danced across the Solar System when they were young, or if they grew up quietly without moving much."

This research was presented in a paper entitled "Inner Solar System Material Discovered in the Oort Cloud", by Karen Meech et al., in the journal Science Advances.

The team is composed of Karen J. Meech (Institute for Astronomy, University of Hawai`i, USA), Bin Yang (ESO, Santiago, Chile), Jan Kleyna (Institute for Astronomy, University of Hawai`i, USA), Olivier R. Hainaut (ESO, Garching, Germany), Svetlana Berdyugina (Institute for Astronomy, University of Hawai'i, USA; Kiepenheuer Institut für Sonnenphysik, Freiburg, Germany), Jacqueline V. Keane (Institute for Astronomy, University of Hawai`i, USA), Marco Micheli (ESA, Frascati, Italy), Alessandro Morbidelli (Laboratoire Lagrange/Observatoire de la Côte d'Azur/CNRS/Université Nice Sophia Antipolis, France) and Richard J. Wainscoat (Institute for Astronomy, University of Hawai`i, USA).

http://www.eurekalert.org/pub_releases/2016-04/nhgr-nca042916.php

NIH creates Atlas of Human Malformation Syndromes in Diverse Populations

Photographic resource will aid diagnosing genomic diseases in patients of non-European ancestry

Researchers with the National Human Genome Research Institute (NHGRI), part of the National Institutes of Health, have collaborated with physicians and medical geneticists around the world to create the Atlas of Human Malformation Syndromes in Diverse Populations. Health care providers can use the new atlas to diagnose diverse patients with inherited diseases by comparing physical traits (called phenotypes) and written descriptions of their symptoms with photos and descriptions of people with the same condition and ancestry. Previously, the only available diagnostic atlas featured photos of patients with northern European ancestry, which often does not represent the characteristics of these diseases in patients from other parts of the world. The free electronic atlas was announced online in Genetics in Medicine.

"This atlas is long overdue and much needed," said Daniel Kastner, M.D., Ph.D., NHGRI scientific director. "The impact of such a resource will be immediate and profound for all health care providers who are diagnosing and treating birth defects and genetic diseases in people of diverse ancestry."

Congenital malformations, also known as birth defects, are the leading cause of infant deaths and diseases worldwide. Examples include heart defects, such as missing or misshaped valves; abnormal limbs, such as a clubfoot; neural tube defects, such as spina bifida; and problems related to the growth and development of the brain and spinal cord. Birth defects can be caused by genes not working properly, missing or extra chromosomes or mothers' exposure to medications and chemicals during pregnancy.

"The atlas will enable health care providers to diagnose patients as early as possible," said Maximilian Muenke, M.D., atlas co-creator and chief of NHGRI's Medical Genetics Branch. "Once they have an accurate diagnosis, health care providers can provide better care and information for patients and their families."

The first disorders added to the atlas are Down syndrome and 22q11.2 deletion syndrome. Down syndrome is the most common chromosomal condition, affecting roughly 1 in 1,000 babies worldwide and representing a diagnostic challenge for doctors. A feature of Down syndrome in persons of European descent is the skin fold of the upper eyelid, covering the inner corner of the eye. But these epicanthal eye folds are completely normal in people of Asian descent without Down syndrome, which means they are not a distinguishing characteristic.

The 22q11.2 deletion syndrome, also known as velocardiofacial syndrome, affects 1 in 4,000 newborns and is characterized by a combination of cleft palate, heart defects, differences in the way the kidneys are formed or work, a characteristic facial appearance, learning problems, and speech and feeding problems.

When complete, the atlas will consist of photos of physical traits of people with many different inherited diseases around the world, including Asia, the Indian subcontinent, the Middle East, South America and sub-Saharan Africa. In addition to the photos, the atlas will include written descriptions of affected people and will be searchable by phenotype (a person's traits), syndrome, continental region of residence and genomic/molecular diagnosis.

The need for the tool became evident after three clinical geneticists from NHGRI - Dr. Muenke, Paul Kruszka, M.D., and Adebowale Adeyemo, M.D. - visited children's heart clinics in Africa. "We found ourselves struggling to diagnose the African children," Dr. Kruszka said. "We were doing our best but we needed reference photos that didn't exist."

They were not the only ones with this problem. In Lagos, Nigeria, the three physicians presented sessions on clinical genetics (the practice of medicine focused on genetic disorders) to a standing-room-only audience. Afterward, they had discussions with a long line of doctors, many holding phones with photos of affected children they needed help diagnosing. Over dinner that night, the three cemented a plan to build the atlas.

Over the next year and a half, the group brought together a network of experts from China, India, Mali, the Middle East, Malaysia, Nigeria, Rwanda, South Africa, South America, Thailand and Uganda. From this group, NHGRI formed an advisory board to guide the project, maintain the website and oversee potential ethical issues.

Ethical issues

Before posting photos of diverse people affected by genetic diseases, the team requested an ethics consultation from the NHGRI Bioethics Core. Based on this input, health care providers sought permission from patients and their caregivers before contributing unpublished photos of affected patients to the atlas. Informed consent, the process of informing participants of the risks and benefits of contributing to the project, is tailored to local communities and translated and administered through the use of local interpreters.

"The job of the ethicist is to shed light on the aspects of the project that might harm the person sharing information, and to think about ways to reduce those risks," said Sara C. Hull, Ph.D., director of the NHGRI Bioethics Core. "We wanted to weigh carefully those risks in light of the justice-oriented benefits of this important project."

To ensure the atlas does not make mistaken connections between race, ethnicity and genetic diseases or reinforce stereotypes that were potentially harmful to different groups, health care providers are relying on participants' descriptions of his or her four grandparents' nationalities and about their ethnic and cultural identity. The photos and descriptive information included in the atlas are organized by disease and by continental ancestry, so a health care provider can compare their patient to someone of similar ancestral origin.

Now that the atlas is established, the next step is to inform physician communities -- pediatricians, family physicians, internists, cardiologists, neurologists and craniofacial surgeons -- about the atlas, said Dr. Adeyemo, atlas co-founder and deputy director of the NIH Center for Research on Genomics and Global Health.

"This project was born out of a real need," Dr. Adeyemo said. "The doctors who approached us after our talks in Nigeria, the ones who regularly send us photos of affected children and our clinical colleagues seeing patients in Africa, Asia and South America will now have the help they need to diagnose their patients."

For more information on the Atlas of Human malformation Syndromes in Diverse Populations, please visit: http://www.genome.gov/atlas.

http://bit.ly/1QJMmHQ

Science Explains Why Your Mom Calls You by Your Brother's Name

The next time your mom calls you by your brother's name (or even your dog's name), don't be offended — she's probably not doing it because she thinks you look like him, a new study finds.

by Sara G. Miller, Staff Writer | April 29, 2016 05:19pm ET

Such "misnamings," or when a person calls someone else by the wrong name, occur frequently, according to the study. But the incorrect names aren't chosen at random. Rather, they tend to follow certain patterns, according to the study, which was published April 22 in the journal Memory & Cognition.

When people call someone by the wrong name, they tend to call that person by the name of someone in the same social group, the researchers found. Or, they'll call someone by a name that sounds similar, according to the study. Physical appearance, however, was less influential in misnaming, the study found.

For the study, the researchers carried out five surveys of more than 1,700 people. They included participants who had reported either being called by the wrong name or who had misnamed someone else. In all instances, the participants in the study knew the person they were misnaming well, or were misnamed by someone they knew well.

The incorrect name often came from the same social group, the researchers found. For example, family members called other family members by a wrong name belonging to another family member, the researchers wrote. So, your mom might call you by all of your siblings' names before she gets around to your actual name. Similarly, friends may call each other by the name of another friend in the group, according to the study.

Misnaming is "a cognitive mistake we make, which reveals something about who we consider to be in our group," David Rubin, a professor of psychology and neuroscience at Duke University and the senior author on the study, said in a statement. (So, when your mom calls you by the dog's name, it just goes to show that she really does consider Fido to be part of the family.)

Similar-sounding names were also frequently mixed-up, the researchers found. For example, a person may call Mitchell by the name Michael, because the names sound similar. Notably, the physical appearance of a person was less of a factor in causing people to say the wrong name, the researchers found.

Nor did aging appear to influence people's tendency to misname others, the researchers found. In the study, they surveyed undergraduate students as well as older individuals, and found that misnamings occurred just as often in the undergraduate group.

But the researchers didn't limit the study to humans — pet names were also included in the surveys. In 42 instances, a participant reported that he or she had either been called a pet's name or called someone else by the name of a pet. In all of the cases except one, the pet's name was substituted for the name of a family member, the researchers wrote.

Notably, calling a family member by the pet dog's name was much more common than calling a family member by the name of the cat, suggesting that dogs are grouped with other family members more than other pets, the researchers wrote.

Of course, there may be a simpler way to explain this phenomenon.

"Dogs will respond to their names much more than cats, so those names are used more often," Samantha Deffler, a Ph.D. student at Duke and the lead author on the study, said in a statement. "Perhaps because of that, the dog's name seems to become more integrated with people's conceptions of their families," she said.

http://www.eurekalert.org/pub_releases/2016-04/tjnj-daj042916.php

Diluted apple juice, preferred fluids for treating mild gastroenteritis in kids

Half-strength apple juice followed by their preferred fluid choice reduces treatment failures

Children with mild gastroenteritis and minimal dehydration experienced fewer treatment failures such as IV rehydration or hospitalization when offered half-strength apple juice followed by their preferred fluid choice compared with

children who received electrolyte maintenance solution to replace fluid losses, according to a study published online by JAMA. The study is being released to coincide with its presentation at the Pediatric Academic Societies meeting.

Gastroenteritis is a common pediatric illness. Electrolyte maintenance solution is recommended to treat and prevent dehydration, although it is relatively expensive and its taste can limit use. Its advantage in minimally dehydrated children is unproven. Stephen B. Freedman, M.D.C.M., M.Sc., of the University of Calgary, Canada, and colleagues randomly assigned children age 6 to 60 months with gastroenteritis and minimal dehydration to receive color-matched half-strength apple juice/preferred fluids (n = 323) or apple-flavored electrolyte maintenance solution (n = 324). After discharge, the half-strength apple juice/preferred fluids group was administered fluids as desired; the electrolyte maintenance solution group replaced losses with electrolyte maintenance solution.

The primary outcome for the study was a composite of treatment failure defined by any of the following occurring within 7 days of enrollment: intravenous rehydration, hospitalization, subsequent unscheduled physician encounter, protracted symptoms, crossover, and 3 percent or more weight loss or significant dehydration at in-person follow-up.

Among 647 randomized children (average age, 28 months; 68 percent without evidence of dehydration), 644 completed follow-up. Children who were administered diluted apple juice experienced treatment failure less often than those given electrolyte maintenance solution (17 percent vs 25 percent). Fewer children administered apple juice/preferred fluids received intravenous rehydration (2.5 percent vs 9 percent). Hospitalization rates and diarrhea and vomiting frequency were not significantly different between groups.

The authors write that these results challenge the recommendation to routinely administer electrolyte maintenance solution when diarrhea begins, based primarily on an unblinded study in which blocks of participants were provided instructions for use of electrolyte maintenance solution or instructions plus a prescription for electrolyte maintenance solution at no charge. "The present study findings, derived from a larger and more heterogeneous population, confirmed via provincial registries, and conducted in an era when complicated episodes of gastroenteritis have become uncommon, may more accurately reflect the effect rehydration fluid choice has on unscheduled medical visits."

"In many high-income countries, the use of dilute apple juice and preferred fluids as desired may be an appropriate alternative to electrolyte maintenance fluids in children with mild gastroenteritis and minimal dehydration."

(doi:10.1001/jama.2016.5352; this study is available pre-embargo at the For The Media website.)

http://www.eurekalert.org/pub_releases/2016-04/wuso-bml042816.php

Breast milk linked to significant early brain growth in preemies

Preemies fed mostly breast milk had larger brains by their due dates than those who consumed small amounts or none

Feeding premature babies mostly breast milk during the first month of life appears to spur more robust brain growth, compared with babies given little or no breast milk.

Studying preterm infants in the Neonatal Intensive Care Unit (NICU) at St. Louis Children's Hospital, the researchers found that preemies whose daily diets were at least 50 percent breast milk had more brain tissue and cortical-surface area by their due dates than premature babies who consumed significantly less breast milk. The researchers present their findings May 3 at the annual meeting of the Pediatric Academic Societies, in Baltimore.

"The brains of babies born before their due dates usually are not fully developed," said senior investigator Cynthia Rogers, MD, an assistant professor of child psychiatry who treats patients at St. Louis Children's Hospital. "But breast milk has been shown to be helpful in other areas of development, so we looked to see what effect it might have on the brain. With MRI scans, we found that babies fed more breast milk had larger brain volumes. This is important because several other studies have shown a correlation between brain volume and cognitive development."

The study included 77 preterm infants. The researchers retrospectively looked to see how much breast milk those babies had received while being cared for in the NICU. Then, the researchers conducted brain scans on those infants at about the time each would have been born had the babies not arrived early. All of the babies were born at least 10 weeks early, with an average gestation of 26 weeks, or about 14 weeks premature. Because they are still developing, preemies typically have smaller brains than full-term infants.

First author Erin Reynolds, a research technician in Rogers' laboratory, said in gauging the effects of breast milk on the babies' brains, the researchers didn't distinguish between milk that came from the babies' own mothers and breast milk donated by other women. Rather, they focused on the influence of breast milk in general.

"As the amount of breast milk increased, so did a baby's chances of having a larger cortical surface area," Reynolds said. "The cortex is the part of the brain associated with cognition, so we assume that more cortex will help improve cognition as the babies grow and develop."

Preterm birth is a leading cause of neurologic problems in children and has been linked to psychiatric disorders later in childhood. Rogers and her team plan to

follow the babies in the study through their first several years of life to see how they grow, focusing on their motor, cognitive and social development. As the babies get older, the researchers believe they will be able to determine the effects of early exposure to breast milk on later developmental outcomes.

"We want to see whether this difference in brain size has an effect on any of those developmental milestones," Rogers said. "Neonatologists already believe breast milk is the best nutrition for preterm infants. We wanted to see whether it was possible to detect the impact of breast milk on the brain this early in life and whether the benefits appeared quickly or developed over time."

Rogers said further investigation is needed to determine specifically how breast milk affects the brain and what is present in the milk that seems to promote brain development. She explained that because all of the babies in the study were born early it isn't clear whether breast milk would provide similar benefits for babies born at full term.

Reynolds E, et al. Effects of breast milk consumption in the first month of life on early brain development in premature infants. Abstract presented at the Pediatric Academic Societies 2016 meeting, May 3, 2016.

This work was supported by the National Institute of Mental Health, the Eunice Kennedy Shriver National Institute of Child Health and Human Development, the National Center for Research Resources and the National Institute of Neurological Disorders and Stroke of the National Institutes of Health (NIH), grant numbers K23 MH105179, K02 NS089852, P30 HD062171, R01 HD057098 and UL1 TR000448. Additional funding was provided by the Cerebral Palsy International Research Foundation, the Dana Foundation, the Child Neurology Foundation and the Doris Duke Foundation.

http://bit.ly/1rghNT6

First Human Head Transplant Planned for 2017

Many prominent surgeons think the idea is crazy and will not work, but Italian neurosurgeon Sergio Canavero says he still plans to attempt the first human head transplant late next year.

George Putic

He even has a volunteer, 31-year-old Russian software development manager Valery Spiridonov, who suffers from a debilitating muscle-wasting disease.

Canavero's project does have supporters in the medical community, including Dr. Michael Sarr, professor emeritus of surgery at the Mayo Clinic. He said the procedure is very risky, but experiments show that reconnected spinal cord nerves may actually function.

During the procedure, estimated to last about 36 hours, Spiridonov's head will be cooled to around 12 degrees Celsius, cut from his body and, as quickly as possible, connected to a donated body of a brain-dead person.

Canavero will be assisted by a team of 100 surgeons and other medical staff, including some who have experience in head transplants on animals.

After surgery, Spiridonov will be kept in an artificially-induced coma for 3 to 4 weeks while doctors stimulate his spinal cord nerves to reconnect and start functioning.

Valery Spiridonov, who has volunteered to be the first person to undergo a head transplant, attends a news conference in Vladimir, Russia, June 25, 2015.

Transplants of various organs are now routinely done on human patients in many parts of the world, but all attempts at head transplants done on monkeys quickly resulted in death. However, Canavero predicts that Spiridonov will not only live with his new body, but be able to walk within a year of the operation.

http://www.eurekalert.org/pub_releases/2016-05/iocr-mrt042816.php

New cancer drugs could treat lethal resistant prostate cancers

Men with aggressive prostate cancer that has stopped responding to conventional treatment could potentially benefit from a new class of cancer drug designed to overcome drug resistance, a new study suggests.

Researchers found that the drugs, called Hsp90 inhibitors, specifically target and inactivate a mechanism commonly used by prostate cancer cells to evade the effects of standard treatment.

The findings provide vital information about the role of Hsp90 in drug-resistant prostate cancers, and open up potential new routes to cancer treatment based on blocking this or related proteins.

A team at The Institute of Cancer Research, London, found that Hsp90 inhibitors countered the effect of malfunctions in the androgen receptor, which often occur in resistance to hormone treatments.

The research suggests that Hsp90 inhibitors could be effective in prostate cancers that have become resistant to treatment and started spreading round the body.

The study is published in the journal Cancer Research, and was mainly funded by the Wellcome Trust.

Hsp90 inhibitors are among several innovative new types of treatment designed to attack cancer indirectly, by destabilising multiple different proteins required for the growth and survival of cancer cells.

By destroying several cancer signals at once, they are designed to make it hard for cancers to escape the effects of treatment, giving them promise as potential 'resistance-busting' drugs.

The new research found that on top of their known effects on cancer, Hsp90 inhibition also blocked production of abnormal forms of the androgen receptor, stripping cancer cells of their defences against hormone treatments.

Prostate tumours rely on male hormones called androgens to grow and spread, and blocking androgen receptors can be an effective treatment.

However, cancer cells often generate abnormal forms of the androgen receptor that can be switched on all the time without the need for androgen hormone stimulation.

Researchers investigated the effect of Hsp90 inhibition on human cancer cells that produced the most common androgen receptor variant, called AR-V7. They grew the cancer cells in the lab and injected them into mice.

The researchers showed that Hsp90 inhibition reduced production of AR-V7 through a new and unexpected mechanism of action - by changing the way that messenger RNA molecules carrying the code for AR-V7 are processed.

Hsp90 inhibition also reduced the levels of the normal androgen receptor, and other important prostate cancer molecules called AKT and GR.

Study co-leader Professor Paul Workman, Chief Executive of The Institute of Cancer Research, London, said:

"We call Hsp90 inhibitors 'network drugs' because they tackle several of the signals that are hijacked in cancer all at once, across a network rather than just a single signalling pathway. These drugs can hit cancer harder than those targeting only one protein, and look promising for preventing or overcoming drug resistance.

"Our study has found that Hsp90 inhibition can specifically stop resistance to hormone treatments in prostate cancer, through a completely new mechanism of action involving the processing of messenger RNA.

"It's an exciting discovery which adds a string to the bow of these cancer drugs, and means they could work against prostate cancers that have otherwise stopped responding to treatment."

Study co-leader Professor Johann de Bono, Professor of Experimental Cancer Medicine at The Institute of Cancer Research, London, said:

"We have demonstrated for the first time that Hsp90 inhibitors can block the production of the most common abnormal androgen receptors that cause many prostate cancers to stop responding to current treatments.

"These drugs are already in clinical trials for several types of cancer, and I am excited that our work suggests they could also benefit men with prostate cancer who have otherwise run out of treatment options."

http://nyti.ms/1SXc1Va

Childcare and housework are what give women more heart problems

Housework takes a heavy toll. Women may be more likely to die after a heart attack than men because they do more housework, childcare and looking after relatives.

By Jessica Hamzelou

Women who have heart disease tend to have worse symptoms and are more likely to die from the condition than men. Until now, it has been hard to distinguish whether this might be due to differences in biology or lifestyle. But a new method for teasing apart physiological and social factors has shown that caring for children and performing household chores account for more of this difference than biological factors do.

Worldwide, heart diseases kill more men and women than anything else. Doctors have long observed that acute coronary syndrome (ACS) – an umbrella term that covers many heart disorders including heart attacks and angina – affects women more severely. They have worse symptoms, poorer recoveries and are more likely to die from it.

To understand why, Colleen Norris at the University of Alberta in Edmonton, Canada, and her colleagues have been following the progress of men and women diagnosed with ACS.

Housework heartache

The team analysed data from about a thousand people in Canada who were treated for ACS before they were 55 – the age at which differences between men and women's health outcomes from the condition are starkest.

They then looked at how each person was doing a year after starting treatment, and used a statistical programme to compare this with their biological sex, medical factors like blood pressure, plus 31 traits or attributes such as salary size and time spent doing housework that have been historically linked to a male or female gender.

As well as showing that the women were in worse health a year after diagnosis, the analysis identified seven factors that seemed to play a role in determining how well a person was likely to recover.

People who experienced more stress at home and spent more time doing housework fared less well, as did people who had lower personal incomes, or were a household's primary earner.

Those whose personality traits and social behaviours ranked as less masculine or more feminine based on answers to questions adapted from a standard questionnaire developed in the 1970s also suffered worse health.

Back to work

With the exception of being a household's primary earner, it was the women in the study who tended to fulfil most of these criteria. Data from Statistics Canada suggests that women spend about 65 per cent more time doing unpaid domestic chores than men, including housework and maintenance work around the home and garden. On average, women spend nearly 14 hours on such work a week, while men spend only about 8 hours on the same. It's a pattern seen elsewhere – on any day, 20 per cent of US men do housework, compared with 49 per cent of women, while in the UK, women carry out 70 per cent of household chores.

Norris has also found that women are more likely to look after other members of the family, even when they themselves are unwell. "We have noticed that women who have bypass surgery tend to go right back into their caregiver roles, while men were more likely to have someone to look after them," says Norris, who presented the team's findings on gender and cardiovascular health at the Canadian Women's Heart Health Summit in Ottawa, Canada, earlier this month.

Similar trends are seen in other countries. One Finnish study, for example, has found that men are more likely to survive a heart attack if they are married, but the opposite is true for women – single women recover better than those who are married.

Norris hopes her tool – the combination of a newly compiled questionnaire with a statistical analysis – can be used to investigate the importance of people's roles and responsibilities in other diseases, and to improve healthcare for women.

"The tool is the first of its kind, and will influence cardiovascular health significantly," says Rachel Dreyer at Yale School of Medicine. "The fact that there is little data on gender-related differences on coronary heart disease in 2016 is very concerning, because it is the leading cause of death in women."

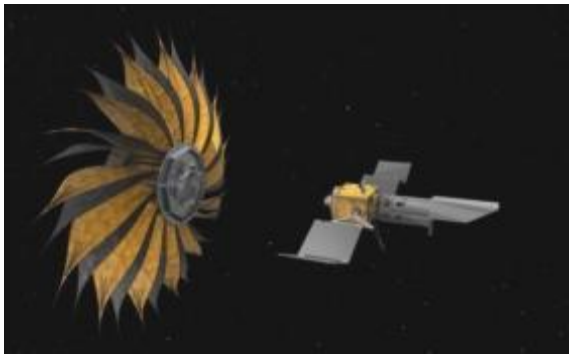
http://bit.ly/23iIvZC

How NASA's Next Big Telescope Could Take Pictures of Another Earth

A "starshade" flying alongside the WFIRST observatory could deliver images of potentially habitable worlds decades ahead of schedule

- **By Lee Billings on May 2, 2016**

Can NASA's next big space telescope take a picture of an alien Earth-like planet orbiting another star? Astronomers have long dreamed of such pictures, which would allow them to study worlds beyond our solar system for signs of habitability and life. But for as long as astronomers have dreamed, the technology to make those dreams a reality has seemed decades away. Now, however, a growing number of experts believe NASA's Wide-Field Infrared Survey Telescope (WFIRST) could take snapshots of "other Earths"—and soon. The agency formally started work on WFIRST in February of this year and plans to launch the observatory in 2025.



This artist's rendition shows the deployment of a starshade—a giant flower-shaped screen for blocking starlight. Starshades could allow future space telescopes to snap pictures of Earth-like planets beyond our solar system. **NASA/JPL-Caltech**

WFIRST was conceived in 2010 as the top-ranked priority of the National Academy of Sciences' Decadal Survey, a report from U.S. astronomers that proposes a wish list of future missions for NASA and other federal science agencies.

The telescope's heart is a 2.4-meter mirror that, although the same size and quality as the Hubble Space Telescope's, promises panoramic views of the heavens a hundred times larger than anything Hubble could manage. Using a camera called the Wide Field Instrument, WFIRST's primary objective will be to study dark energy, the mysterious force driving the universe's accelerating expansion. But another hot topic—the existential quest to know whether we are alone in the universe—is already influencing the mission.

Researchers have discovered more than a thousand exoplanets—planets around other stars—since the Decadal Survey's crucial recommendation of WFIRST as NASA's top-priority next-generation astrophysics mission. They expect to find tens of thousands more within the next 10 years. Many will be discovered by WFIRST itself when it surveys the Milky Way's galactic bulge for stars that briefly brighten as planets cross in front of them, acting as gravitational lenses to magnify their light. That survey could yield at least as many worlds as NASA's wildly successful planet-hunting Kepler space telescope, which used different techniques to net about 5,000 probable planets before hardware failures ended its primary mission in 2013.

Already, rough statistics from the entirety of known planets suggest that every star in the sky is accompanied by at least one, and that perhaps one in five sunlike stars bears a rocky orb in a not-too-hot, not-too-cold "habitable zone" where liquid water can exist. The best way to learn whether any of these worlds are Earth-like is to see them—but taking a planet's picture from light-years away is far from easy. A habitable world would be a faint dot lost in the overpowering glare of its larger, 10-billion-times-brighter star. Glimpsing it would be like seeing

a firefly fluttering next to a searchlight or a wisp of bioluminescent algae on a wave crashing against a lighthouse.

Fighting the light

The Earth's turbulent, starlight-blurring atmosphere is a severe obstacle to imaging faint planets from ground-based observatories, and most experts agree that the solution is to use space telescopes. But neither Hubble nor its supersize successor, the James Webb Space Telescope launching in 2018, comes anywhere close to achieving the high contrast needed for such observations. Both telescopes' hardware was mostly designed before the massive surge in planetary discovery—when imaging worlds around other stars was still considered a fringe research topic. In addition to carrying a Wide Field Instrument for general astrophysics surveys and dark-energy studies, WFIRST is also planned to use an advanced planet-imaging coronagraph, an instrument inside the telescope that filters out starlight using a complex series of masks, mirrors and lenses. But this second instrument is a late addition, and WFIRST's mirror and other optical components are not optimized for a coronagraph. Consequently, most experts predict that WFIRST's coronagraph will fall short of the contrast required to image Earths. Instead, it will focus on imaging gas-giant planets and, in the most favorable circumstances, a few so-called "super-Earths" or "mini-Neptunes" that are roughly twice the size of our own planet and thought to offer poor prospects for life.

WFIRST's coronagraph is officially only a technology demonstrator meant to accelerate the development of more sophisticated coronagraphs that could collect images of alien Earths—someday. Snapping such pictures is so challenging that NASA's tentative plans call for putting it off for perhaps 20 years or more as the agency develops the technology and budgetary breathing room to build an entirely new space telescope after WFIRST. And during that time, astronomers will continue discovering astronomical numbers of tantalizing planets.

WFIRST, however, may offer a shortcut via technology called a starshade—a sunflower-shaped, paper-thin screen half as big as a football field that would float tens of thousands of kilometers directly ahead of the telescope, blocking out a target star's light in much the same way one might blot out the sun in the sky with an extended thumb. The starshade's feathered shape is designed to prevent waves of light flowing around it like water over a rock, something that would ruin its ultradark shadow. Unlike coronagraphs, which must be custom-built for any given telescope's optics and function best with very large ones, starshades work with practically any size space telescope.

This JPL-produced video highlights the differences between coronagraphs and starshades, two technologies NASA is considering for future planet-imaging space telescopes.

A shortcut to Earths

Last year a NASA study (pdf) found that a functional starshade could be built and flown as an independent mission to rendezvous with WFIRST for an estimated half billion to a billion dollars. Working in tandem, the starshade and the telescope could snap pictures of perhaps 40 planets, including a few that in size and orbit would mirror Earth. "If and only if it has a starshade, WFIRST could give us images of a few true-blue Earths late next decade rather than waiting for another 20 years," says Jeremy Kasdin, a Princeton University professor and lead scientist for WFIRST's coronagraph who co-authored the NASA starshade study. "This is a real opportunity to find another Earth sooner and for less money before making a huge investment in NASA's next giant space telescope."

In the basement of Princeton's sprawling Frick Chemistry Lab, Kasdin is feverishly working on a test bed: a meter-wide, 75-meter-long tube with a camera at one end, a laser at the other and a scaled down starshade in between. By the end of the summer, he predicts, the test bed will have demonstrated the necessary contrast ratio that, scaled up to full size, could enable the imaging of Earth-like planets.

Kasdin is not alone in his basement labors; a burgeoning "starshade community" is now performing additional work. The aerospace company Northrop Grumman has tested miniaturized starshades at a dry lakebed in Nevada and at a giant solar telescope in Arizona. And at NASA Jet Propulsion Laboratory (JPL), researchers are demonstrating how to fabricate a larger-scale starshade's delicate petals, fold the entire structure up inside a rocket, and deploy and unfurl it to the size of a baseball diamond.

Despite WFIRST being nearly a decade away from launch, the decision to move forward with preparations for a starshade rendezvous must come soon, because WFIRST must receive minor modifications to allow it to sync up with a starshade across tens of thousands of kilometers of empty space. "We call this being 'starshade ready,'" Kasdin says. "This is *not* in WFIRST's current design, and we can't just put these changes off indefinitely…. By next year we pretty much need to have decided whether we're going to make it starshade-ready or not."

A "Starshade Technology Project"

But so far, senior NASA officials have expressed caution about committing to such a mission. "In principle, adding a starshade would enable WFIRST to image and study exoplanets in more detail than possible with the internal coronagraph," says John Grunsfeld, outgoing associate administrator of NASA's Science Mission Directorate. "However, starshade technology is still in its infancy, so we have a ways to go before we could build a starshade mission to fly with WFIRST."

A key impediment is money. WFIRST's budget of $2.3 billion is relatively svelte as far as major NASA space telescopes go, constrained by the extreme cost growth of its more ambitious yet-to-launch predecessor, the $8.8-billion Webb. With NASA's Astrophysics Division prepping Webb for launch and ramping up work on WFIRST, its present budget cannot support the full-throttle development of a starshade at the same time.

Politics and timing are other obstacles. NASA's professed budgetary limitations dovetail with the agency's aversion to unilaterally choosing major astrophysics missions. Instead, NASA intends to let U.S. astronomers chart its course via the next Decadal Survey in 2020, in which a starshade rendezvous with WFIRST could formally compete for prioritization with a large and diverse menu of other possible space missions. "Right now there are no plans to put a starshade on WFIRST," says Paul Hertz, director of NASA's Astrophysics Division. Instead, he says, the agency is "in a 'don't-preclude-a-starshade' mode." As it happens, though, not precluding a starshade closely resembles a concerted effort to build and launch one.

When NASA announced the formal start of WFIRST in February, it also confirmed that the telescope would be launched into an orbit 1.5 million kilometers from Earth, where conditions are tranquil enough for a starshade to function undisturbed. In many earlier plans the mission was instead bound for high Earth orbit, where sunlight bouncing off our planet would have scuttled a starshade's delicate work. In January NASA formed a Starshade Readiness Working Group to devise plans for validating the necessary technology for a starshade in time for a rendezvous with WFIRST. Finally, last month NASA formally designated the starshade as a "technology development activity," a move that integrates all the agency's disparate related projects into a more cohesive whole. "Internally, we are calling this the 'Starshade Technology Project,'" says Nick Siegler, chief technologist of NASA's Exoplanet Exploration Program based at the JPL. "The goal is to mature all the starshade's technology before the end of the decade so we can submit it with high confidence for endorsement by the Decadal Survey."

Risky business

Although politically prudent, NASA's current plan to defer a decision on the starshade–WFIRST rendezvous until the 2020s carries significant risks. It would almost certainly delay the launch of any starshade until after WFIRST's six-year primary mission had ended. Most of NASA's spacecraft outlive their primary missions and enter "extended" phases after achieving their key objectives, but mission-ending accidents or hardware failures can and do occur. "As a scientist, I want to see a starshade fly with the primary mission of WFIRST," says Sara Seager, a professor at Massachusetts Institute of Technology who chaired NASA's starshade rendezvous study, "because we can't guarantee WFIRST will live beyond its primary mission." She adds, "The Kepler mission had a four-year primary mission, and guess how long the spacecraft lasted? Four years. I'd hate to develop a starshade only to have no WFIRST to use it with. What will NASA do then—build us another telescope? That doesn't seem likely."

According to Siegler and others, an additional risk to deferring starshade development is that it could hinder planning for a notional space telescope to come years if not decades after WFIRST, one with a monumental mirror eight or even 16 meters wide. That would be big enough to search for and image Earths around thousands of the sun's neighboring stars—big enough to at last provide a statistically meaningful answer to the question of whether or not we are cosmically alone. Just last month NASA chartered two teams to study and recommend possible designs for such telescopes, ordering each team to submit their findings back to the agency by 2019—well before the Decadal Survey would decide about a starshade rendezvous. "The big question is which starlight-suppression technology are these studies going to pick?" Siegler says. "You might think the coronagraph is in pole position because it is easier to build and to test, and you would probably be right. That's one reason it is already baselined on WFIRST. The starshade could be a better option, but it calls for both a telescope and a separate spacecraft, with something like 50,000 kilometers between them. Where on Earth can you really test something like that? Wouldn't it be a great use of taxpayer dollars to test a starshade on a telescope that is already in space?"

In their observational capabilities, the two technologies are complementary. As just another instrument on a telescope, coronagraphs can nimbly dart between targets on the sky and excel at planetary discovery. Starshades, by contrast, take days or weeks to drift between targets—but they make up for their slow pace with better broadband sensitivity that makes them the superior choice for studying planets in greater detail.

Aki Roberge, an astrophysicist at NASA Goddard Space Flight Center and lead scientist for one of the agency's studies of future telescopes, says the correct path to finding another Earth may be to choose and use both. "In a perfect world the perfect mission probably has both a coronagraph and a starshade. Anything that can be done to keep both options open is desirable for the long-term future."