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DNA May Have Had Humble Beginnings As Nutrient Carrier

New research intriguingly suggests that DNA, the genetic information carrier for humans and other complex life, might have had a rather humbler origin.

By Adam Hadhazy - Sep 1, 2014

In some microbes, a study shows, DNA pulls double duty as a storage site for phosphate. This all-important biomolecule contains phosphorus, a sometimes hard-to-get nutrient.

Maintaining an in-house source of phosphate is a newfound tactic for enabling microorganisms to eke out a living in harsh environments, according to a new study published in the open-access, peer reviewed scientific journal PLOS ONE. The finding bodes well for life finding a way, as it were, in extreme conditions on worlds less hospitable than Earth.

The results also support a second insight: DNA might have come onto the biological scene merely as a means of keeping phosphate handy. Only later on in evolutionary history did the mighty molecule perhaps take on the more advanced role of genetic carrier.

"DNA might have initially evolved for the purpose of storing phosphate, and the various genetic benefits evolved later," said Joerg Soppa, senior author of the paper and a molecular biologist at Goethe University in Frankfurt, Germany.

Unraveling life's origins

Scientists continue to investigate the development of self-replicating, intricate sets of chemistry - in other words, life - from the chemical compounds thought available on early Earth. Out of this mixture of prebiotic chemicals, two nucleic acids - RNA and DNA - emerged as champions.

Today, these two types of biomolecules serve as the genetic information carriers for all Earthly biota. RNA on its own suffices for the business of life for simpler creatures, such as some viruses. Complex life, like humans, however, relies on DNA as its genetic carrier.

Astrobiologists want to understand the origin of DNA and its genetic cousin, RNA, because figuring out how life got started here on Earth is key for gauging if it might ever develop on alien planets.

Many researchers think RNA must have preceded DNA as the genetic molecule of choice. RNA is more versatile, acting as both genetic code and a catalyst for chemical reactions. Explicating the rise of DNA as a genetic material directly from RNA, however, is tricky. Compared to RNA, DNA needs significantly more supporting players for it to work well in a biological setting.

"The switch from RNA to DNA is not easy because many additional enzymes are required for DNA genomes," said Soppa.

This unclear transition from RNA to DNA opens the door for a precursor to DNA possibly having a more mundane job. The new study offers an attractive explanation: that DNA was a fancy way to store nutrients in cells.

Phosphate depot?

DNA is chock-full of phosphate. Cells depend on phosphate to form not only DNA and RNA, but also related genetic machinery, such as the ribosome. Phosphate, furthermore, is a must for building the molecule ATP, life's energy carrier, as well as fatty membrane molecules, certain phospho-proteins and phospho-sugars, and more.

"Phosphate is important for an immense set of biomolecules," said Soppa.

Unfortunately for some microbes, ample phosphate is not always available. For example, in salty, nutrient-poor habitats, such as the Dead Sea in the Middle East, an organism called Haloferax volcanii must regularly "eat" ambient DNA to obtain phosphate (plus some other nutritional goodies, such as nitrogen). Notably, H. volcanii can still survive and reproduce when phosphorus, the element needed to make phosphate, is lacking. Somehow, then, the microbe must turn to an inner source of phosphate, for otherwise it should cease to grow.

In their study, Soppa and colleagues from Germany, the United States and Israel sought out this source. The nature of H. volcanii provided some clues. The organism is classified as archaea, one of the three domains of life, in addition to bacteria and eukarya, the latter encompassing all multicellular organisms, from fungi to fruit flies. Many archaea and bacteria - collectively, "prokaryotes" - have just one, circular chromosome. Eukaryotes, like us, on the other hand, can have any number of the chunky pieces of DNA, RNA and proteins. (Humans have 23 pairs of different chromosomes, for the record.) H. volcanii is unusual. It has 20 copies of the same chromosome when it's growing happily under favorable conditions, and 10 when nutrients are exhausted and it reaches a stationary phase.

Strength in numbers

Lots of chromosome copies are good to have in a pinch. So-called polyploidal organisms like H. volcanii use their copious chromosomes to tough it out through bad situations, such as high radiation exposure or total dry-outs, called desiccation. Either scenario causes the strands in chromosomal DNA to break. For single-chromosome species, only a few breaks lead to death because it is impossible to repair a chromosome scattered into fragments.

But if there are multiple copies of the cracked chromosomes, fragments can fortuitously line up. Rather like how a jigsaw puzzle is easier to put together if there are numerous duplicates of each necessary piece, the chromosome shards can sync up and restore a functional chromosome.

"In polyploid species, the fragments generated from different copies of the chromosome overlap, and it is possible to regenerate an intact chromosome from overlapping fragments," said Soppa.

Desperate times, desperate measures

To investigate if H. volcanii's extra chromosomes might help the archaeon survive low phosphate conditions, Soppa and colleagues starved the organism in the lab of the critical substance. The microbe continued to reproduce by splitting one cell apart into two. Interestingly, chromosome counts diminished in the "parent" and the "daughter" cells.

"From quantifying the number of chromosomes prior to and after growth in the absence of phosphate, we have found that about 30 percent of the chromosomes are 'missing' afterwards," said Soppa.

The numbers for another potential in-house source of phosphate, H. volcanii's ribosomes, however, remained steady. The most likely explanation, then, of the microorganism's hardiness when facing a phosphate nutrient shortage: H. volcanii simply cannibalizes some of its own chromosomes.

As further verification, Soppa and colleagues tested the survival skills of H. volcanii cells that contained varying numbers of chromosome copies. Those archaea with just two copies of their chromosome turned out to be more than five times as sensitive to desiccation as those H. volcanii with a hefty complement of 20 chromosomes.

Life, undaunted

This newly described benefit of polyploidy in H. volcanii is a fresh demonstration of how life can make do in severe environments. So-called extremophiles have been discovered in recent decades thriving in strongly acidic hot springs, within liquid asphalt, and in other eyebrow-raising niches. Salt-tolerant bacteria and archaea, like H. volcanii, have been found to survive in deserts, simulated Mars conditions, and even the rigors of a space flight. We should not be surprised, perhaps, if life has managed to take hold on formidable worlds.

"The understanding of how harsh the conditions can be that can be survived by some archaea and bacteria helps us to be more optimistic that life could have evolved at very rough and unsuitable places on early Earth or on other planets," said Soppa.

The new role ascribed to DNA, as phosphate storage, might help to explain how a completely RNA-dominated primordial era began sharing genetic duties with DNA. Life did not leap from RNA to DNA. Rather, DNA, slowly but surely, learned new tricks.

"The hypothesis that DNA might have evolved as a storage polymer and became genetic material later, makes the step from RNA to DNA as genetic material easier, because it then would be a two-step and not a one-step process," said Soppa. "DNA would have been around, and during long time spans additional roles could have been evolved."

http://bit.ly/1luVqrs

Eruption of Yellowstone supervolcano could spell the end of the U.S.: geologists

Eruption of the supervolcano beneath Yellowstone National Park would blanket much of the United States in a meter of ash

By Scott Kaufman

According to an article published by United States Geological Survey scientist Larry Mastin in the latest edition of Geochemistry, Geophysics, Geosystems, an eruption of the supervolcano beneath Yellowstone National Park would blanket much of the United States in a meter of ash.

Mastin and his colleagues used computer modeling to determine the effects of the kind of ash cloud - known as an "umbrella" - the supervolcano would produce. A supereruption would eject 240 cubic miles of material into the atmosphere, which would not only shut down electronic communication and render air travel impossible, it would immediately and dramatically alter climate across the continent.

The supervolcano beneath Yellowstone has produced eruptions of this scale at least three times - once 2.1 million year ago, once 1.3 million, and most recently, 640,00 years ago. Mastin and his team used data on ash distribution from the most recent eruption to calculate the thickness of the ash fall from another potential supereruption, and found that cities close to the supervolcano would be buried beneath more than a meter of ash.

The "umbrella" ash cloud would deposit ash as far away as New York and Los Angeles, but the damage to the central region of the country would make it difficult, if not impossible, for the two coasts to have any meaningful communication with each other.

Even the small accumulation of ash on the East and West Coast would create massive problems for the population. Traction on roads would be significantly decreased, leading to more automobile accidents; electrical transformers would be shorted-out; sewer and water lines would be blocked; crops would be ruined; and individuals with respiratory problems would find it difficult, if not impossible, to breathe.

Such a cloud would spread across the country in a bull's eye pattern, because the force of the ejection and the composition of the ejected material would make the cloud more powerful than the prevailing winds.

"In essence, the eruption makes its own winds that can overcome the prevailing westerlies, which normally dominate weather patterns in the United States," Mastin said. "This helps explain the distribution from large Yellowstone eruptions of the past, where considerable amounts of ash reached the West Coast."

http://read.bi/1pC1lMx

Cholesterol Drug Halves Heart Attack and Stroke in Early Test

An experimental cholesterol-lowering drug from Sanofi and Regeneron Pharmaceuticals cut roughly in half the number of heart attacks and strokes in a clinical trial, researchers reported on Sunday.

BARCELONA - The result is not conclusive, because the analysis was done retrospectively, but the study provides the first evidence that targeting a protein known as PCSK9 could reduce cardiovascular risks for millions of patients.

The drug, alirocumab, is from a new class of medicines, which are also being developed by Amgen and Pfizer. They lower LDL, the so-called bad cholesterol, in a new way and are expected to reap multibillion-dollar sales.

The finding is likely to spur enthusiasm about the drugs, which could reach the market next year, although specialists said it remained subject to confirmation in a much larger trial.

Sanofi and Regeneron said in July that nine studies had shown consistent LDL reductions with alirocumab, which is injectable. But details from four of those trials have only now been reported at the European Society of Cardiology's annual meeting in Barcelona.

The encouraging cardiovascular findings came from an interim safety analysis of one of these studies showing patients on alirocumab were less prone to a combination of cardiovascular events, including cardiac death, heart attack, stroke and chest pain requiring hospitalization.

Both groups of patients received conventional anti-cholesterol statin pills in addition to alirocumab or a placebo. Among the alirocumab group, 1.4 percent of patients suffered a major cardiovascular event compared with 3.0 percent of those in the placebo group.

The 2,341-patient study, called Odyssey Long Term, is expected to conclude early next year, but researchers said the early sign of effectiveness was clearly positive.

"To have this result emerge so quickly in this study is very encouraging," said Dr. Jennifer Robinson, a cardiologist at the University of Iowa, who led the study.

No other drug maker has previously released data suggesting reduced cardiovascular risk from PCSK9 inhibitors.

Dr. Patrick T. O'Gara of the Brigham and Women's Hospital in Boston and president of the American College of Cardiology said that the finding was "biologically plausible," but that the retrospective nature of the analysis necessitated caution. "It's so much wished-for that we must be careful," he said.

http://bit.ly/1nQzfaB

Leading expert on search for intelligent extra-terrestrial life optimistic

The Conversation organised a public question-and-answer session on Reddit in which Seth Shostak, senior astronomer at the SETI Institute, explained why searching for intelligent life is so important and why we may soon find it.

Why are we continuing the search? For instance, isn't it true that radio waves become almost indistinguishable from background noise just a few light years from their origin?

We can detect radio waves from billions of light-years away, and without a whole lot of trouble, either. The idea that they become indistinguishable from noise at some small distance is incorrect. With a big enough antenna, you can always find the signal.

But the broader point is that we now know two things that we didn't know 20 years ago. First that planets, including ones that might be like Earth, are incredibly plentiful in the visible universe. There could be a billion trillion cousins of our world. Second, life got started on Earth very early.

If intelligent life is not out there, then we have done far better than merely win the lottery. And if you think we are that special … well, consider that you might just be wrong. And that possibility makes it worthwhile to try to answer the question with experiment, rather than saying "I know the answer already".

When you do eventually find intelligent life beyond the Earth, who would govern the announcement? Is there a protocol you need to follow before it becomes public?

There is a document. Briefly, it says, check the signal to make sure it is truly extraterrestrial. Then announce it to the world, and consult internationally before transmitting a reply.

But, in reality, it will be a mad media scramble, and the scientists will be trying their best to learn as much as they could about the signal.

How would such contact proceed? As Stephen Hawking believes that based on how we as humans treat many forms of less intelligent life on earth, do you believe that it is likely that higher forms of life would not have our best intentions in mind at the point of contact?

We will probably develop strong artificial intelligence (AI) in this century. That suggests that any signal we might pick up will be coming from AI on their end.

To impute the kinds of motives described in many of the postings here to such "intelligence" seems largely ungrounded. We have no idea what would interest them, but destroying us seems a bit too self-centred.

Can you tell us about the WOW signal and its importance?

It was nothing more than a drift plot on a computer's line printer that showed up once. Not a second time, even though it was looked for only a minute later. There were lots of such "one-offs" in the old days of SETI, and there is no good evidence that any of them were extraterrestrial signals.

How often does something happen that makes you say to yourself 'This could be it?'

Thanks to filtering out of interference by our computer programs, a "this could be it" moment only occurs very infrequently. The last good one was in 1997.

What do you think about the Fermi Paradox which states that perhaps life is not so abundant, because if it were it would have contacted us already?

The Fermi Paradox is a big extrapolation from a very local observation. We don't see any obvious evidence of galactic colonisation around here. So they couldn't be out there. Really? I don't see any evidence of mega fauna in my back yard, so maybe there aren't any …

You can find many ideas about why galactic colonisation isn't much of a desideratum for advanced intelligence, and the fact that people can cook up plausible reasons should cause you to consider the Paradox as an interesting idea, but not a very meaningful observation.

What are your thoughts on panspermia – the idea that life exists throughout the universe in microbial form distributed by celestial bodies like asteroids?

Panspermia might be occurring, although most of the astrobiologists I have talked to about this opine that, while bacterial spores could survive a trip within a solar system, they wouldn't make it between solar systems.

Why do scientists keep looking for water and oxygen when looking for intelligent life?

Chemistry suggests that carbon-based molecules are probably the best bet for biology. But SETI doesn't make any assumptions about this.

How many in your field worry about Bill Watterson's quote that "The surest sign that intelligent life exists elsewhere in the universe is that it has never tried to contact us"?

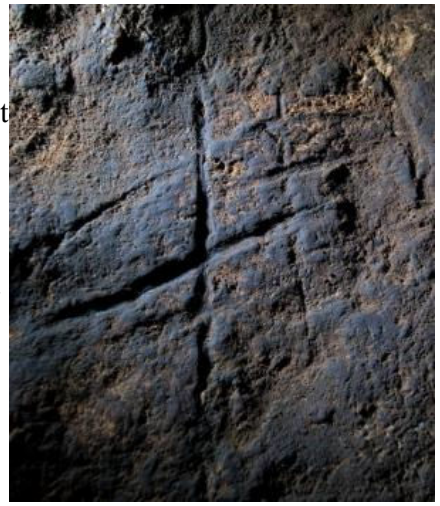
To begin with, the assumption (it has never tried to contact us) is a statement without any proof at all. The self-effacing part of this quote … that we are not worthy of being contacted … is more about Watterson then about humanity.

http://phys.org/news/2014-09-cave-art-neanderthals.html

Study claims cave art made by Neanderthals

A series of lines scratched into rock in a cave near the southwestern tip of Europe could be proof that Neanderthals were more intelligent and creative than previously thought.

The cross-hatched engravings inside Gorham's Cave in Gibraltar are the first known examples of Neanderthal rock art, according to a team of scientists who studied the site. The find is significant because it indicates that modern humans and their extinct cousins shared the capacity for abstract expression.



Neanderthal rock engraving from Gorham's Cave, Gibraltar. **Credit: Stewart Finlayson**

The study, released Monday by the journal *Proceedings of the National Academy of Sciences*, examined grooves in a rock that had been covered with sediment. Archaeologists had previously found artifacts associated with Neanderthal culture in the overlying layer, suggesting that the engravings must be older, said Clive Finlayson, one of the study's authors.

"It is the last nail in the coffin for the hypothesis that Neanderthals were cognitively inferior to modern humans," said Paul Tacon, an expert in rock art at Australia's Griffith University. Tacon, who was not involved in the study, said the research showed that the engravings were made with great effort for ritual purposes, to communicate with others, or both.

"We will never know the meaning the design held for the maker or the Neanderthals who inhabited the cave but the fact that they were marking their territory in this way before modern humans arrived in the region has huge implications for debates about what it is to be human and the origin of art," said Tacon.

Not everyone is convinced: Another recently published study examining the dating of various archaeological sites across Europe raises the possibility that the artifacts may not have been made by Neanderthals but by modern humans. Neanderthals disappeared between 41,030 and 39,260 years ago, while modern humans arrived in Europe about 45,000-43,000 years ago, according to that study, leaving several thousand years of overlap.

"Any discovery that helps improve the public image of Neanderthals is welcome," said Clive Gamble, an archaeologist at the University of Southampton, England. "We know they spoke, lived in large social groups, looked after the sick, buried their dead and were highly successful in the ice age environments of northern latitudes. As a result rock engraving should be entirely within their grasp."

"What is critical, however, is the dating," said Gamble. "While I want Neanderthals to be painting, carving and engraving, I'm reserving judgment."

But Finlayson, who is the director of the heritage division at the Gibraltar Museum, is certain that the artifacts, and therefore the engravings, were made by Neanderthals.

"All European Neanderthal fossil sites from this period, including Devil's Tower Rock Shelter just one mile from Gorham's Cave, have this technology associated," he said in an email. "In contrast no modern human site in Europe has this type of technology. So we are confident that the tools were made by Neanderthals."

More information: *A rock engraving made by Neanderthals in Gibraltar, Joaquín Rodríguez-Vidal et al. PNAS (2014)* www.pnas.org/cgi/doi/10.1073/pnas.1411529111

http://nyti.ms/1x3s1K3

A Call for a Low-Carb Diet

People who avoid carbohydrates and eat more fat lose more body fat and have fewer cardiovascular risks than people who follow the recommended low-fat diet

By Anahad O'Connor SEPT. 1, 2014

People who avoid carbohydrates and eat more fat, even saturated fat, lose more body fat and have fewer cardiovascular risks than people who follow the low-fat diet that health authorities have favored for decades, a major new study shows.

The findings are unlikely to be the final salvo in what has been a long and often contentious debate about what foods are best to eat for weight loss and overall health. The notion that dietary fat is harmful, particularly saturated fat, arose decades ago from comparisons of disease rates among large national populations. But more recent clinical studies in which individuals and their diets were assessed over time have produced a more complex picture. Some have provided strong evidence that people can sharply reduce their heart disease risk by eating fewer carbohydrates and more dietary fat, with the exception of trans fats. The new findings suggest that this strategy more effectively reduces body fat and also lowers overall weight.

The new study was financed by the National Institutes of Health and published in the Annals of Internal Medicine. It included a racially diverse group of 150 men and women - a rarity in clinical nutrition studies - who were assigned to follow diets for one year that limited either the amount of carbs or fat that they could eat, but not overall calories.

"To my knowledge, this is one of the first long-term trials that's given these diets without calorie restrictions," said Dariush Mozaffarian, the dean of the Friedman School of Nutrition Science and Policy at Tufts University, who was not involved in the new study. "It shows that in a free-living setting, cutting your carbs helps you lose weight without focusing on calories. And that's really important because someone can change what they eat more easily than trying to cut down on their calories."

Diets low in carbohydrates and higher in fat and protein have been commonly used for weight loss since Dr. Robert Atkins popularized the approach in the 1970s. Among the longstanding criticisms is that these diets cause people to lose weight in the form of water instead of body fat, and that cholesterol and other heart disease risk factors climb because dieters invariably raise their intake of saturated fat by eating more meat and dairy.

Many nutritionists and health authorities have "actively advised against" low-carbohydrate diets, said the lead author of the new study, Dr. Lydia A. Bazzano of the Tulane University School of Public Health and Tropical Medicine. "It's been thought that your saturated fat is, of course, going to increase, and then your cholesterol is going to go up," she said. "And then bad things will happen in general."

The new study showed that was not the case. By the end of the yearlong trial, people in the low-carbohydrate group had lost about eight pounds more on average than those in the low-fat group. They had significantly greater reductions in body fat than the low-fat group, and improvements in lean muscle mass - even though neither group changed their levels of physical activity.

While the low-fat group did lose weight, they appeared to lose more muscle than fat. "They actually lost lean muscle mass, which is a bad thing," Dr. Mozaffarian said. "Your balance of lean mass versus fat mass is much more important than weight. And that's a very important finding that shows why the low-carb, high-fat group did so metabolically well."

Robots may already think faster than we do, but they are just starting to be able to move like us; one researcher has set out to prove an 84-year-old hypothesis about how trees move nutrients around; a lower-carb, higher-fat diet may be better for you than a low-fat diet. David Corcoran, Michael Mason, Joshua A. Krisch and Jeffery DelViscio

The high-fat group followed something of a modified Atkins diet. They were told to eat mostly protein and fat, and to choose foods with primarily unsaturated fats,

like fish, olive oil and nuts. But they were allowed to eat foods higher in saturated fat as well, including cheese and red meat.

A typical day's diet was not onerous: It might consist of eggs for breakfast, tuna salad for lunch, and some kind of protein for dinner - like red meat, chicken, fish, pork or tofu - along with vegetables. Low-carb participants were encouraged to cook with olive and canola oils, but butter was allowed, too. Over all, they took in a little more than 13 percent of their daily calories from saturated fat, more than double the 5 to 6 percent limit recommended by the American Heart Association. The majority of their fat intake, however, was unsaturated fats.

The low-fat group included more grains, cereals and starches in their diet. They reduced their total fat intake to less than 30 percent of their daily calories, which is in line with the federal government's dietary guidelines. The other group increased their total fat intake to more than 40 percent of daily calories.

Both groups were encouraged to eat vegetables, and the low-carbohydrate group was told that eating some beans and fresh fruit was fine as well.

In the end, people in the low-carbohydrate group saw markers of inflammation and triglycerides - a type of fat that circulates in the blood - plunge. Their HDL, the so-called good cholesterol, rose more sharply than it did for people in the low-fat group.

Blood pressure, total cholesterol and LDL, the so-called bad cholesterol, stayed about the same for people in each group. Nonetheless, those on the low-carbohydrate diet ultimately did so well that they managed to lower their Framingham risk scores, which calculate the likelihood of a heart attack within the next 10 years. The low-fat group on average had no improvement in their scores.

The decrease in risk on the low-carbohydrate diet "should translate into a substantial benefit," said Dr. Allan Sniderman, a professor of cardiology at McGill University in Montreal.

One important predictor of heart disease that the study did not assess, Dr. Sniderman said, was the relative size and number of LDL particles in the bloodstream. Two people can have the same overall LDL concentration, but very different levels of risk depending on whether they have a lot of small, dense LDL particles or a small number of large and fluffy particles.

Eating refined carbohydrates tends to raise the overall number of LDL particles and shift them toward the small, dense variety, which contributes to atherosclerosis. Saturated fat tends to make LDL particles larger, more buoyant and less likely to clog arteries, at least when carbohydrate intake is not high, said Dr. Ronald M. Krauss, the former chairman of the American Heart Association's dietary guidelines committee.

Small, dense LDL is the kind typically found in heart patients and in people who have high triglycerides, central obesity and other aspects of the so-called metabolic syndrome, said Dr. Krauss, who is also the director of atherosclerosis research at Children's Hospital Oakland Research Institute.

"I've been a strong advocate of moving saturated fat down the list of priorities in dietary recommendations for one reason: because of the increasing importance of metabolic syndrome and the role that carbohydrates play," Dr. Krauss said.

Dr. Mozaffarian said the research suggested that health authorities should pivot away from fat restrictions and encourage people to eat fewer processed foods, particularly those with refined carbohydrates.

The average person may not pay much attention to the federal dietary guidelines, but their influence can be seen, for example, in school lunch programs, which is why many schools forbid whole milk but serve their students fat-free chocolate milk loaded with sugar, Dr. Mozaffarian said.

http://www.eurekalert.org/pub_releases/2014-09/uu-nih090114.php

Neurons in human skin perform advanced calculations

Neurons in human skin perform advanced calculations, previously believed that only the brain could perform.

This is according to a study from Umeå University in Sweden published in the journal Nature Neuroscience.

A fundamental characteristic of neurons that extend into the skin and record touch, so-called first-order neurons in the tactile system, is that they branch in the skin so that each neuron reports touch from many highly-sensitive zones on the skin. According to researchers at the Department of Integrative Medical Biology, IMB, Umeå University, this branching allows first-order tactile neurons not only to send signals to the brain that something has touched the skin, but also process geometric data about the object touching the skin.

"Our work has shown that two types of first-order tactile neurons that supply the sensitive skin at our fingertips not only signal information about when and how intensely an object is touched, but also information about the touched object's shape" says Andrew Pruszynski, who is one of the researchers behind the study. The study also shows that the sensitivity of individual neurons to the shape of an object depends on the layout of the neuron's highly-sensitive zones in the skin.

"Perhaps the most surprising result of our study is that these peripheral neurons, which are engaged when a fingertip examines an object, perform the same type of calculations done by neurons in the cerebral cortex. Somewhat simplified, it means that our touch experiences are already processed by neurons in the skin before they reach the brain for further processing" says Andrew Pruszynski.

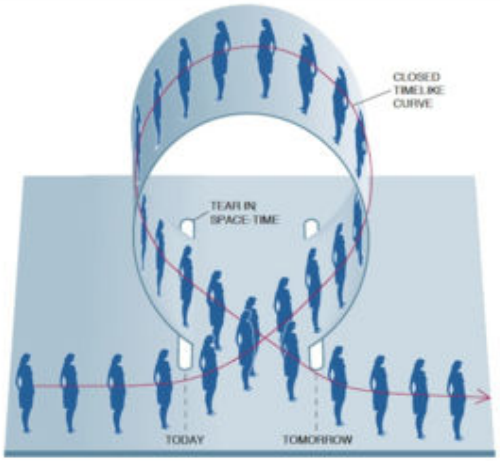
http://bit.ly/1rNEZcx

Time Travel Simulation Resolves "Grandfather Paradox"

What would happen to you if you went back in time and killed your grandfather? A model using photons reveals that quantum mechanics can solve the quandary—and even foil quantum cryptography

Sep 2, 2014 |By Lee Billings

On June 28, 2009, the world-famous physicist Stephen Hawking threw a party at the University of Cambridge, complete with balloons, hors d'oeuvres and iced champagne. Everyone was invited but no one showed up. Hawking had expected as much, because he only sent out invitations after his party had concluded. It was, he said, "a welcome reception for future time travelers," a tongue-in-cheek experiment to reinforce his 1992 conjecture that travel into the past is effectively impossible.



Entering a closed timelike curve tomorrow means you could end up at today. **Dmitry Schidlovsky**

But Hawking may be on the wrong side of history. Recent experiments offer tentative support for time travel's feasibility—at least from a mathematical perspective. The study cuts to the core of our understanding of the universe, and the resolution of the possibility of time travel, far from being a topic worthy only of science fiction, would have profound implications for fundamental physics as well as for practical applications such as quantum cryptography and computing.

Closed timelike curves

The source of time travel speculation lies in the fact that our best physical theories seem to contain no prohibitions on traveling backward through time. The feat should be possible based on Einstein's theory of general relativity, which describes gravity as the warping of spacetime by energy and matter. An extremely powerful gravitational field, such as that produced by a spinning black hole, could in principle profoundly warp the fabric of existence so that spacetime bends back on itself. This would create a "closed timelike curve," or CTC, a loop that could be traversed to travel back in time.

Hawking and many other physicists find CTCs abhorrent, because any macroscopic object traveling through one would inevitably create paradoxes where cause and effect break down. In a model proposed by the theorist David Deutsch in 1991, however, the paradoxes created by CTCs could be avoided at the quantum scale because of the behavior of fundamental particles, which follow only the fuzzy rules of probability rather than strict determinism. "It's intriguing that you've got general relativity predicting these paradoxes, but then you consider them in quantum mechanical terms and the paradoxes go away," says University of Queensland physicist Tim Ralph. "It makes you wonder whether this is important in terms of formulating a theory that unifies general relativity with quantum mechanics."

Experimenting with a curve

Recently Ralph and his PhD student Martin Ringbauer led a team that experimentally simulated Deutsch's model of CTCs for the very first time, testing and confirming many aspects of the two-decades-old theory. Their findings are published in *Nature Communications.* Much of their simulation revolved around investigating how Deutsch's model deals with the "grandfather paradox," a hypothetical scenario in which someone uses a CTC to travel back through time to murder her own grandfather, thus preventing her own later birth. (*Scientific American* is part of Nature Publishing Group.)

Deutsch's quantum solution to the grandfather paradox works something like this: Instead of a human being traversing a CTC to kill her ancestor, imagine that a fundamental particle goes back in time to flip a switch on the particle-generating machine that created it. If the particle flips the switch, the machine emits a particle—*the* particle—back into the CTC; if the switch isn't flipped, the machine emits nothing. In this scenario there is no *a priori* deterministic certainty to the particle's emission, only a distribution of probabilities. Deutsch's insight was to postulate self-consistency in the quantum realm, to insist that any particle entering one end of a CTC must emerge at the other end with identical properties. Therefore, a particle emitted by the machine with a probability of one half would enter the CTC and come out the other end to flip the switch with a probability of one half, imbuing itself at birth with a probability of one half of going back to flip the switch. If the particle were a person, she would be born with a one-half probability of killing her grandfather, giving her grandfather a one-half probability of escaping death at her hands—good enough in probabilistic terms to close the causative loop and escape the paradox. Strange though it may be, this solution is in keeping with the known laws of quantum mechanics.

In their new simulation Ralph, Ringbauer and their colleagues studied Deutsch's model using interactions between pairs of polarized photons within a quantum system that they argue is mathematically equivalent to a single photon traversing a CTC. "We encode their polarization so that the second one acts as kind of a past incarnation of the first," Ringbauer says. So instead of sending a person through a

time loop, they created a stunt double of the person and ran him through a time-loop simulator to see if the doppelganger emerging from a CTC exactly resembled the original person as he was in that moment in the past.

By measuring the polarization states of the second photon after its interaction with the first, across multiple trials the team successfully demonstrated Deutsch's self-consistency in action. "The state we got at our output, the second photon at the simulated exit of the CTC, was the same as that of our input, the first encoded photon at the CTC entrance," Ralph says. "Of course, we're not really sending anything back in time but [the simulation] allows us to study weird evolutions normally not allowed in quantum mechanics."

Those "weird evolutions" enabled by a CTC, Ringbauer notes, would have remarkable practical applications, such as breaking quantum-based cryptography through the cloning of the quantum states of fundamental particles. "If you can clone quantum states," he says, "you can violate the Heisenberg uncertainty principle," which comes in handy in quantum cryptography because the principle forbids simultaneously accurate measurements of certain kinds of paired variables, such as position and momentum. "But if you clone that system, you can measure one quantity in the first and the other quantity in the second, allowing you to decrypt an encoded message."

"In the presence of CTCs, quantum mechanics allows one to perform very powerful information-processing tasks, much more than we believe classical or even normal quantum computers could do," says Todd Brun, a physicist at the University of Southern California who was not involved with the team's experiment. "If the Deutsch model is correct, then this experiment faithfully simulates what could be done with an actual CTC. But this experiment cannot test the Deutsch model itself; that could only be done with access to an actual CTC."

Alternative reasoning

Deutsch's model isn't the only one around, however. In 2009 Seth Lloyd, a theorist at Massachusetts Institute of Technology, proposed an alternative, less radical model of CTCs that resolves the grandfather paradox using quantum teleportation and a technique called post-selection, rather than Deutsch's quantum self-consistency. With Canadian collaborators, Lloyd went on to perform successful laboratory simulations of his model in 2011. "Deutsch's theory has a weird effect of destroying correlations," Lloyd says. "That is, a time traveler who emerges from a Deutschian CTC enters a universe that has nothing to do with the one she exited in the future. By contrast, post-selected CTCs preserve correlations, so that the time traveler returns to the same universe that she remembers in the past."

This property of Lloyd's model would make CTCs much less powerful for information processing, although still far superior to what computers could achieve in typical regions of spacetime. "The classes of problems our CTCs could help solve are roughly equivalent to finding needles in haystacks," Lloyd says. "But a computer in a Deutschian CTC could solve why haystacks exist in the first place."

Lloyd, though, readily admits the speculative nature of CTCs. "I have no idea which model is really right. Probably both of them are wrong," he says. Of course, he adds, the other possibility is that Hawking is correct, "that CTCs simply don't and cannot exist." Time-travel party planners should save the champagne for themselves—their hoped-for future guests seem unlikely to arrive.

http://www.eurekalert.org/pub_releases/2014-09/bu-edh090214.php

Extinctions during human era worse than thought

Newest estimate is that the pre-human rate was 10 times lower than scientists had thought

PROVIDENCE, R.I. [Brown University] - It's hard to comprehend how bad the current rate of species extinction around the world has become without knowing what it was before people came along. The newest estimate is that the pre-human rate was 10 times lower than scientists had thought, which means that the current level is 10 times worse.

Extinctions are about 1,000 times more frequent now than in the 60 million years before people came along. The explanation from lead author Jurriaan de Vos, a Brown University postdoctoral researcher, senior author Stuart Pimm, a Duke University professor, and their team appears online in the journal Conservation Biology.

"This reinforces the urgency to conserve what is left and to try to reduce our impacts," said de Vos, who began the work while at the University of Zurich. "It was very, very different before humans entered the scene."

In absolute, albeit rough, terms the paper calculates a "normal background rate" of extinction of 0.1 extinctions per million species per year. That revises the figure of 1 extinction per million species per year that Pimm estimated in prior work in the 1990s. By contrast, the current extinction rate is more on the order of 100 extinctions per million species per year.

Orders of magnitude, rather than precise numbers are about the best any method can do for a global extinction rate, de Vos said. "That's just being honest about the uncertainty there is in these type of analyses."

From Fossils to Genetics

The new estimate improves markedly on prior ones mostly because it goes beyond the fossil record. Fossils are helpful sources of information, but their

shortcomings include disproportionate representation of hard-bodied sea animals and the problem that they often only allow identification of the animal or plant's genus, but not its exact species.

What the fossils do show clearly is that apart from a few cataclysms over geological periods — such as the one that eliminated the dinosaurs — biodiversity has slowly increased.

The new study next examined evidence from the evolutionary family trees — phylogenies — of numerous plant and animal species. Phylogenies, constructed by studying DNA, trace how groups of species have changed over time, adding new genetic lineages and losing unsuccessful ones. They provide rich details of how species have diversified over time.

"The diversification rate is the speciation rate minus the extinction rate," said co-author Lucas Joppa, a scientist at Microsoft Research in Redmond, Wash. "The total number of species on earth has not been declining in recent geological history. It is either constant or increasing. Therefore, the average rate at which groups grew in their numbers of species must have been similar to or higher than the rate at which other groups lost species through extinction."

The work compiled scores of studies of molecular phylogenies on how fast species diversified.

For a third approach, de Vos noted that the exponential climb of species diversity should take a steeper upward turn in the current era because the newest species haven't gone extinct yet. "It's rather like your bank account on the day you get paid," he said. "It gets a burst of funds — akin to new species — that will quickly become extinct as you pay your bills."

By comparing that rise of the number of species from the as-yet unchecked speciation rate with the historical trend (it was "log-linear") evident in the phylogenies, he could therefore create a predictive model of what the counteracting historical extinction rate must have been.

The researchers honed their models by testing them with simulated data for which they knew an actual extinction rate. The final models yielded accurate results. They tested the models to see how they performed when certain key assumptions were wrong and on average the models remained correct (in the aggregate, if not always for every species group).

All three data approaches together yielded a normal background extinction rate squarely in the order of 0.1 extinctions per million species per year.

A Human Role

There is little doubt among the scientists that humans are not merely witnesses to the current elevated extinction rate. This paper follows a recent one in Science , authored by Pimm, Joppa, and other colleagues, that tracks where species are threatened or confined to small ranges around the globe. In most cases, the main cause of extinctions is human population growth and per capita consumption, although the paper also notes how humans have been able to promote conservation.

The new study, Pimm said, emphasizes that the current extinction rate is a more severe crisis than previously understood. "We've known for 20 years that current rates of species extinctions are exceptionally high," said Pimm, president of the conservation nonprofit organization SavingSpecies. "This new study comes up with a better estimate of the normal background rate — how fast species would go extinct were it not for human actions. It's lower than we thought, meaning that the current extinction crisis is much worse by comparison."

Other authors on the paper are John Gittleman and Patrick Stephens of the University of Georgia.

http://www.eurekalert.org/pub_releases/2014-09/sri-sfs090214.php

Scripps Florida scientists make diseased cells synthesize their own drug

Scientists have adapted a chemical approach to turn diseased cells into unique manufacturing sites for molecules

JUPITER, FL – In a new study that could ultimately lead to many new medicines, scientists from the Florida campus of The Scripps Research Institute (TSRI) have adapted a chemical approach to turn diseased cells into unique manufacturing sites for molecules that can treat a form of muscular dystrophy.

"We're using a cell as a reaction vessel and a disease-causing defect as a catalyst to synthesize a treatment in a diseased cell," said TSRI Professor Matthew Disney. "Because the treatment is synthesized only in diseased cells, the compounds could provide highly specific therapeutics that only act when a disease is present. This means we can potentially treat a host of conditions in a very selective and precise manner in totally unprecedented ways." The promising research was published recently in the international chemistry journal Angewandte Chemie.

Targeting RNA Repeats

In general, small, low molecular weight compounds can pass the blood-brain barrier, while larger, higher weight compounds tend to be more potent. In the new study, however, small molecules became powerful inhibitors when they bound to targets in cells expressing an RNA defect, such as those found in myotonic dystrophy.

Myotonic dystrophy type 2, a relatively mild and uncommon form of the progressive muscle weakening disease, is caused by a type of RNA defect known as a "tetranucleotide repeat," in which a series of four nucleotides is repeated more times than normal in an individual's genetic code. In this case, a cytosine-

cytosine-uracil-guanine (CCUG) repeat binds to the protein MBNL1, rendering it inactive and resulting in RNA splicing abnormalities that, in turn, results in the disease.

In the study, a pair of small molecule "modules" the scientists developed binds to adjacent parts of the defect in a living cell, bringing these groups close together. Under these conditions, the adjacent parts reach out to one another and, as Disney describes it, permanently hold hands. Once that connection is made, the small molecule binds tightly to the defect, potently reversing disease defects on a molecular level.

"When these compounds assemble in the cell, they are 1,000 times more potent than the small molecule itself and 100 times more potent than our most active lead compound," said Research Associate Suzanne Rzuczek, the first author of the study. "This is the first time this has been validated in live cells."

Click Chemistry Construction

The basic process used by Disney and his colleagues is known as "click chemistry"—a process invented by Nobel laureate K. Barry Sharpless, a chemist at TSRI, to quickly produce substances by attaching small units or modules together in much the same way this occurs naturally.

"In my opinion, this is one unique and a nearly ideal application of the process Sharpless and his colleagues first developed," Disney said.

Given the predictability of the process and the nearly endless combinations, translating such an approach to cellular systems could be enormously productive, Disney said. RNAs make ideal targets because they are modular, just like the compounds for which they provide a molecular template.

Not only that, he added, but many similar RNAs cause a host of incurable diseases such as ALS (Lou Gehrig's Disease), Huntington's disease and more than 20 others for which there are no known cures, making this approach a potential route to develop lead therapeutics to this large class of debilitating diseases.

In addition to Rzuczek and Disney, the other author of the study, "A Toxic RNA Catalyzes the In Cellulo Synthesis of Its Own Inhibitor," is HaJeung Park of TSRI. For more information on the study, see http://onlinelibrary.wiley.com/doi/10.1002/anie.201406465/abstract

The work was supported by the Muscular Dystrophy Foundation, the Myotonic Dystrophy Foundation and the State of Florida.

http://www.wiley-vch.de/util/hottopics/clickchem/

Click Chemistry

The term "click chemistry" was introduced by K. Barry Sharpless et al. and denotes the development of a set of powerful, highly reliable, and selective reactions for the rapid synthesis of useful new compounds and combinatorial libraries through heteroatom links. Their Review in *Angewandte Chemie* in 2001 still ranks among the most accessed online articles in the journal.

Hartmuth C. Kolb, M. G. Finn, K. Barry Sharpless

Click Chemistry: Diverse Chemical Function from a Few Good Reactions

Angew. Chem. 2001, vol. 113, no. 11, pp. 2056–2075; Angew. Chem. Int. Ed. 2001, vol. 40, no. 11, pp. 2004–2021

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Breast cancer patients with bilateral mastectomy don't have better survival rates

Breast cancer patients treated with lumpectomy followed by radiation therapy survived as long as patients who had bilateral mastectomy

Breast cancer patients treated with lumpectomy followed by radiation therapy survived as long as patients who had bilateral mastectomy, according to a large study conducted by researchers at the Stanford University School of Medicine and the Cancer Prevention Institute of California.

The comprehensive analysis of nearly 190,000 California women with the disease is the first to directly compare survival rates following the three most common surgical interventions: bilateral mastectomy (the removal of both breasts), unilateral mastectomy (the removal of the affected breast), and lumpectomy (the selective removal of cancerous tissue within the breast) plus radiation. Women in the study were diagnosed between 1998 and 2011 with cancer in one breast.

The study will be published on Sept. 2 in the Journal of the American Medical Association.

The researchers sought to understand why increasing numbers of women are choosing bilateral mastectomies after a diagnosis of cancer in just one breast. The study found that, in 2011, as many as 12 percent of newly diagnosed breast cancer patients opted for a bilateral mastectomy, despite uncertainty as to whether this approach was better than the alternatives. This study dispels much of that uncertainty.

"We can now say that the average breast cancer patient who has bilateral mastectomy will have no better survival than the average patient who has lumpectomy plus radiation," said Allison Kurian, MD, an assistant professor of medicine and of health research and policy at Stanford. "Furthermore, a mastectomy is a major procedure that can require significant recovery time and may entail breast reconstruction, whereas a lumpectomy is much less invasive with a shorter recovery period."

The study did find, however, a slightly lower survival rate among women who underwent a unilateral mastectomy.

Kurian is the lead author of the study. Scarlett Gomez, PhD, a research scientist at CPIC, is the senior author.

"Given the recent attention around bilateral mastectomies, we wanted to know whether there are particular types of patients likely to receive a bilateral mastectomy," Gomez said. "And, secondly, are there relative differences in mortality among the three procedures? We were able to address these questions using data from the California Cancer Registry, which covers nearly all women diagnosed with breast cancer in the state. The registry is enhanced with information on factors that may influence a treatment decision, including their socioeconomic status, health insurance and where they received their care."

The researchers found that of the 189,734 women in the study, 55 percent received a lumpectomy with follow-up radiation, 38.8 received a unilateral mastectomy and 6.2 percent received a bilateral mastectomy. Overall, the proportion of women receiving unilateral mastectomies declined during the study period, while the proportion of women receiving bilateral mastectomies increased.

Racial and ethnic minorities, as well as women of lower socioeconomic status, were more likely than others to receive a unilateral mastectomy. In contrast, women who received a bilateral mastectomy were more likely to be middle- or upper-class, younger than 50 or non-Hispanic whites, or some combination of these.

The difference in the long-term survival rates between women who underwent a bilateral mastectomy and women who received a lumpectomy plus radiation was not statistically significant.

The slightly lower survival rate among women who underwent a unilateral mastectomy could be due to the fact that these patients tended to be members of racial or ethnic minorities or have a lower socioeconomic status than other patient groups, or both, the researchers said. Gomez and Kurian speculate that these patients may have been more likely to have other health problems, such as diabetes, that could have affected or limited the course or effectiveness of their cancer treatment. They may also have had difficulty securing transportation to radiation appointments or had other barriers in access to care, according to Gomez and Kurian.

Physicians in California are legally required to report all cancer cases in the state to the Cancer Registry. The researchers used this data to assess the outcomes of women diagnosed with stages 0 to 3 unilateral breast cancer — that is, cancer affecting only one breast — in the state from 1998 to 2011.

The registry is unique because it includes information about nearly every cancer case in the state. It captures important information, such as the stage of the disease, the surgical outcome chosen by the patient and her physician, and whether the patient eventually died from her disease. It also includes information about the patient's racial or ethnic background and where she lived.

"The registry allows us to do a population-based study to gain a real-world picture of cancer cases in California," said Kurian. "We can ask and answer questions that couldn't be answered in a randomized clinical trial." For example, Kurian and Gomez point out that it would not be ethical to assign a woman randomly to one of the three common surgical options. But using the registry, they can simply track who received which intervention.

Despite the fact that women who removed both breasts did not have better survival rates, the study found that rapidly increasing numbers of women are opting for the complex surgery, which requires a long recovery period and possibly reconstructive surgery.

The bilateral mastectomy procedure is particularly prevalent among non-Hispanic white women younger than 40 who have private insurance and receive care at a National Cancer Institute-designated cancer center. In fact, 33 percent of women under age 40 received bilateral mastectomies in 2011, compared with 3.6 percent in 1998. (The prevalence of bilateral mastectomy among all patients in the study increased from 2 to 12.3 percent during the same time period.)

In contrast, racial or ethnic minorities and women with public insurance, such as Medicaid, were more likely to receive a unilateral mastectomy.

Kurian and Gomez emphasize that the study's findings don't mean that a woman with a BRCA1, BRCA2 or other gene mutation known to significantly increase the risk of developing breast cancer, or with a strong family history of breast cancer, should not get a bilateral mastectomy. A genetic predisposition may mean that removing both breasts is an effective option.

There are also other reasons why a woman might choose a bilateral mastectomy. Some newer breast-reconstruction methods achieve better symmetry when both breasts are reconstructed simultaneously. Removal of both breasts may also alleviate a woman's fear and worry that a second cancer will occur in her remaining breast, the researchers said.

"We're hopeful that this study will open a dialogue between a patient and her physician to discuss these kinds of questions," said Gomez. "It's an important piece of evidence that can guide their decision-making process."

Other co-authors of the study are affiliated with the Cancer Prevention Institute of California. The study was supported by the Suzanne Pride Bryan Fund for Breast Cancer Research, the Jan Weimer Junior Faculty Chair in Breast Oncology at the Stanford Cancer Institute, the National Cancer Institute, the California Department of Health Services and the U.S. Centers for Disease Control and Prevention.

http://www.eurekalert.org/pub_releases/2014-09/jhm-btf090214.php

'Prepped' by tumor cells, lymphatic cells encourage breast cancer cells to spread

HIV drug plus blood vessel growth-blockers could halt metastasis

Breast cancer cells can lay the groundwork for their own spread throughout the body by coaxing cells within lymphatic vessels to send out tumor-welcoming signals, according to a new report by Johns Hopkins scientists.

Writing in the Sept. 2 issue of Nature Communications, the researchers describe animal and cell-culture experiments that show increased levels of so-called signaling molecules released by breast cancer cells. These molecules cause lymphatic endothelial cells (LECs) in the lungs and lymph nodes to produce proteins called CCL5 and VEGF. CCL5 attracts tumor cells to the lungs and lymph nodes, and VEGF increases the number of blood vessels and makes them more porous, allowing tumor cells to metastasize and infiltrate the lungs.

In the same report, the researchers say maraviroc, a drug already approved for treating HIV infection, blocked the siren call of CCL5 in tests on animals and cells and prevented tumor spread (metastasis). Additional experiments using a combination of maraviroc and a drug that blocks the VEGF protein suggest that the treatment duo could be an effective way to prevent metastatic disease in human breast cancer patients, according to the researchers.

Because the anti-retroviral drug maraviroc has already been approved by the U.S. Food and Drug Administration and has been shown safe for long term, oral use, it could be tested in clinical trials sooner rather than later, says Aleksander Popel, Ph.D., a professor in the Department of Biomedical Engineering at the Johns Hopkins University School of Medicine and member of the Johns Hopkins Kimmel Cancer Center.

"It was surprising to find that LECs can play such an active and significant role in tumor spread." Popel noted. "Conventionally, lymphatic vessels are regarded mainly as passive conduits through which tumor cells spread from the primary tumor and eventually metastasize," he said. "However, we now know that lymphatic vessels enable metastasis, and other studies also show that they play an important role in whether or not immune cells recognize and attack cancer cells."

Popel and colleagues traced the influence of tumor signaling on LECs in cell cultures and in mice. Breast cancer cells were bathed in a nutrient-rich liquid, and, as the cancer cells grew, the investigators detected secretions of a signaling molecule called interleukin-6 (IL6) in the liquid.

Mice that were injected with the IL6-containing liquid experienced a continual rise in CCL5 levels in blood samples for several weeks. Nine of 10 tumor-bearing mice injected with the IL6-laden liquid developed metastases five weeks later. Only two of 10 mice, exposed to the liquid and given a combination of maraviroc and a VEGF-blocking drug, developed metastases.

Because maraviroc blocks the actions of CCL5, it could be delivered, along with standard chemotherapy, right after surgically removing a tumor in a bid to prevent any leftover circulating tumor cells from finding a new metastatic niche in the body, Popel says.

"However, IL6-secreting tumors could be laying the groundwork for metastasis much earlier than surgery occurs in a patient," he said. "To prevent metastatic sites from taking root, we could administer drugs that block IL6 before surgery."

The study did not address when or how to remove lymph node tissue surgically, as is often done as part of breast cancer treatment, but Popel and colleagues hope to explore the issue in future studies.

Other researchers on the paper include Esak Lee, the first author, and Niranjan Pandey of the Department of Biomedical Engineering, Johns Hopkins University School of Medicine and Elana Fertig, Kideok Jin, and Saraswati Sukumar of the Johns Hopkins Kimmel Cancer Center.

Funding for the study was provided by the National Institutes of Health's National Cancer Institute (R01 CA138264) and the Safeway Foundation for Breast Cancer.

http://www.eurekalert.org/pub_releases/2014-09/foas-ssp090214.php

Salamander skin peptide promotes quick and effective wound healing in mice

Short peptide called tylotoin exerts the promotion of wound healing with epidermal growth factor (EGF) in mice

New research in The FASEB Journal suggests that a short peptide called tylotoin exerts the promotion of wound healing with epidermal growth factor (EGF) in a murine model of a full thickness dermal wound

Move over antibiotic ointment, there might be a new salve to dominate medicine cabinets of the future, and it comes from an unlikely place—the lowly salamander. Salamanders may not be the cuddliest of animals, but they can regenerate lost limbs and achieve amazing recovery of seriously damaged body parts. Now, a new report published in the September 2014 issue of The FASEB Journal, identifies a small protein (called a "peptide") from the skin of salamanders that may be the key to unlocking the secret of this amazing wound healing trick in humans.

"This research takes a step toward an understanding of the cellular and molecular events that underlie quick wound healing in the salamander by the discovery of a potential wound healing promoting peptide," said Ren Lai, Ph.D., a researcher

involved in the work from the Kunming Institute of Zoology at the Chinese Academy of Sciences in Yunnan, China.

To make this discovery, Lai and colleagues collected skin extract from salamanders and separated it by gel filtration and high performance liquid chromatography. The skin component from salamanders was subjected to keratinocyte cell proliferation and endothelial cell tube formation assay to evaluate possible wound healing potential. This component was further subjected to structure and functional analysis, which pointed toward a short peptide called tylotoin that contained 12 amino acid residues. This peptide was found to exert the ability to promote wound healing with epidermal growth factor (EGF) in a murine model of a full thickness dermal wound. Tylotoin directly enhances the motility and proliferation of keratinocytes, vascular endothelial cells and fibroblasts, resulting in accelerated re-epithelialization and granulation tissue formation in the wound site. Tylotoin also promotes the release of transforming growth factor beta1 and interleukin 6, which are essential in the wound healing response.

"Until now, rapid wound healing has been the stuff of superheroes and science fiction," said Gerald Weissmann, M.D., Editor-in-Chief of The FASEB Journal. "Scientists have always wondered how some 'lower' animals heal wounds that would be mortal to humans. Now, we are taking concrete steps to mimic this ancient – and forgotten – healing process in our own bodies."

Details: Lixian Mu, Jing Tang, Han Liu, Chuanbin Shen, Mingqiang Rong, Zhiye Zhang, and Ren Lai. A potential wound-healing-promoting peptide from salamander skin. FASEB J. September 2014 28:3919-3929; doi:10.1096/fj.13-248476 ;
http://www.fasebj.org/content/28/9/3919.abstract

http://www.eurekalert.org/pub_releases/2014-09/cmc-sls090214.php

Study links sex hormone levels in the blood to risk of sudden cardiac arrest

For first time, researchers analyze levels of testosterone and estradiol to predict patients' likelihood of suffering usually fatal condition, take another step toward offering preventive treatments

LOS ANGELES – Measuring the levels of sex hormones in patients' blood may identify patients likely to suffer a sudden cardiac arrest, a heart rhythm disorder that is fatal in 95 percent of patients.

A new study, published online by the peer-reviewed journal Heart Rhythm, shows that lower levels of testosterone, the predominant male sex hormone, were found in men who had a sudden cardiac arrest. Higher levels of estradiol, the major female sex hormone, were strongly associated with greater chances of having a sudden cardiac arrest in both men and women.

"Because sudden cardiac arrest is usually fatal, we are constantly looking for ways to predict which patients are susceptible so we can concentrate on prevention," said Sumeet Chugh, MD, director of the Heart Rhythm Center in the Cedars-Sinai Heart Institute and the Pauline and Harold Price Chair in Cardiac Electrophysiology Research. "If we wait until someone has a sudden cardiac arrest, it is usually too late for treatment."

Unlike heart attacks (myocardial infarction), which are typically caused by clogged coronary arteries reducing blood flow to the heart muscle, sudden cardiac arrest is the result of defective electrical impulses. Patients may have little or no warning, and the disorder usually causes nearly instantaneous death. Every year, 250,000 to 300,000 people in the U.S. and up to 5 million worldwide die from sudden cardiac arrest.

Despite years of significant advances in emergency medicine and resuscitation, just 5 percent of those who suffer sudden cardiac arrest survive. For patients at known risk for this or other heart rhythm abnormalities, an implantable cardioverter-defibrillator, or ICD, may be placed in the chest or abdomen to detect faulty electrical impulses and provide a shock to return normal rhythm.

The sex hormone findings are a result of the Oregon Sudden Unexpected Death Study, a comprehensive, 16-hospital, multiyear assessment of cardiac deaths in the 1 million population Portland, Oregon metropolitan area. Led by Chugh and funded in part by the National Heart, Lung, and Blood Institute, the study's goal is to shed light on the risk factors, triggers and genetic defects associated with sudden cardiac death. "This is the first time it has been reported that there is an association between sex hormone levels and sudden cardiac arrest," said Chugh. "While these findings need to be confirmed by other studies, they suggest that higher testosterone levels in men may offer protection from sudden cardiac arrest and lower levels of estrogen may protect both men and women."

Researchers measured blood hormone levels in 149 patients who had a sudden cardiac arrest, comparing them with levels in 149 patients who had coronary artery disease but did not have sudden cardiac arrest.

The study's findings include:

Men who had sudden cardiac arrests had testosterone levels of 4.4 nanograms per milliliter, compared to 5.4 nanograms per milliliter for men who did not have sudden cardiac arrest.

Men who had sudden cardiac arrest had estradiol levels of 68 picograms per milliliter, compared to 52 picograms per milliliter for men who did not have sudden cardiac arrest.

Women who had sudden cardiac arrest had estradiol levels of 54 picograms per milliliter, compared to 36 picograms per milliliter for the control group.

http://www.eurekalert.org/pub_releases/2014-09/smh-pip082814.php

Protein in plasma may one day change transfusions

Fibronectin is instrumental in stopping bleeding but interestingly also at preventing life-threatening blood clots

TORONTO – In injured mice, the naturally occurring protein fibronectin is instrumental in stopping bleeding but interestingly also at preventing life-threatening blood clots – according to new research published today in Journal of Clinical Investigation.

When someone is bleeding, a blood clot is a positive response – the body forms the clot as a plug to stop bleeding. But when blood clots form in the absence of an injury, those clots can be life-threatening. Excessive blood clots in arteries and the brain are the main cause of heart attack and stroke.

Researchers found that fibronectin can actually switch its function from stopping bleeding to stopping overactive blood clots.

"Most treatments that help the body stop bleeding can actually cause blood clots and many treatments to prevent excessive blood clots increase risk of bleeding out," said Dr. Heyu Ni, the principal investigator and a scientist in the Keenan Research Centre for Biomedical Science of St. Michael's Hospital. "But when given to mice after an injury or to mice treated with blood thinners – which frequently lead to bleeding complications – fibronectin seems to offer a win-win solution."

More clinical studies are required to determine whether fibronectin – one of many proteins found in blood – plays a similar role in people. Dr. Ni's research shows that fibronectin may actually be the body's first response to prevent bleeding at an injured blood vessel. This discovery highlights a possible new research direction for bleeding control and may be most relevant for surgery and traumatic injuries, which often require a large amount of blood transfusions.

"Blood transfusions carry risk of heart attack and stroke, especially in surgical patients, so researchers and clinicians around the world are experimenting with different forms of blood product to determine which is best for transfusions," said Dr. Ni, who is also a scientist with Canadian Blood Services.

At this point, however, experts disagree about what blood products are most beneficial for the control of bleeding. The most common form of blood product used in Canada is processed by testing and preserving donor blood. Other forms of blood product are more heavily refined; one such product is refined by stripping away most of the proteins found in blood, including fibronectin, to create a concentrated form of a single blood protein – fibrinogen.

"Fibrinogen has been shown to help the body stop bleeding, but our research indicates that less-refined blood products that include fibronectin and fibrinogen may help stop bleeding even more effectively," said Dr. Ni. "And, as an added bonus, fibronectin likely also reduces the risk of life-threatening blood clots from forming."

Debate concerning infection risks has led to some of the more processed blood products being withdrawn from a number of European countries but Canada, the United States, and England are still using them. The more heavily refined blood products, including concentrated fibrinogen, have been approved by many countries but are only available in Canada through Health Canada's special access program.

"There is a lot of work to be done but we might find that the less expensive and less processed form of donor blood may be more effective for transfusions," said Dr. Ni. "We've shown that fibronectin might play a role in improving results from transfusions and should not be discarded during blood product processing. It may be also an important protein in transfusions for stopping bleeding, particularly for patients who receive blood thinners during surgeries."

http://www.wired.com/2014/09/cdc-director-ebola/

CDC Director on Ebola: 'The Window of Opportunity Really Is Closing'

We need action now to scale up the response. We know how to stop Ebola. The challenge is to scale it up to the massive levels needed to stop this outbreak."

- **By Maryn McKenna**

I said last month that I was going to try to stay out of Ebola news because so much is being written about it elsewhere. Since then, the African outbreak — now really an epidemic, since it is in multiple countries – has ballooned to 3,000 cases, and the World Health Organization has predicted it may take 6 months or more to bring it under control.

Something caught my attention today though that felt worth highlighting. Dr. Tom Frieden, director of the US Centers for Disease Control and Prevention, gave a lengthy press conference immediately after returning to the US from a visit to the Ebola zone. Frieden has shown in the past that he knows how to be outspoken in a very strategic way; yet even so, the urgency of his language, and his call for an immediate, comprehensive global response, was striking.

You can find the whole transcript on this page, but here are some highlights:

"Despite tremendous efforts from the U.S. Government, from CDC, from within countries, the number of cases continues to increase and is now increasing rapidly. I'm afraid over the next few weeks, those numbers are likely to increase further and significantly. There is a window of opportunity to tamp this down, but that window is closing. We need action now to scale up the response. We know how

to stop Ebola. The challenge is to scale it up to the massive levels needed to stop this outbreak."

"The number of cases is increasing so quickly that for every day's delay, it becomes that much harder to stop it. There are three key things that we need. The first is more resources. This is going to take a lot to confront. The second are technical experts in health care and management to help in country. And the third is a global coordinated unified approach because this is not just a program for … West Africa, it's not just a problem for Africa, it's a problem for the world and the world needs to respond."

"In some ways the most upsetting thing I saw is what I didn't see. I didn't see enough beds for treatment. So in one facility which had just opened with 35 beds, there were 63 patients, many of them lying on the ground. I didn't see data coming in from large parts of the country where Ebola might be spreading. I didn't see the kind of rapid response team that's needed to stop a single cluster from becoming a large outbreak. I didn't see the kind of efficient management systems and support and transport and jeeps that are essential for a rapid and effective response."

"Everything I've seen suggests over the next few weeks it's likely to get worse. We're likely to see significant increases in cases. Already we have widespread transmission in Liberia. In Sierra Leone, we are seeing strong signs that that will happen in the near future." "There's a real risk to the stability and security of societies as governments are increasingly challenged to not only control Ebola but provide basic health services, security services, and keep the government running, the stability of these countries, of their economies, of their neighbors and of others is increasingly at risk."

"There is a theoretical risk that may be very low: we simply don't know that Ebola could become easier to spread through genetic mutation. That risk may be very low, but it's probably not zero. The longer it spreads, the higher the risk."

"In theory it's not hard to stop Ebola. We know what to do. Find patients quickly. Isolate them effectively and promptly. Treat them. Make sure their contacts are traced and tracked for 21 days, if they develop fever, do the same thing and make sure they're tested and treated. Make sure health care is safe and that burial practices are safe. The challenge is not those efforts, it's doing them consistently at the scale that we need."

"One of the most experienced Ebola experts in the world was there on one of my site visits, his comment to me summed up my visit. What has worked to stop every Ebola outbreak until now will work here if we can get it to scale."

"The window of opportunity really is closing. I could not possibly overstate the need for an urgent response."

For more about the epidemic, the work facing the 70 CDC people sent to Africa so far, and glimpses of what it's like to wear protective gear in an Ebola hospital and to meet some of the victims, check out the full transcript.

http://bit.ly/1qeYJ6r

Modern population boom traced to pre-industrial roots

The foundation of the human population explosion, commonly attributed to a sudden surge in industrialization and public health during the 18th and 19th centuries, was actually laid as far back as 2,000 years ago, suggests an extended model of detailed demographic and archeological data.

The *Public Library of Science One* (*PLOS ONE*) recently published the analytical framework developed by Aaron Stutz, an associate professor of anthropology at Emory University's Oxford College.

"The industrial revolution and public health improvements were proximate reasons that more people lived longer," Stutz says. "If you dig further in the past, however, the data suggest that a critical threshold of political and economic organization set the stage 1,500 to 2,000 years ago, around the start of the Common Era. The resulting political-economic balance was the tipping point for economies of scale: It created a range of opportunities enabling more people to get resources, form successful families, and generate enough capital to transfer to the next generation."

Population dynamics have been a hot topic since 1798, when English scholar Thomas Robert Malthus published his controversial essay that population booms in times of plenty will inevitably be checked by famine and disease. "The power of population is indefinitely greater than the power in the earth to produce subsistence for man," he wrote. The so-called Malthusian Catastrophe theory was penned just prior to the global census size reaching one billion.

While it took hundreds of thousands of years for humans to reach that one billion milestone, it took only another 120 years for humanity to double to two billion. And during the past 50 years, the human population has surged to near eight billion.

"It's mind-boggling," Stutz says. "The human population has not behaved like any other animal population. We haven't stayed in any kind of equilibrium with what we would consider a typical ecological niche."

Economic historians and demographers have focused on societal changes that occurred during the Industrial Revolution as the explanation for this super-exponential population growth. An archeologist by training, Stutz wanted to explore further back in time.

"Archeologists are interested in looking at much earlier changes in human society," Stutz says. "In addition to looking at data, we dig up things like people's

houses, community courtyards, agricultural fields, harbors and so on. That gives us this sort of holistic view of how human society and the environment influence one another over time."

His analysis found that that the potential for the human population to burgeon despite environmental degradation, conflict and disease could be traced to a subtle interaction between competition and organization. At a certain tipping point, this interaction created opportunities for individuals to gain more control over their lives and prosper, opening the door to economies of scale.

Stutz cites the Roman Empire, which spanned 500 years, from just before the Common Era to 476 CE, as a classic example of passing through this threshold. One of the largest and most prosperous empires in history, it is noteworthy for economic and political organization, literature, and advances in architecture and engineering.

And yet, on an individual level, life was not necessarily so grand. Farm laborers and miners were ground into short, miserable lives to produce all those surplus goods for trading and empire building. And large numbers of young males had to serve in the military to ward off rebellions.

"The vast majority of people who lived under Roman rule had a life expectancy into their late 20s or early 30s," Stutz says. "A huge swath of the population was feeding, quite literally, the dynamism that was taking place in terms of economic and political development. Their labor increased the potential for providing more democracy and competition on the smaller scale. That, in turn, led to a more complex, inter-generational dynamic, making it possible to better care for offspring and even transfer resources to them."

The tipping point had been reached, Stutz says, and the trend continued despite the collapse of the Roman Empire. "The increasingly complex and decentralized economic and political entities that were built up around the world from the beginning of the Common Era to 1500 CE created enough opportunities for individuals, states and massive powers like England, France and China to take advantage of the potential for economies of scale," Stutz says.

This revised framework for the underpinnings of human population dynamics could lead to better understanding of how economic and political organization is affecting modern-day society, he adds.

"We might wind up being back in a situation where a growing part of the population is basically providing labor to sustain a minority," Stutz says. "You could certainly point to the sweat shops in the developing world. Another potential example is the growing income inequality that's been well-documented in the United States over the last couple of decades."

More information: *www.plosone.org/article/info%3... journal.pone.0105291*

http://bit.ly/1nZNDgL

Brain circuit differences reflect divisions in social status

Life at opposite ends of primate social hierarchies is linked to specific brain networks, a new Oxford University study has shown.

The importance of social rank is something we all learn at an early age. In non-human primates, social dominance influences access to food and mates. In humans, social hierarchies influence our performance everywhere from school to the workplace and have a direct influence on our well-being and mental health. Life on the lowest rung can be stressful, but life at the top also requires careful acts of balancing and coalition forming.

However, we know very little about the relationship between these social ranks and brain function.

The new research, conducted at the University of Oxford, reveals differences between individual primate's brains which depend on the their social status. The more dominant you are, the bigger some brain regions are. If your social position is more subordinate, other brain regions are bigger. Additionally, the way the brain regions interact with each other is also associated with social status.

The pattern of results suggests that successful behaviour at each end of the social scale makes specialised demands of the brain.

The research, led by Dr MaryAnn Noonan of the Decision and Action Laboratory at the University of Oxford, determined the position of 25 macaque monkeys in their social hierarchy and then analysed non-invasive scans of their brains that had been collected as part of other ongoing University research programs.

The findings, publishing September 2 in the open access journal PLOS Biology, show that brain regions in one neural circuit are larger in more dominant animals. The regions composing this circuit are the amygdala, raphe nucleus and hypothalamus.

Previous research has shown that the amygdala is involved in learning, and processing social and emotional information. The raphe nucleus and hypothalamus are involved in controlling neurotransmitters and neurohormones, such as serotonin and oxytocin.

The MRI scans also revealed that another circuit of brain regions, which collectively can be called the striatum, were found to be larger in more subordinate animals. The striatum is known to play a complex but important role in learning the value of our choices and actions.

The study also reports that the brain's activity, not just its structure, varies with position in the social hierarchy. The researchers found that the strength with which activity in some of these areas was coupled together was also related to social status. Collectively, these results mean that social status is not only

reflected in the brain's hardware, it is also related to differences in the brain's software, or communication patterns.

Finally, the size of another set of brain regions correlated not only with social status but also with the size of the animal's social group. The macaque groups ranged in size between one and seven.

The research showed that grey matter in regions involved in social cognition, such as the mid-superior temporal sulcus and rostral prefrontal cortex, correlated with both group size and social status.

Previous research has shown that these regions are important for a variety of social behaviours, such as interpreting facial expressions or physical gestures, understanding the intentions of others and predicting their behaviour.

"This finding may reflect the fact that social status in macaques depends not only on the outcome of competitive social interactions but on social bonds formed that promote coalitions," says Matthew Rushworth, the head of the Decision and Action Laboratory in Oxford. "The correlation with social group size and social status suggests this set of brain regions may coordinate behaviour that bridges these two social variables".

The results suggest that just as animals assign value to environmental stimuli they may also assign values to themselves – 'self-values'. Social rank is likely to be an important determinant of such self-values.

We already know that some of the brain regions identified in the current study track the value of objects in our environment and so may also play a key role in monitoring longer-term values associated with an individual's status.

The reasons behind the identified brain differences remain unclear, particularly whether they are present at birth or result from social differences. Dr Noonan said: "One possibility is that the demands of a life in a particular social position use certain brain regions more frequently and as a result those areas expand to step up to the task. Alternatively, it is possible that people born with brains organised in a particular way tend towards certain social positions. In all likelihood, both of these mechanisms will work together to produce behaviour appropriate for the social context".

Social status also changes over time and in different contexts. Dr Noonan added: "While we might be top-dog in one circle of friends, at work we might be more of a social climber. The fluidity of our social position and how our brains adapt our behavior to succeed in each context is the next exciting direction for this area of research."

More information: The paper, A neural circuit covarying with social hierarchy in macaques, is due to be published in the journal PLOS Biology on September 2, 2014.

http://bit.ly/1rugXAV

Should Monkeys Go to School?

Showing instructional videos to monkeys in the wild has proven to be a resounding success, finds a new study that describes the first known usage of such videos in an animal's native habitat.

Sep 2, 2014 07:00 PM ET // by Jennifer Viegas

The study, published in the latest issue of Biology Letters, opens the door to further instruction of animals, both wild and captive.

"I believe that videos and other instructional tools can indeed accelerate the learning of non-human primates and also other non-human animals," lead author Tina Gunhold told Discovery News.

Marmosets watch an instructional video. Tina Gunhold

"Such instructional tools might even have the potential to be used in conservation programs where animals in captivity have to learn certain skills before they get released to the wild," added Gunhold, who is a researcher in the University of Vienna's Department of Cognitive Biology.

For the study, she and colleagues Andrew Whiten and Thomas Bugnyar produced videos showing marmosets demonstrating different foraging techniques used to open an artificial fruit. They then set up an elevated box in the Atlantic Forest of Aldeia, Pernambuco, Brazil. Marmosets living in the forest, who had never before seen the marmosets featured in the videos, could scale a viewing platform to watch the footage.

The primates "were immediately attracted to the video box," Gunhold said. They lined up in front of it like kids fixated on a television show, with one big difference. "They need to be constantly on alert and have to scan their surroundings for potential danger," she explained. "Therefore, their attention span is quite short." Some of the marmosets could view the entire video, but others were just shown a static image with no instructional value.

The marmosets were then given a chance to open the artificial fruit themselves. Those that watched the instructional video performed the task much more successfully. It is probable that they also taught others what they learned.

"Common marmosets represent an ideal subject species to study social learning, as they live in small family groups, show high levels of social tolerance and exhibit a cooperative breeding system, where the father and other family members

take great care of the infants," Gunhold said. "Consequently," she added, "young individuals have access to a big 'information network' within the family and ample opportunities to learn from both parents and siblings."

Instructional videos have already been used as enrichment for captive animals, such as chimpanzees, gorillas, zebra finches, and Japanese macaques. Differences in visual systems can affect the success of such efforts, since some animals literally see the world differently than humans do. Marmosets, for example, do not process colors precisely the same way, so the researchers presented the videos in grey scale.

Some animals might also think that the demonstrator on the screen is a live, present animal that could pose a threat. For the new study, however, the marmosets seemed to know that the demonstrators were not there in the flesh.

Scottish Primate Research Group member Erica van de Waal, commenting from a savanna full of vervet monkeys, told Discovery News that the "instructional video technique is great," especially from a research standpoint, since it gives scientists a better look at how animals learn.

Charles Snowdon, a professor of psychology and zoology at the University of Wisconsin, Madison, agrees with van de Waal. He also said, "It is a major advance to demonstrate that video techniques can facilitate social learning in the wild." "The implications are several," he continued. "For example it is important to teach rehabilitated or reintroduced animals what foods are valuable and how predators are to be avoided. This method can facilitate that teaching by understanding better what variables are important to wild and to reintroduced animals in being able to learn how to forage, on what foods to forage and how to recognize and avoid predators."

"Thus, there are several important applications of this method for future work."

http://www.eurekalert.org/pub_releases/2014-09/bc-gso082914.php

Global snapshot of infectious canine cancer shows how to control the disease

Some countries have curbed an infectious and gruesome canine cancer but the disease still lurks in most free-roaming dog populations around the world

While countries with dog control policies have curbed an infectious and gruesome canine cancer, the disease is continuing to lurk in the majority of dog populations around the world, particularly in areas with many free-roaming dogs. This is according to research published in the open access journal BMC Veterinary Research.

The survey of veterinarians across the world confirmed that Canine Transmissible Venereal Tumor (CTVT) has a global reach. Researchers from the University of Cambridge found that the countries and areas with the lowest rates of the disease also had strong dog control policies. These include managing the number of street dogs; spay and neuter practices; and quarantine procedures for imported dogs.

CTVT first originated as a tumor in a single dog that lived thousands of years ago, and by becoming transmissible, this cancer has become the oldest, most widespread and prolific cancer known in nature. It causes tumors of the genitals, and is spread by the transfer of living cancer cells between dogs during sex. The tumor cells multiply and can be sloughed off and transferred to another dog during mating. CTVT is one of only two known transmissible cancers – the other has decimated the wild Tasmanian devil population.

Until now, no systematic global survey of the disease had been performed. To understand the global distribution and prevalence of the disease, the scientists sent a questionnaire to 645 veterinarians and animal health workers around the world. The replies showed that CTVT is endemic in dogs in at least 90 of 109 countries surveyed.

The researchers found that the only cases of CTVT reported in countries in Northern Europe, where free-roaming dogs are absent, were found in dogs that had been imported from abroad. There were no reports of CTVT in New Zealand, a country with strict dog quarantine policies. On the other hand, the disease was more likely to be present in countries or areas with free-roaming dog populations.

Andrea Strakova, University of Cambridge, said: "Although CTVT can usually be effectively treated, lack of awareness of the disease and poor access to veterinary care mean it can go untreated and impact the welfare of dogs. Research and monitoring of this disease may lead to improved methods for disease prevention, detection and treatment."

Dr Elizabeth Murchison, University of Cambridge, said: "Our study has suggested that free-roaming dogs are a reservoir for CTVT. Our review of the historical literature indicated that CTVT was eradicated in the UK during the twentieth century, probably as an unintentional result of the introduction of dog control policies. Careful management of free-roaming dog populations, as well as inclusion of CTVT in dog import/export quarantine policies, may help to control CTVT spread."

The research also highlighted the importance of dog sterilisation programs in controlling CTVT spread. However, dog spaying and neutering may not always be protective against CTVT, possibly because the disease can also be spread by biting, licking or sniffing. The research highlights the remarkable global spread of a single canine cancer which has continued to survive beyond the animal that first spawned it.

The changing global distribution and prevalence of canine transmissible venereal tumour.
Andrea Strakova and Elizabeth Murchison
BMC Veterinary Research 2014, 10: 168, doi:10.1186/s12917-014-0168-9

http://www.eurekalert.org/pub_releases/2014-09/uob-sdh090114.php

Scientists discover how to 'switch off' autoimmune diseases

Scientists have made an important breakthrough in the fight against debilitating autoimmune diseases such as multiple sclerosis by revealing how to stop cells attacking healthy body tissue.

Rather than the body's immune system destroying its own tissue by mistake, researchers at the University of Bristol have discovered how cells convert from being aggressive to actually protecting against disease. The study, funded by the Wellcome Trust, is published today [03 September] in Nature Communications.

It's hoped this latest insight will lead to the widespread use of antigen-specific immunotherapy as a treatment for many autoimmune disorders, including multiple sclerosis (MS), type 1 diabetes, Graves' disease and systemic lupus erythematosus (SLE). MS alone affects around 100,000 people in the UK and 2.5 million people worldwide.

Scientists were able to selectively target the cells that cause autoimmune disease by dampening down their aggression against the body's own tissues while converting them into cells capable of protecting against disease. This type of conversion has been previously applied to allergies, known as 'allergic desensitisation', but its application to autoimmune diseases has only been appreciated recently.

The Bristol group has now revealed how the administration of fragments of the proteins that are normally the target for attack leads to correction of the autoimmune response. Most importantly, their work reveals that effective treatment is achieved by gradually increasing the dose of antigenic fragment injected. In order to figure out how this type of immunotherapy works, the scientists delved inside the immune cells themselves to see which genes and proteins were turned on or off by the treatment.

They found changes in gene expression that help explain how effective treatment leads to conversion of aggressor into protector cells. The outcome is to reinstate self-tolerance whereby an individual's immune system ignores its own tissues while remaining fully armed to protect against infection.

By specifically targeting the cells at fault, this immunotherapeutic approach avoids the need for the immune suppressive drugs associated with unacceptable side effects such as infections, development of tumours and disruption of natural regulatory mechanisms.

Professor David Wraith, who led the research, said: "Insight into the molecular basis of antigen-specific immunotherapy opens up exciting new opportunities to enhance the selectivity of the approach while providing valuable markers with which to measure effective treatment. These findings have important implications for the many patients suffering from autoimmune conditions that are currently difficult to treat."

This treatment approach, which could improve the lives of millions of people worldwide, is currently undergoing clinical development through biotechnology company Apitope, a spin-out from the University of Bristol.

http://www.eurekalert.org/pub_releases/2014-09/bidm-rdd090314.php

Researchers demonstrate direct brain-to-brain communication in human subjects

Advanced neuro-technologies including wireless EEG and robotized TMS enable first successful transmission

BOSTON –In a first-of-its-kind study, an international team of neuroscientists and robotics engineers have demonstrated the viability of direct brain-to-brain communication in humans. Recently published in PLOS ONE the highly novel findings describe the successful transmission of information via the internet between the intact scalps of two human subjects – located 5,000 miles apart.

"We wanted to find out if one could communicate directly between two people by reading out the brain activity from one person and injecting brain activity into the second person, and do so across great physical distances by leveraging existing communication pathways," explains coauthor Alvaro Pascual-Leone, MD, PhD, Director of the Berenson-Allen Center for Noninvasive Brain Stimulation at Beth Israel Deaconess Medical Center (BIDMC) and Professor of Neurology at Harvard Medical School.

"One such pathway is, of course, the internet, so our question became, 'Could we develop an experiment that would bypass the talking or typing part of internet and establish direct brain-to-brain communication between subjects located far away from each other in India and France ?'"

It turned out the answer was "yes."

In the neuroscientific equivalent of instant messaging, Pascual-Leone, together with Giulio Ruffini and Carles Grau leading a team of researchers from Starlab Barcelona, Spain, and Michel Berg, leading a team from Axilum Robotics, Strasbourg, France, successfully transmitted the words "hola" and "ciao" in a computer-mediated brain-to-brain transmission from a location in India to a location in France using internet-linked electroencephalogram (EEG) and robot-assisted and image-guided transcranial magnetic stimulation (TMS) technologies.

Previous studies on EEG-based brain-computer interaction (BCI) have typically made use of communication between a human brain and computer. In these studies, electrodes attached to a person's scalp record electrical currents in the brain as a person realizes an action-thought, such as consciously thinking about moving the arm or leg. The computer then interprets that signal and translates it to a control output, such as a robot or wheelchair.

But, in this new study, the research team added a second human brain on the other end of the system. Four healthy participants, aged 28 to 50, participated in the study. One of the four subjects was assigned to the brain-computer interface (BCI) branch and was the sender of the words; the other three were assigned to the computer-brain interface (CBI) branch of the experiments and received the messages and had to understand them.

Using EEG, the research team first translated the greetings "hola" and "ciao" into binary code and then emailed the results from India to France. There a computer-brain interface transmitted the message to the receiver's brain through noninvasive brain stimulation.

The subjects experienced this as phosphenes, flashes of light in their peripheral vision. The light appeared in numerical sequences that enabled the receiver to decode the information in the message, and while the subjects did not report feeling anything, they did correctly receive the greetings.

A second similar experiment was conducted between individuals in Spain and France, with the end result a total error rate of just 15 percent, 11 percent on the decoding end and five percent on the initial coding side.

"By using advanced precision neuro-technologies including wireless EEG and robotized TMS, we were able to directly and noninvasively transmit a thought from one person to another, without them having to speak or write," says Pascual-Leone.

"This in itself is a remarkable step in human communication, but being able to do so across a distance of thousands of miles is a critically important proof-of-principle for the development of brain-to-brain communications. We believe these experiments represent an important first step in exploring the feasibility of complementing or bypassing traditional language-based or motor-based communication."

Study coauthors include Romuald Ginhous, Alejandro Riera, Thanh Lam Nguyen, Hubert Chauvat, and Julia L. Amengual.

This work was partly supported by the EU FP7 FET Open HIVE project, the Starlab Kolmogorov project, and the Neurology Department of the Hospital de Bellvitge.

http://phys.org/news/2014-09-pacific-fisheries-chief-tuna-stocks.html

Pacific fisheries chief warns tuna stocks dangerously low

The outgoing head of the fisheries management body for the western and central Pacific has warned that some tuna stocks were now so low they should not be fished.

Glenn Hurry, executive director of the Western and Central Pacific Fisheries Commission (WCPFC), said the situation was not yet unrecoverable, but it was at a dangerous level and worsening.

"The Pacific bluefin is I would have thought at the biggest risk, it's at about 3.0 percent of its original spawning biomass, so the amount of adult fish in the water that can spawn ... it's at a pretty dangerous level," Hurry told AFP late Tuesday.

Hurry said other species were also depleted, with bigeye tuna below the critical level of about 20 percent of its original spawning biomass, and fishing this species should stop to allow it to recover.

"Of the big ones - bigeye and skipjack tuna - bigeye is about 16 percent of its original spawning biomass, so it's below the limit," he said. Yellowfin tuna was below 40 percent of its original biomass.

Hurry, an Australian, welcomed Japan's plans to propose a 50 percent cut on catches of young bluefin tuna in the western and central Pacific in a historic shift aimed at safeguarding the at-risk species.

But he said fish stocks in the Pacific had slowly worsened in the four years he had spent in the job, which he expects to leave this month, and more tough decisions needed to be made.

Pacific island nations have complained that there are too many fishing boats catching too few fish.

"We started with one of the best stocks of fish in the world, and we've fished them down," Hurry said. "And when it comes to the crunch and you've got to make hard decisions about reducing the catch on the stock, it gets really difficult.

"Take a little country like Tuvalu; 50 percent of the income of Tuvalu is the income they get from fishing. If you're going to reduce (its catch) it's going to hurt."

Hurry said fishing stocks could recover, but the more valuable fish became, the harder it would be for small countries dependant on the fishing industry to pull back on their hauls. "They will bounce back so long as you restrict the fishing pressure on them and we're just increasing it," he said. "It's not looking particularly positive if you keep doing that."

With too many boats catching too few fish, Pacific island nations in June said they were ratcheting up the fees they charge tuna fishing boats to enter their waters by a hefty 33 percent.

The eight countries involved are from the Parties to the Nauru Agreement (PNA), which control waters covering more than half the world's skipjack tuna, the most commonly canned variety. From January 1, 2015, the PNA will raise the fishing day fee for so-called "distant water" fleets from as far afield as Europe, China, South Korea, Japan and Taiwan, from US$6,000 to US$8,000.

http://www.eurekalert.org/pub_releases/2014-09/uom-it2090114.php

Is type 2 diabetes 'diabetes' as currently understood?

Current way of diagnosing type 2 diabetes needs to be revised, study shows

The current way of diagnosing type-2 diabetes using blood glucose levels needs to be revised, research by scientists from The University of Manchester and King's College London suggests.

The findings, published in the journal PLOS ONE today (3 September), show the current method of diagnosis - using blood glucose levels - means patients are diagnosed too late so that their blood vessels may already be damaged.

Type 2 diabetes, which affects over 90% of all adults with diabetes, often leads to heart damage and blood vessel problems in the brain, eyes and kidneys. It is closely linked to increasing levels of obesity, lack of exercise, unhealthy diets and our aging population.

The study focused on young, previously pregnant women followed up in Greater Manchester after being identified as at increased, intermediate and low risk of developing type-2 diabetes. Researchers examined biochemical markers in the blood before glucose became elevated – so before the patients reached the pre-diabetes stage.

Their findings show that changes in types of blood fat metabolites - naturally occurring particles that come from and make up fats in the blood - appear to be good indicators of developing type-2 diabetes. The changes in these particles were detectable well before changes in blood glucose that now define type-2 diabetes or pre-diabetes.

Professor Kennedy Cruickshank, lead author of the study and Professor of Cardiovascular Medicine and Diabetes, in the Division of Nutrition at King's College London, formerly at The University of Manchester, said his team's findings could be important for future diagnosis and, in turn, treatments.

Professor Cruickshank said: "We found that several groups of fat metabolites, also linked to body fat, were changed in the blood, as were others including some amino acids and to some extent vitamin D, before glucose levels increased.

"Blood vessels become damaged as part of the condition, but problems in the vessels arise before high blood sugar sets in during a 'pre-diabetes' period.

"The current method of categorising type-2 diabetes solely by a patient's glucose level means that many will already have suffered blood vessel damage and will experience poorer outcomes. "Our study overall adds weight to the argument that type-2 diabetes should not be classified as 'diabetes' as we currently understand it from just measuring blood glucose."

The authors argue that rather than concentrating purely on glucose-directed treatments, which do not improve blood vessel health, a new, quite different definition of type-2 diabetes is required, partly based on the distribution of fat metabolites in the blood in the pre-diabetes stage.

Dr Simon Anderson, co-author of the study and National Institute for Health Research Clinical Lecturer in Cardiology from The University of Manchester, said: "This long-term study of women in Greater Manchester adds to growing evidence about the major role that fats and fat metabolites play in the health of blood vessels, and in diabetes per se. "To help clarify the metabolic conditions that lead to the development of type-2 diabetes, further assessment of the total chemicals in the blood – the metabolome - is necessary.

"In the long-term we aim to identify a biomarker or a disorder in a chemical pathway that is linked to blood vessel health and subsequent diabetes.

"Ultimately this might translate into a specific blood test to identify people at risk of type-2 diabetes early on but most importantly, it may allow advice on lifestyle modification at an earlier stage to reduce the long-term impact of diabetes."

The team say more work is now needed to validate this alternative approach to diagnosing, treating and preventing diabetes.

Work is now ongoing at King's to establish earlier treatments for blood vessels and the heart in people at risk of diabetes, while researchers in Manchester are looking at the risk of developing diabetes for children born from mothers with gestational diabetes and varying degrees of fatness.

http://www.eurekalert.org/pub_releases/2014-09/p-nds082814.php

New deep sea mushroom-shaped organisms discovered

Organisms' discovery spurs identification of 2 new species

Scientists discovered two new species of sea-dwelling, mushroom-shaped organisms, according to a study published September 3, 2014 in the open-access journal PLOS ONE by Jean Just from University of Copenhagen, Denmark, and colleagues.

Scientists classify organisms based on shared characteristics using a taxonomic rank, including kingdom, phylum, and species. In 1986, the authors of this study collected organisms at 400 and 1000 meters deep on the south-east Australian continental slope and only just recently isolated two types of mushroom-shaped organisms that they couldn't classify into an existing phylum.

The new organisms are multicellular and mostly non-symmetrical, with a dense layer of gelatinous material between the outer skin cell and inner stomach cell layers. The organisms were classified as two new species in a new genus, Dendrogramma enigmatica and Dendrogramma discoides, in the new family, Dendrogrammatidae. Scientists found similarities between the organisms and members of Ctenophora and Cnidaria and suggest that they may be related to one of these phyla. Scientists also found similarities to 600 million year-old Pre-Cambrian extinct life forms, suggested by some to be early but failed attempts at multi-cellular life.

***This is a photo of the new deep sea mushroom-shaped organism*. Just et al.**

The authors originally preserved the specimens in neutral formaldehyde and stored them in 80% ethanol, which makes them unsuitable for molecular analysis. However, they suggest attempting to secure new samples for further study, which may provide further insight into their relationship to other organisms.

Jørgen Olesen added: "New mushroom-shaped animals from the deep sea discovered which could not be placed in any recognized group of animals. Two species are recognized and current evidence suggest that they represent an early branch on the tree of life, with similarities to the 600 mill old extinct Ediacara fauna."

Citation: Just J, Kristensen RM, Olesen J (2014) Dendrogramma, New Genus, with Two New Non-Bilaterian Species from the Marine Bathyal of Southeastern Australia (Animalia, Metazoa incertae sedis) – with Similarities to Some Medusoids from the Precambrian Ediacara. PLoS ONE 9(9): e102976. doi:10.1371/journal.pone.0102976

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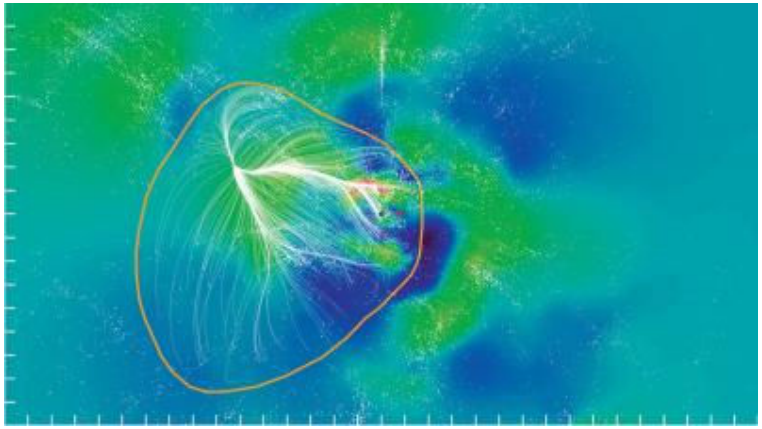
http://www.eurekalert.org/pub_releases/2014-09/nrao-nig090314.php

Newly identified galactic supercluster is home to the Milky Way

Way galaxy is part of a newly identified ginormous supercluster of galaxies

Astronomers using the National Science Foundation's Green Bank Telescope (GBT) -- among other telescopes -- have determined that our own Milky Way galaxy is part of a newly identified ginormous supercluster of galaxies, which they have dubbed "Laniakea," which means "immense heaven" in Hawaiian. This discovery clarifies the boundaries of our galactic neighborhood and establishes previously unrecognized linkages among various galaxy clusters in the local Universe. The paper explaining this work is the cover story of the September 4 issue of the journal Nature.

"We have finally established the contours that define the supercluster of galaxies we can call home," said lead researcher R. Brent Tully, an astronomer at the University of Hawaii at Manoa.



***A slice of the Laniakea Supercluster in the supergalactic equatorial plane -- an imaginary plane containing many of the most massive clusters in this structure. The colors represent density within this slice, with red for high densities and blue for voids -- areas with relatively little matter. Individual galaxies are shown as white dots. Velocity flow streams within the region gravitationally dominated by Laniakea are shown in white, while dark blue flow lines are away from the Laniakea local basin of attraction. The orange contour encloses the outer limits of these streams, a diameter of about 160 Mpc. This region contains the mass of about 100 million billion suns.* SDvision interactive visualization software by DP at CEA/Saclay, France.**

"This is not unlike finding out for the first time that your hometown is actually part of much larger country that borders other nations."

Superclusters are among the largest structures in the known Universe. They are made up of groups, like our own Local Group, that contain dozens of galaxies, and massive clusters that contain hundreds of galaxies, all interconnected in a web of filaments. Though these structures are interconnected, they have poorly defined boundaries.

To better refine cosmic mapmaking, the researchers are proposing a new way to evaluate these large-scale galaxy structures by examining their impact on the motions of galaxies. A galaxy between structures will be caught in a gravitational tug-of-war in which the balance of the gravitational forces from the surrounding large-scale structures determines the galaxy's motion.

By using the GBT and other radio telescopes to map the velocities of galaxies throughout our local Universe, the team was able to define the region of space where each supercluster dominates. "Green Bank Telescope observations have played a significant role in the research leading to this new understanding of the limits and relationships among a number of superclusters," said Tully.

The Milky Way resides in the outskirts of one such supercluster, whose extent has for the first time been carefully mapped using these new techniques. This so-called Laniakea Supercluster is 500 million light-years in diameter and contains the mass of one hundred million billion Suns spread across 100,000 galaxies.

This study also clarifies the role of the Great Attractor, a gravitational focal point in intergalactic space that influences the motion of our Local Group of galaxies and other galaxy clusters.

Within the boundaries of the Laniakea Supercluster, galaxy motions are directed inward, in the same way that water streams follow descending paths toward a valley. The Great Attractor region is a large flat bottom gravitational valley with a sphere of attraction that extends across the Laniakea Supercluster.

The name Laniakea was suggested by Nawa'a Napoleon, an associate professor of Hawaiian Language and chair of the Department of Languages, Linguistics, and Literature at Kapiolani Community College, a part of the University of Hawaii system. The name honors Polynesian navigators who used knowledge of the heavens to voyage across the immensity of the Pacific Ocean.

The other authors are Hélène Courtois (University Claude Bernard Lyon 1, Lyon, France), Yehuda Hoffman (Racah Institute of Physics, Hebrew University, Jerusalem), and Daniel Pomarède (Institute of Research on Fundamental Laws of the Universe, CEA/Saclay, France).

The GBT is the world's largest fully steerable radio telescope. Its location in the National Radio Quiet Zone and the West Virginia Radio Astronomy Zone protects the incredibly sensitive telescope from unwanted radio interference.

A short video about Laniakea that gives the viewer a general sense of the structure of our home supercluster and of galaxy motions in the nearby universe is available at http://vimeo.com/104704518.

http://www.eurekalert.org/pub_releases/2014-09/fm-amr082914.php

Ancient mammal relatives were active at night 100 million years before origin of mammals

Most living mammals are active at night (or nocturnal), and many other mammal species are active during twilight conditions.

It has long been thought that the transition to nocturnality occurred at about the same time as mammals evolved, around 200 million years ago. This thinking was based on on features such as the large brains of mammals (good for processing information from senses like hearing, touch, and smell) and the details of light-sensitive chemicals in the eyes of mammals.

It turns out that nocturnal activity might have a much older origin among ancient mammal relatives, called synapsids.

"Synapsids are most common in the fossil record between about 315 million years ago and 200 million years ago. The conventional wisdom has always been that they were active during the day (or diurnal), but we never had hard evidence to say that this was definitely the case," says Kenneth Angielczyk, a curator at The Field Museum. He's the lead author of a paper appearing September 3 in the early edition of Proceedings of the Royal Society B entitled "Nocturnality in Synapsids Predates the Origin of Mammals by 100 Million Years."

The new insights come from an analysis of tiny bones, called scleral ossicles, that are found in the eyes of many backboned animals, including birds and lizards. Living mammals lack scleral ossicles, but they were present in many of their ancient synapsid relatives. "The scleral ossicles tell us about the size and shape of different parts of the eyeball," said Lars Schmitz, a professor of biology at Claremont McKenna, Pitzer, and Scripps Colleges, located near Los Angeles. "In turn, this information allows us to make predictions about the light sensitivity of the eye, which usually reflects the time of day an animal is active.

The arrow on this gorgonsopian skull indicates where the fossil scleral ring is found.
Kenneth Angielczyk

Because scleral ossicles are very delicate, they usually aren't preserved in synapsid fossils. However, by scouring museum collections in the United States and South Africa, and with help from other paleontologists, Angielczyk and Schmitz were able to collect data on scleral ossicles from 24 species that represent most major groups of synapsids. The synapsid data were then compared to a large dataset of similar measurements for living lizards and birds that have known daily activity patterns, using a statistical technique developed by Schmitz.

The technique revealed that the eyes of ancient synapsid species likely spanned a wide range of light sensitivities, with some consistent with activity under bright conditions during the day and others having eyes best suited to low-light conditions at night. Of particular interest was the fact that the oldest synapsids in the dataset, including the famous sail-backed carnivore Dimetrodon, were found to have eye dimensions consistent with activity at night. Based on the ages of the rocks in which these fossils are found, the results indicate that nocturnality had evolved in at least some synapsids by about 300 million years ago, or 100 million years earlier than the age of the first mammals. Indeed, Angielczyk and Schmitz's results raise the possibility that the common ancestor of all synapsids was active at night.

"The idea of a nocturnal Dimetrodon was very surprising," said Angielczyk, "but it shows how little we really known about the daily lives of some of our oldest relatives." "This is the first time we can make informed predictions about the activity patterns of synapsids," added Schmitz. "As we discover more fossils, we can continue to test these predictions and start to address questions such as how many times nocturnality evolved in synapsids and whether the synapsids most closely related to mammals were also nocturnal."

The new study reveals that Dimetrodon's would have been one of many synapsids who were active at night. **Illustration by Marlene Hill Donnelly**

The results should be useful to researchers studying the visual systems and behavior of living mammals, and they also will necessitate the rethinking of some long-held ideas, such as mammals becoming nocturnal to avoid competition with dinosaurs.

This study was funded by the Geology Department of the Field Museum of Natural History.

http://nyti.ms/1lOWt65

First Vaccine for Dengue Fever Shows Promise in 2nd Big Trial

An experimental vaccine against dengue fever being developed by Sanofi proved about 60 percent effective in its second large clinical trial.

By Andrew Pollack Sept. 3, 2014

The results could clear the way for the introduction of the world's first inoculation against the disease, which is mosquito-borne and becoming an increasing threat.

Sanofi, a French drug company, said on Wednesday that use of the vaccine cut the risk of getting dengue by 60.8 percent in the trial, which involved 20,875 children ages 9 to 16 from several countries in Latin America and the Caribbean.

Those who received the vaccine also had an 80.3 percent lower risk of being hospitalized for dengue compared with children who received injections of a placebo.

The results are roughly similar to those from the first large clinical trial, in which the vaccine reduced the incidence of dengue fever by 56.5 percent. That trial

"For the first time ever, after 20 years of research and industrial commitment, dengue is set to become a vaccine-preventable disease," Olivier Charmeil, chief executive of Sanofi Pasteur, the vaccine division of Sanofi, said in a statement.

A question now is how widely such a vaccine would be adopted. Some experts hoped for a greater effectiveness, especially since in the first large trial, the vaccine was somewhat less effective in younger children, who are most vulnerable to the disease. Both trials were late-stage versions known as Phase 3.

"It's certainly not anywhere close to what we had hoped, something that would reach up into the 90s," said Dr. Scott B. Halstead, scientific adviser to the nonprofit Dengue Vaccine Initiative.

Still, he said, the vaccine does appear to prevent severe disease. Moreover, Sanofi is a few years ahead of others in developing a vaccine. Those factors could persuade countries to use the product.

Sanofi executives argue that with no other vaccine and no treatments available for dengue, a vaccine that reduces the number of cases by more than half and hospitalizations by 80 percent represents a big advance.

"When I talk to health ministers, they're pretty excited about this, actually," Christopher A. Viehbacher, Sanofi's chief executive, told analysts in a conference call discussing quarterly earnings in late July.

Mr. Viehbacher said the company would apply for approvals in the first quarter of 2015 and hoped to begin sales in the fourth quarter of that year. He said the priority countries would be Mexico, Brazil and Colombia and possibly Singapore and Malaysia. The company plans to apply eventually for approval in the United States as well, executives said.

Sanofi has invested more than 1.3 billion euros, or $1.7 billion, in developing the vaccine. Guillaume Leroy, dengue vaccine chief at Sanofi Pasteur, said the company had already begun manufacturing vaccine in a new factory it built outside Lyon so as to have enough ready by 2015. He said that beginning in 2016, the company would have the capacity to make 100 million doses a year.

An estimated 50 million to 100 million people a year are sickened by dengue, though that might be an underestimate. The disease, also known as breakbone fever, can cause high temperatures and intense joint and muscle pain.

In the most severe cases, infection causes hemorrhagic fever, which is characterized by bleeding and shock and can be fatal. The number of dengue cases has been increasing rapidly worldwide in part because of urbanization, since the mosquito that carries the disease is well adapted to urban areas. Dengue is even moving out of tropical areas in developing countries to industrialized countries in more temperate zones.

There is now an outbreak in Tokyo, the first one in Japan in nearly 70 years. Yoyogi Park is being fumigated to try to eliminate disease-carrying mosquitoes. The Florida Keys had its first cases in decades in 2009.

Sanofi said that in the second trial, as in the first, the vaccine was more effective in people previously exposed to dengue. That might make the vaccine especially useful in endemic areas, where people often are exposed more than once, but it would probably make it less useful for tourists traveling to an infected area.

The vaccine is a live weakened yellow fever virus that is genetically engineered to make proteins from the four subtypes of dengue virus. It is given as three shots spaced over a year.

The vaccine seems particularly weak against one of the four subtypes of dengue, known as Serotype 2. In the Latin America trial, the protection against that serotype was only 42.3 percent, compared with 50.3 percent protection against Serotype 1, and greater than 70 percent protection against Serotypes 3 and 4.

Sanofi said the vaccine seemed safe in the new trial, as it had in the previous trial, with the rate of so-called adverse events being the same in the vaccine arm and the control arm.

Sanofi announced the results in a news release, saying more detail would be presented at a medical conference in November and published in a journal. The trial took place in Brazil, Colombia, Honduras, Mexico and Puerto Rico.

http://scitechdaily.com/chimpanzees-outplay-humans-brain-games/

Chimpanzees Outplay Humans in Brain Games

In a new study chimpanzees outplay humans in a two-player game, suggesting that chimps may have a superior memory and strategy when it comes to recalling their opponent's choice history.

We humans assume we are the smartest of all creations. In a world with over 8.7 million species, only we have the ability to understand the inner workings of our body while also unraveling the mysteries of the universe. We are the geniuses, the philosophers, the artists, the poets and savants. We amuse at a dog playing ball, a dolphin jumping rings, or a monkey imitating man because we think of these as remarkable acts for animals that, we presume, aren't smart as us. But what is smart? Is it just about having ideas, or being good at language and math?

Scientists have shown, time and again, that many animals have an extraordinary intellect. Unlike an average human brain that can barely recall a vivid scene from the last hour, chimps have a photographic memory and can memorize patterns they see in the blink of an eye. Sea lions and elephants can remember faces from decades ago. Animals also have a unique sense perception. Sniffer dogs can detect the first signs of colon cancer by the scents of patients, while doctors flounder in early diagnosis. So the point is animals are smart too. But that's not the upsetting realization. What happens when, for just once, a chimp or a dog challenges man to one of their feats? Well, for one, a precarious face-off – like the one Matt Reeves conceived in the Planet of the Apes – would seem a tad less unlikely than we thought.

In a recent study by psychologists Colin Camerer and Tetsuro Matsuzawa, chimps and humans played a strategy game – and unexpectedly, the chimps outplayed the humans.

Chimps are a scientist's favorite model to understand human brain and behavior. Chimp and human DNAs overlap by a whopping 99 percent, which makes us closer to chimps than horses to zebras. Yet at some point, we evolved differently. Our behavior and personalities, molded to some extent by our distinct societies, are strikingly different from that of our fellow primates. Chimps are aggressive and status-hungry within their hierarchical societies, knit around a dominant alpha male. We are, perhaps, a little less so. So the question arises whether competitive behavior is hard-wired in them.

In the present study, chimp pairs or human pairs contested in a two-player video game. Each player simply had to choose between left and right squares on a touch-screen panel, while being blind to their rival's choice. Player A, for instance, won, each time their choices matched, and player B won, if their choices did not. The opponent's choice was displayed after every selection, and payoffs in the form of apple cubes or money were dispensed to the winner.

In competitive games such as this, like in chess or poker, the players learn to guess their opponent's moves based on the latter's past choices, and adjust their own strategy at every step in order to win. An ideal game, eventually, develops a certain pattern. Using a set of math equations, described by game theory, it is easy to predict this pattern on paper. When the players are each making the most strategic choices, the game hovers around what is called an 'equilibrium' state.

In Camerer's experiment, it turned out that chimps played a near-ideal game, as their choices leaned closer to game theory equilibrium. Whereas, when humans played, their choices drifted farther off from theoretical predictions. Since the game is a test of how much the players recall of their opponent's choice history, and how cleverly they maneuver by following choice patterns, the results suggest that chimps may have a superior memory and strategy, which help them perform better in a competition, than humans. In other words, chimps seem to have some sort of a knack when fighting peers in a face-off.

Their exceptional working memory may be a key factor for chimps' strategic skills. A movie clip, part of a study in 2007, impressively captures the eidetic memory of a 2-year old chimp as he played a memory masking game. It makes jaws drop to see him memorize random numerical patterns within 200 milliseconds, about half the time it takes for the human eye to blink. Memory of

such incredible precision is rare in human babies and close to absent in adults, save for fictitious characters like Sheldon Cooper.

It may seem dispiriting to have chimps make chumps of us. But such human-chimp comparisons point to how the two species have evolved along different trajectories. The human brain is three times larger, and has about 20 billion neurons in the cortex, the seat of cognition, compared to 6 billion in chimps. This means that our brain is capable of highly specialized functions that a chimp brain isn't. For example, we can build and use language in a myriad ways unlike chimps. But, to get such an advanced brain, psychologists believe that humans may have had to "tradeoff" the fine working memory and strategic thinking of the apes. Chimps use their strategic minds to get a competitive edge over their peers and climb their way up to be the alpha male. Whereas the human brain, with its unique language-related and collaborative skills, gives us a survival advantage in an egalitarian society. It's the result of use it or lose it, where the environment has a major say.

In sum, what we garner from these studies is that every species has its own idiosyncrasies. Evolution is not just about adding on to existing prototypes, it is about fine-tuning them by eliminating the non-essential to create newer species that are, on the whole, better adapted to their surroundings — even if, in some particular ways, they are inferior.

Publication: Christopher Flynn Martin, et al., "Chimpanzee choice rates in competitive games match equilibrium game theory predictions," Scientific Reports 4, Article number: 5182; doi:10.1038/srep05182

Source: Madhuvanthi Kannan, Yale University; Scientific American

http://www.wired.com/2014/09/abx-perdue/

Chicken Company Perdue Takes Big Steps to Reduce Antibiotic Use

America's third-largest chicken producer announced it has ceased using most antibiotics

By Maryn McKenna

Big news in the world of food policy, farming and antibiotic use: Perdue Farms, the third-largest chicken producer in the United States, announced today that during the past decade it has ceased using most of the antibiotics that formerly propped up its chicken production.

There are caveats to that "most," and I'll explain them. But it's important to say up front that this is a nationally significant move and looks like an industry-leading step.

Here are the details: In a statement, and in a press conference held in Washington, DC, the poultry company said that it has ceased:

using any antibiotics for growth promotion or for disease prevention;
using antibiotics that are important in human medicine in 95 percent of its birds;
injecting meat chickens with antibiotics while still in the shell.

Those restrictions mean the company has eliminated most of the uses of antibiotics that public health campaigners have been concerned about since the 1970s, and has gone beyond current federal requirements for what can be done to meat chickens before they hatch. And while the impact probably can't be measured with precision as long as other firms continue to use antibiotics routinely, it seems likely that Perdue has taken an important step in reducing the amount of antibiotic resistance that comes off farms and causes human illness.

The company said it began its antibiotic reduction program 12 years ago. The trigger for today's announcement was completing the removal of antibiotic use from its hatcheries, which was a five-year project that ended this summer.

"When we started hearing from consumers that they were becoming concerned about the amount of antibiotics used to raise chickens they were buying, we were listening," company chairman Jim Perdue said at the DC briefing. "Coupled with information coming from the USDA and FDA and other sources, we began to look critically at our practices. It wasn't easy…but we found along the way that we could raise healthy chickens with fewer antibiotics."

Routine antibiotic use in meat production — that is, giving meat animals small doses of antibiotics every day in food or water, to make them put on weight faster and to prevent disease from the conditions they live in — has been under scrutiny for decades. The first federal action addressing it happened just last December, when the FDA asked veterinary pharmaceutical manufacturers to relabel the antibiotics they make, so that "growth promotion" — that weight-gain use — would become an unapproved, technically illegal use of the drug.

The concern that lies behind routine animal antibiotic use is that most of the drugs used on farms are the same ones used against infections that humans develop. Bacteria in animals' guts or on their skin develop resistance to protect themselves; when the animals are slaughtered, or their manure washes or wafts off the farm property, the resistant bacteria go along too. When humans pick up those bacteria from meat or the environment, they can't be treated — because the drug needed to cure them is the same one that was used on the farm in the first place.

The one exception to that concern is a category of antibiotics called ionophores. They are only used in animal medicine and not approved for humans. So while they promote the emergence of resistance — all antibiotics do — they don't take a human treatment out of the medical artillery. (Nationally, according to FDA data, 4.12 million kilos of ionophores were sold for animal use in 2011, the last year for

which data has been published. That comes out to 30 percent of the 13.5 million kilos of antibiotics sold for animal use that year overall.)

The "ionophore exception" is why the Perdue announcement and release today included words like "fewer" from Perdue himself, and statements like this from Dr. Bruce Stewart-Brown, Senior Vice President of Food Safety, Quality and Live Operations: "By no longer using any antibiotics in our hatcheries or any human antibiotics in feed, we've reached the point where 95 percent of our chickens never receive any human antibiotics, and the remainder receive them only for a few days when prescribed by a veterinarian."

Stewart-Brown said during the briefing that the company's ionophore use is also trending down, but wasn't willing to give figures. The only birds to receive the ionophores, he said, are the company's regular brand of chicken; neither the organic nor the "no antibiotics ever" lines do. However, he said, animals that get sick will be treated with antibiotics if the company's veterinarians think it is needed, but then will be sold under the regular brand.

To compensate for the lost effect of the antibiotics the company relinquished, Stewart-Brown said they also improved chickens' diets by removing animal byproducts and going to an all-vegetable feed of soybean meal and corn oil; using prebiotics and probiotics including "oregano and yucca" and "yogurt type things"; increasing the number of vaccinations chickens receive; and doubling down on cleaning chicken "houses," the long sheds that can hold tens of thousands of broilers at a time. "This doesn't mean we are done," he said. "We constantly learn new things and try to evolve our program."

Campaigners for reduced antibiotic use mostly supported the comprehensive moves. Gail Hansen, a public health veterinarian with the Pew Charitable Trusts, told me: "This is a lot of what we have been asking for, for six years, so it is pretty positive," adding that she would like to see the company be more specific about the amounts of ionophores it uses and about better husbandry practices that could help boost broiler chickens' immune systems.

Caroline Smith DeWaal, food safety director at the Center for Science in the Public Interest, said: "The amount of antibiotics used on the farm is simply not sustainable if we want to preserve their uses in human medicine. I hope Perdue's actions foreshadow changes across the industry, and embolden regulators to prohibit the misuse of antibiotics in animal agriculture."

Paige Tomaselli, senior attorney at the Center for Food Safety, said: "We appreciate Perdue's initiative, but they produce only 7 percent of the broilers produced in the U.S. Other companies should follow suit."

Jonathan Kaplan, Natural Resources Defense Council: "Jim Perdue [says]: '… human-approved antibiotics should not be used to boost production or in place of responsible animal husbandry or hatchery management.' We agree!… We'd like to hear more about how Perdue is verifying these accomplishments and hope the company will also publish its actual antibiotic use data."

Susan Vaughn Grooters of Keep Antibiotics Working praised the moves but raised a concern about birds that are outside Perdue's system but feed into it: the great-grandparent and grandparent birds that maintain the lines Perdue uses to create its broilers' parents.

"Reducing antibiotics use is laudable, but we won't fully address threats to human health until we're looking at the whole poultry production system, including breeders," she told me. "Purdue mentioned that they don't own the grandparent breeding flocks that supply to them. Consumers should be concerned with this black box. Through purchasing specifications and breeder production agreements, Purdue could further drive down antibiotic use in food animal production by addressing that use."

In a follow-up interview, Stewart-Brown said: "We are not in the genetics business, but one thing we are really clear on (with the breeding companies) is we believe it is very important they are breeding in such a way that the parents and the progeny from those parents are as hearty and capable. They understand, when we are buying their product, that we need birds that will be healthy enough not to need the help of antibiotics."

http://www.eurekalert.org/pub_releases/2014-09/tcd-tgr090414.php

Trinity geologists re-write Earth's evolutionary history books

Oxygen-producing life forms appeared at least 60 million years earlier than previously thought

Geologists from Trinity College Dublin have rewritten the evolutionary history books by finding that oxygen-producing life forms were present on Earth some 3 billion years ago – a full 60 million years earlier than previously thought. These life forms were responsible for adding oxygen (O2) to our atmosphere, which laid the foundations for more complex life to evolve and proliferate.

Working with Professors Joydip Mukhopadhyay and Gautam Ghosh and other colleagues from the Presidency University in Kolkata, India, the geologists found evidence for chemical weathering of rocks leading to soil formation that occurred in the presence of O2. Using the naturally occurring uranium-lead isotope decay system, which is used for age determinations on geological time-scales, the authors deduced that these events took place at least 3.02 billion years ago. The ancient soil (or paleosol) came from the Singhbhum Craton of Odisha, and was named the 'Keonjhar Paleosol' after the nearest local town.

The pattern of chemical weathering preserved in the paleosol is compatible with elevated atmospheric O2 levels at that time. Such substantial levels of oxygen

could only have been produced by organisms converting light energy and carbon dioxide to O2 and water. This process, known as photosynthesis, is used by millions of different plant and bacteria species today. It was the proliferation of such oxygen-producing species throughout Earth's evolutionary trajectory that changed the composition of our atmosphere – adding much more O2 – which was as important for the development of ancient multi-cellular life as it is for us today.

Quentin Crowley, Ussher Assistant Professor in Isotope Analysis and the Environment in the School of Natural Sciences at Trinity, is senior author of the journal article that describes this research which has just been published online in the world's top-ranked Geology journal, Geology. He said: "This is a very exciting finding, which helps to fill a gap in our knowledge about the evolution of the early Earth. This paleosol from India is telling us that there was a short-lived pulse of atmospheric oxygenation and this occurred considerably earlier than previously envisaged."

The early Earth was very different to what we see today. Our planet's early atmosphere was rich in methane and carbon dioxide and had only very low levels of O2. The widely accepted model for evolution of the atmosphere states that O2 levels did not appreciably rise until about 2.4 billion years ago. This 'Great Oxidation Event' event enriched the atmosphere and oceans with O2, and heralded one of the biggest shifts in evolutionary history.

Micro-organisms were certainly present before 3.0 billion years ago but they were not likely capable of producing O2 by photosynthesis. Up until very recently however, it has been unclear if any oxygenation events occurred prior to the Great Oxidation Event and the argument for an evolutionary capability of photosynthesis has largely been based on the first signs of an oxygen build-up in the atmosphere and oceans.

"It is the rare examples from the rock record that provide glimpses of how rocks weathered," added Professor Crowley. "The chemical changes which occur during this weathering tell us something about the composition of the atmosphere at that time. Very few of these 'paleosols' have been documented from a period of Earth's history prior to 2.5 billion years ago. The one we worked on is at least 3.02 billion years old, and it shows chemical evidence that weathering took place in an atmosphere with elevated O2 levels."

There was virtually no atmospheric O2 present 3.4 billion years ago, but recent work from South African paleosols suggested that by about 2.96 billion years ago O2 levels may have begun to increase. Professor Crowley's finding therefore moves the goalposts back at least 60 million years, which, given humans have only been on the planet for around a tenth of that time, is not an insignificant drop in the evolutionary ocean.

Professor Crowley concluded: "Our research gives further credence to the notion of early and short-lived atmospheric oxygenation.

This particular example is the oldest known example of oxidative weathering from a terrestrial environment, occurring about 600 million years before the Great Oxidation Event that laid the foundations for the evolution of complex life."

The journal article Abstract can be viewed here. A copy of the full journal article and images for use with this press release can be viewed in this Dropbox folder: https://www.dropbox.com/sh/3lykgod3rggsjv2/AAD_2JMksTIUXu0A74Gyhb0ia?dl=0

http://www.eurekalert.org/pub_releases/2014-09/tl-tli090414.php

The Lancet: International health systems fund could have averted Ebola outbreak

Commitment needed now to prevent another crisis

The Ebola crisis in west Africa could have been averted if governments and health agencies had acted on the recommendations of a 2011 World Health Organisation (WHO) Commission on global health emergencies, according to a new Comment, published in The Lancet.

The Comment, written by Professor Lawrence Gostin, Faculty Director of the O'Neill Institute for National & Global Health Law at Georgetown University, USA, calls for renewed international commitment to a health systems contingency fund to prevent another infectious disease crisis, together with long-term funding for enduring health systems development.

Although WHO has now implemented a plan for dealing with Ebola – five months after the virus first began to spread internationally – implementation will be further delayed while US$490 million are raised to meet the cost of tackling the epidemic. In the meantime, Ebola continues to spread amongst health workers and the general population, in countries where health resources were already strained before the outbreak.

The 2011 WHO Review Committee proposed a Global Health Emergency Workforce, backed by a US$100 million contingency fund, which would have enabled the rapid initial response needed to contain the Ebola outbreak, but the Commission was not acted upon by WHO, lacking sufficient financial commitment from governments in high-income countries.

According to Professor Gostin, "How could this Ebola outbreak have been averted and what could states and the international community do to prevent the next epidemic? The answer is not untested drugs, mass quarantines, or even humanitarian relief. If the real reasons the outbreak turned into a tragedy of these proportions are human resource shortages and fragile health systems, the solution is to fix these inherent structural deficiencies."

"A dedicated International Health Systems Fund at WHO would rebuild broken trust, with the returns of longer, healthier lives and economic development far exceeding the costs. This fund would encompass both emergency response capabilities and enduring health-system development."

"The west African Ebola epidemic could spark a badly needed global course correction that would favour strong health infrastructure. Sustainable funding scalable to needs for enduring health systems is a wise and affordable investment. It is in all states' interests to contain health hazards that may eventually travel to their shores. But beyond self-interest are the imperatives of health and social justice—a humanitarian response that would work, now and for the future."

http://www.bbc.com/news/science-environment-29050114

'Dreadnought' dinosaur yields big bone haul

New fossils found in Argentina represent the most complete giant sauropod dinosaur ever discovered.

By Jonathan Amos Science correspondent, BBC News

Scientists say they have 70% of the key bones needed to fully describe the creature, *Dreadnoughtus schrani*.

It means they can confidently estimate its great bulk - a beast that measured 26m from head to tail and weighed in at almost 60 tonnes. Remarkably, the skeletal analysis reveals *Dreadnoughtus* was still growing at the time of its death.

Quite how large the dino might have become, no-one can say. The Patagonian rocks from which it was pulled suggest that the young animal's life was cut short in a catastrophic flood. A detailed write-up on the 77-million-year-old fossils appears in the journal Scientific Reports.

The study group's leader is Kenneth Lacovara from Drexel University, Philadelphia, US. He told the BBC that the dinosaur's enormous size would have been intimidating. And for that reason, he has given the beast a name that recalls the massive battleships that revolutionised naval warfare in the early 1900s.

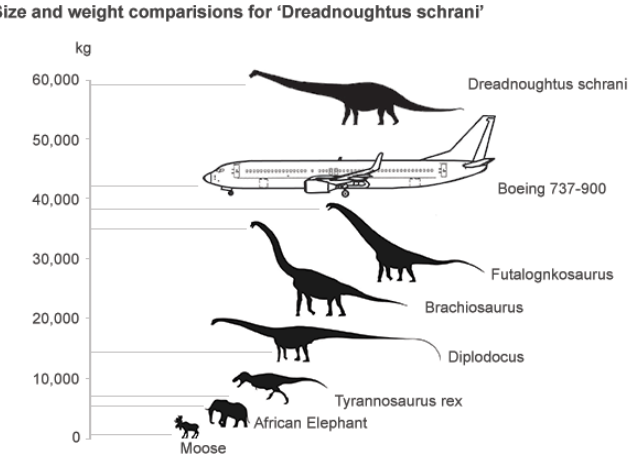
"*Dreadnoughtus* was huge, and in its environment there would have been nothing that could have preyed on it; it was essentially impervious to attack," he explained. "And that evoked in my mind those turn-of-the-last-century battleships - the first really big steel battleships - that were also impervious to attack from the other ships that existed at that time. So, what better name than 'dread nought' - 'fears nothing'."

These immense, long-necked, plant-eating dinos were the most massive beasts ever to plod the Earth's land surface. Ken Lacovara: "Previous skeletons have been so fragmentary"

Some, such as *Argentinosaurus* - a previous South American discovery - could even have topped the scales at close to 100 tonnes. But such estimates are based on very fragmentary evidence. In the case of *Argentinosaurus*, this is just half-a-dozen vertebrae in its mid-back, a few hip pieces and a shin bone.

At 26m from head to tail, Dreadnoughtus was longer than two London buses parked end to end

And this is why *Dreadnoughtus* is generating so much excitement. Although its skull has not survived, almost half of the rest of the skeleton has been preserved. And when you consider just the key bone groups, more than two-thirds of the complete animal is present in fossil form. As a result, *Dreadnoughtus* offers an unprecedented window into the anatomy, biomechanics and evolution of the titanosaurs. And it is sure to stir up that debate over which was really the biggest ever dinosaur.



Dreadnoughtus ***was one of the so-called titanosaurs.***

"When we look at one species and it appears to weigh 20 times more than another species, maybe what we're really looking at is an individual that is simply 30 years older than the other animal," said Dr Lacovara. "Perhaps, what we are looking at are just growth series differences, rather than species or taxonomic differences.

"Certainly, just in terms of physiology, *Dreadnoughtus* Argentinosaurus and some of the other big titanosaurs must have been approaching the limit of what was possible, but we don't know where that wall is."

The animal's great size would have made it pretty much impervious to attack

Dr Paul Barrett from London's Natural History Museum described Dreadnoughtus as a major discovery. "It finally gives some better insights into how these animals were actually built," he told BBC News. "It gives us the opportunity to understand things like the limits of bone strength, in terms of how you can hold up an animal of such immense size.

"We can now start to think about modelling its breathing, its blood pressure and how much food it had to eat to get by. "Once we know more about the overall proportions and shapes of these animals - and Dreadnoughtus is a big step in that direction - we can begin to unravel the secrets of titanosaur biology."

http://www.eurekalert.org/pub_releases/2014-09/wifb-nrf082814.php

New reprogramming factor cocktail produces therapy-grade induced pluripotent stem cells

iPSCs may hold the potential to cure damaged nerves, regrow limbs and organs, and perfectly model a patient's particular disease

CAMBRIDGE, Mass. - Induced pluripotent stem cells (iPSCs)—adult cells reprogrammed back to an embryonic stem cell-like state—may hold the potential to cure damaged nerves, regrow limbs and organs, and perfectly model a patient's particular disease. Yet through the reprogramming process, these cells can acquire serious genetic and epigenetic abnormalities that lower the cells' quality and limit their therapeutic usefulness.

When the generation of iPSCs was first reported in 2006, efficiency was paramount because only a fraction of a percentage of reprogrammed cells successfully became cell lines. Accordingly, the stem cell field focused on reprogramming efficiency to boost the pool of cells that could be studied. However, as scientists gained an increased understanding of the reprogramming process, they realized that myriad variables, including the ratio of reprogramming factors and the reprogramming environment, can also greatly affect cell quality. Now researchers working in the lab of Whitehead Institute Founding Member Rudolf Jaenisch together with scientists from the Hebrew University have determined that the reprogramming factors themselves impact the reprogramming efficiency and the quality of the resulting cells. Their work is described in the current issue of the journal Cell Stem Cell.

"Postdoctoral researcher Yosef Buganim and Research Scientist Styliani Markoulaki show that a different combination of reprogramming factors may be less efficient than the original, but can produce much higher quality iPSCs," says Jaenisch, who is also a professor of biology at MIT. "And quality is a really important issue. At this point, it doesn't matter if we get one colony out of 10,000 or one out of 100,000 cells, as long as it is of high quality."

To make iPSCs, scientists expose adult cells to a cocktail of genes that are active in embryonic stem cells. iPSCs can then be pushed to differentiate into almost any other cell type, such as nerve, liver, or muscle cells. Although the original combination of Oct4, Sox2, Klf4, and Myc (OSKM) efficiently reprograms cells, a relatively high percentage of the resulting cells have serious genomic aberrations, including aneuploidy, and trisomy 8, which make them unsuitable for use in clinical research.

Using bioinformatic analysis of a network of 48 genes key to the reprogramming process, Buganim and Markoulaki designed a new combination of genes, Sall4, Nanog, Esrrb, and Lin28 (SNEL). Roughly 80% of SNEL colonies made from mouse cells were of high quality and passed the most stringent pluripotency test currently available, the tetraploid complementation assay. By comparison, only 20-30% of high quality OSKM passed the same test. Buganim hypothesizes that SNEL reprograms cells better because, unlike OSKM, the cocktail does not rely on a potent oncogene like Myc, which may be causing some of the genetic problems. More importantly, the cocktail does not rely on the potent key master regulators Oct4 and Sox2 that might abnormally activate some regions in the adult cell genome.

To better understand why some reprogrammed cells are of high quality while others fall short, Buganim and Markoulaki analyzed SNEL colonies down to the genetic and epigenetic level. On their DNA, SNEL cells have deposits of the histone protein H2AX in locations very similar to those in ESCs, and the position of H2AX seems to predict the quality of the cell. The researchers believe this characteristic could be used to quickly screen for high quality colonies.

But for all of its promise, the current version of SNEL seems unable to reprogram human cells, which are generally more difficult to manipulate than mouse cells.

"We know that SNEL is not the ideal combination of factors," says Buganim, who is currently a Principal Investigator at Hebrew University in Jerusalem. "This work is only a proof of principle that says we must find this ideal combination. SNEL is an example that shows if you use bioinformatics tools you can get better quality. Now we should be able to find the optimal combination and try it in human cells to see if it works."

This work is supported by the Israeli Centers of Research Excellence (I-CORE) and the National Institutes of Health (NIH; grants HD 045022 and R37CA084198). Jaenisch is an adviser to Stemgent and a cofounder of Fate Therapeutics.

Written by Nicole Giese Rura

Rudolf Jaenisch's primary affiliation is with Whitehead Institute for Biomedical Research, where his laboratory is located and all his research is conducted. He is also a professor of biology at Massachusetts Institute of Technology.

"The developmental potential of iPSCs is greatly influenced by reprogramming factor selection" Cell Stem Cell, September 4, 2014.

Yosef Buganim (2,8,), Styliani Markoulaki (1,*), Niek van Wietmarschen (3), Heather Hoke (1,4), Tao Wu (5), Kibibi Ganz (1), Batool Akhtar-Zaidi (1), Yupeng He (6), Brian J. Abraham (1), David Porubsky (3), Elisabeth Kulenkampff (1), Dina A. Faddah (1,4), Linyu Shi (1), Qing Gao (1), Sovan Sarkar (1), Malkiel Cohen (1), Johanna Goldmann (1), Joseph R. Nery (6), Matthew D. Schultz (6), Joseph R. Ecker (6), Andrew Xiao (5), Richard Young (1,4,7), Peter M. Lansdorp (3,7) and Rudolf Jaenisch (1,4,7,8).*

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http://www.eurekalert.org/pub_releases/2014-09/wih-bcs090514.php

Breast cancer specialist reports advance in treatment of triple-negative breast cancer

Major national study that could lead to improvements in outcomes for women with triple-negative breast cancer

William M. Sikov, a medical oncologist in the Breast Health Center and associate director for clinical research in the Program in Women's Oncology at Women & Infants Hospital of Rhode Island, served as study chair and lead author for a recently-published major national study that could lead to improvements in outcomes for women with triple-negative breast cancer, an aggressive form of the disease that disproportionately affects younger women.

"Impact of the Addition of Carboplatin and/or Bevacizumab to Neoadjuvant Once-Per-Week Paclitaxel Followed by Dose-Dense Doxorubicin and Cyclophosphamide on Pathologic Complete Response Rates in Stage II to III Triple-Negative Breast Cancer: CALGB 40603 (Alliance)" was accepted as a rapid publication and published online this month by the Journal of Clinical Oncology. It will come out in print in September.

Because of its rapid growth rate, many women with triple-negative breast cancer receive chemotherapy to try to shrink it before undergoing surgery. With the standard treatment, the cancer is eliminated from the breast and lymph nodes in the armpit before surgery in about one third of women. This is referred to as a pathologic complete response (pCR). In patients who achieve pCR, the cancer is much less likely to come back, spread to other parts of the body, and cause the patient's death than if the cancer survives the chemotherapy.

Sikov and his collaborators studied the addition of other drugs – carboplatin and/or bevacizumab – to the standard treatment regimen to see if they could increase response rates. More than 440 women from cancer centers across the country enrolled in this randomized clinical trial.

"Adding either of these medications significantly increased the percentage of women who achieved a pCR with the preoperative treatment. We hope that this means fewer women will relapse and die of their cancer, though the study is not large enough to prove this conclusively. Of the two agents we studied, we are more encouraged by the results from the addition of carboplatin, since it was associated with fewer and less concerning additional side effects than bevacizumab," Sikov explains.

"More studies are planned to confirm the role of carboplatin in women with triple-negative breast cancer, and also to see if we can better identify which of these patients are most likely to benefit from its use. Until we have those results,

medical oncologists who treat women with triple-negative breast cancer will have to decide whether the potential benefits of adding carboplatin outweigh its risks for each individual patient."

Triple-negative breast cancer accounts for 15 to 20 percent of invasive breast cancers diagnosed in the United States each year, and is more common in younger women, African-Americans, Hispanics, and BRCA1-mutation carriers. With no identified characteristic molecular abnormalities that can be targeted with medication, the current standard of treatment is chemotherapy.

"Overall prognosis for women with this type of breast cancer remains inferior to that of other breast cancer subtypes, with higher risk of early relapse," Sikov says.

http://bit.ly/1oeC0CZ

Island Rising Out of Pacific Could Be Tsunami Hazard

The birth of a new island might seem like a pretty cool thing, but there are a few distinct downsides.

Sep 5, 2014 11:30 AM ET // by Patrick J. Kiger

Nine months after a new volcanic island broke through the surface of the western Pacific Ocean and merged with the existing island of Nishimo-shima 600 miles south of Tokyo, the combined island is still giving off smoke as it grows 200,000 cubic meters in volume per day, thanks to lava flow. (That's enough to fill 80 Olympic-sized swimming pools.)

The birth of a new island might seem like a pretty cool thing, but there are a few distinct downsides.

A rapidly-growing new island in Japan could possibly collapse and cause a tsunami, or else explode, a scientist warns. **Japan Coast Guard**

"If lava continues to mount on the eastern area, it will be deposited on steep slopes," University of Tokyo scientist Fukashi Maeno explained in an email to NASA's Earth Observatory website. "This could cause instability on the slope, so a partial collapse of the island may occur. We need to carefully observe the growth process."

Photos: New Japanese Island Forming in Pacific

Maeno told Agence France-Presse that if the new hybrid island collapses, it could unleash a tsunami upon nearby inhabited areas as it does, He calculated that seismic waves from 12 million cubic meters of collapsing volcanic rock would create a tsunami that would send three feet of water slamming into the nearby town of Chichijima and its 2,000 inhabitants within minutes at bullet-train speed.

An official from the Japan Meteorological Agency, which monitors earthquakes and tsunamis in addition to weather, told AFP that the agency's scientists already are monitoring the island.

"We studied the simulation this morning, and we are thinking of consulting with earthquake prediction experts… about the probability of this actually happening, and what kind of measures we would be able to take," the official told AFP.

There's also apparently the possibility that the island could explode. According to *Asahi Shimbun*, Japan Coast Guard officials say that a cone-shaped mound of congealed lava inside a volcanic vent there could seal off movement of magma and raise interior pressure within the island, which might eventually result in a large-scale explosion.

http://www.bbc.com/news/health-29084254

Use Ebola survivors' blood - WHO

The blood of patients who recover from Ebola should be used to treat others, the World Health Organization has announced.

By James Gallagher Health editor, BBC News website

West Africa is facing the largest Ebola outbreak in history and more than 2,000 people have died. A global group of experts have been meeting to assess the experimental therapies that could contain Ebola. The WHO also announced that Ebola vaccines could be used on the frontline by November.

Blood medicine

People produce antibodies in the blood in an attempt to fight off an Ebola infection. In theory, those antibodies can be transferred from a survivor into a sick patient to give their immune system a boost. However, large scale data on the effectiveness of the therapy is lacking. Studies on the 1995 outbreak of Ebola in Democratic Republic of Congo showed seven out of eight people survived after being given the therapy.

Ebola casualties
Up to 5 September
2,105
Ebola deaths - probable, confirmed and suspected
1,089 Liberia
517 Guinea
491 Sierra Leone
8 Nigeria
Source: WHO

Dr Marie Paule Kieny, an assistant director general at WHO said: "We agreed that whole blood therapies may be used to treat Ebola virus and all efforts must be invested to help infected countries to use them. "There is a real opportunity that a blood-derived product can be used now and this can be very effective in terms of treating patients."

She said that it was the one positive aspect of so many people being infected. "There are also many people now who have survived and are doing well. They can provide blood to treat the other people who are sick."

Vaccines

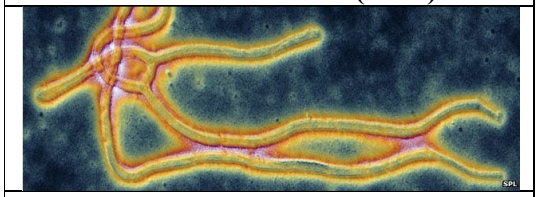
There is no clinically proven drug or vaccine to treat Ebola, but many are in the experimental stage. Around 150 experts have spent the last two days investigating how to fast-track promising experimental drugs to make them available in West Africa as soon as possible.

Ebola vaccine trials started in the US this week and will be extended to centres in the UK, Mali and Gambia in the coming weeks.

The WHO said safety data would be ready by November 2014 and, if it proved safe, would be used in West Africa immediately. Healthcare workers and other frontline staff would be prioritised for vaccination, the WHO said.

Experimental drugs - such as ZMapp, which has been used in seven patients including a British volunteer nurse - were also assessed. However, the supplies of all the experimental drugs are very limited, if not exhausted.

Ebola virus disease (EVD)



Symptoms include high fever, bleeding and central nervous system damage
Spread by body fluids, such as blood and saliva
Fatality rate can reach 90% - but current outbreak has mortality rate of about 55%
Incubation period is two to 21 days
There is no proven vaccine or cure
Supportive care such as rehydrating patients who have diarrhoea and vomiting can help recovery
Fruit bats, a delicacy for some West Africans, are considered to be virus's natural host

The WHO said efforts were underway to increase production, but it would take several months.

Dr Jesse Goodman, from Georgetown University Medical Center in the US, took part in the meeting. He said: "This is a unique opportunity to identify what new treatments and vaccines can really help people and then potentially accelerate their use. "We don't want to end up after this outbreak not knowing how best to prevent or treat the next one."

Yet the WHO warned that all the talk of experimental therapies must not detract from the proven methods of infection control which have defeated all previous outbreaks. Meanwhile, officials in Nigeria have decided to reopen schools in the country from 22 September. They were closed as a precaution to prevent the spread of the virus.

http://nyti.ms/1AmlmgH

Many in West Africa May Be Immune to Ebola Virus

Although few medical experts realize it, part of the population in West Africa is immune to the Ebola virus, according to virologists who specialize in the disease.

By DONALD G. McNEIL Jr. SEPT. 5, 2014

Assuming they are correct, and if those people can be identified, they could be a great help in fighting the outbreak. Immune persons could safely tend the sick and bury the dead just as smallpox survivors did in the centuries before smallpox vaccine.

Also, antibodies could be harvested from their blood to treat new Ebola victims.

But many factors remain unclear, including which Africans have antibodies and how much antibody is needed to be protective. The biggest mystery is how the immunity arose, and there is a mix of explanations, like silent infections and fruit contaminated with bat saliva.

“It’s fair to say that some people are immune,” said Robert F. Garry Jr., a Tulane University expert in hemorrhagic fevers who works in Sierra Leone. “But we don’t know if it’s 1 percent or 2 percent or 20 percent.”

Small studies of household contacts of Ebola victims show that some people are infected without ever falling ill - perhaps because of some unknown genetic advantage.

But many Africans who have never seen a victim also have antibodies.

It is possible that some get low doses of virus by eating infected monkeys or bats that are undercooked.

“If someone got just two or three or four virus particles, if it enters through the mucus membranes in the mouth, yes, it’s plausible,” said Thomas W. Geisbert, a hemorrhagic fever expert at the University of Texas Medical Branch in Galveston. “It would take a while for the virus to get going, and it’s a race with the clock. The immune system gets a chance to fight it off.”

Antibodies, Y-shaped proteins that attach to a virus and block it from invading cells, are the immune system’s first line of defense; the second line is white blood cells primed to recognize and digest the virus.

One of France’s leading Ebola experts says he believes that many rural villagers are “vaccinated” by eating fruit gnawed on by bats and contaminated with their saliva. “We imagine that this is the main route,” said Dr. Eric M. Leroy, a veterinarian and virologist at the International Center for Medical Research in Franceville, Gabon. “But it is a hypothesis. We do not have the evidence.”

Determining the overall level of immunity in West Africa would require testing thousands of blood samples, an impossible task in the current chaos, especially when any slip of a needle or a broken vial could fatally infect a health worker.

But in 2010, Dr. Leroy led such a study in Gabon, a Central African country that had four Ebola outbreaks from 1994 to 2002.

His teams took 4,349 blood samples in 220 randomly selected villages. They found that 15 percent of Gabon's population had antibodies. But it varied widely: near the coast, only 3 percent did; in some jungle villages near the Congo border, up to 34 percent did.

Also, their antibody levels varied widely, and what level is protective is roughly known for lab monkeys, but not for humans.

"I don't think we have a good idea of what constitutes a person who's going to survive versus a person who's going to succumb," said Randal J. Schoepp, head of diagnostics at the United States Army Medical Research Institute of Infectious Diseases in Fort Detrick, Md., who led a study of blood from patients in a Sierra Leone hospital who were originally thought to have Lassa fever but did not.

Nearly 9 percent had Ebola antibodies — and the samples dated from as far back as 2006, proving that the virus circulated long before this year's outbreak.

Also, there is anecdotal evidence that some West Africans are resistant. Victims have relatives who never get sick. At the funeral of a traditional healer where 14 women became infected, at least 26 other mourners did not, Dr. Garry said, even though most probably touched the body.

There is firm evidence for silent infections.

In 2000, Dr. Leroy's team studied 24 Gabonese who had tended victims without ever falling ill. Eleven had not just antibodies but remnants of virus and markers of inflammation in their blood — meaning they had clearly been infected but had defeated the virus on their own.

A similar 1999 study by American scientists in the Democratic Republic of Congo found similar results in five of 152 household contacts.

Those who are immune can donate blood containing antibodies to be given to acutely ill patients, as was done for Dr. Kent Brantly, one of the first two Americans to get Ebola. He survived, although his Emory University doctors later said it was unclear whether the transfusion or an experimental drug, ZMapp, containing cloned antibodies, helped him at all.

Having those who are immune be caregivers and body carriers makes sense, said Tom Skinner, a spokesman for the Centers for Disease Control and Prevention. "But we can't count on their immunity," he added. "They would still need full personal protective gear."

Relying on such measures may be inevitable, Dr. Garry said, adding: "There's no more ZMapp out there. It's time for creative solutions."

http://www.bbc.com/news/health-29060239

Ebola: How bad can it get?

This isn't just the worst single Ebola outbreak in history, it has now killed more than all the others combined.

By James Gallagher Health editor, BBC News website

Healthcare workers are visibly struggling, the response to the outbreak has been damned as "lethally inadequate" and the situation is showing signs of getting considerably worse. The outbreak has been running all year, but the latest in a stream of worrying statistics shows 40% of all the deaths have been in just the past three weeks. So what can we expect in the months, and possibly years, to come?

Taking off

Crystal-ball gazing can be a dangerous affair, particularly as this is uncharted territory. Previous outbreaks have been rapidly contained, affecting just dozens of people; this one has already infected more than 3,900. But the first clues are in the current data.

Dr Christopher Dye, the director of strategy in the office of the director general at the World Health Organization, has the difficult challenge of predicting what will happen next. He told the BBC: "We're quite worried, I have to say, about the latest data we've just gathered."

Ebola patient Man outside his home just outside the Liberian capital Monrovia

Up until a couple of weeks ago, the outbreak was raging in Liberia especially close to the epicentre of the outbreak in Lofa County and in the capital Monrovia. However, the two other countries primarily hit by the outbreak, Sierra Leone and Guinea, had been relatively stable. Numbers of new cases were not falling, but they were not soaring either. That is no longer true, with a surge in cases everywhere except some parts of rural Sierra Leone in the districts of Kenema and Kailahun. "In most other areas, cases and deaths appear to be rising. That came as a shock to me," said Dr Dye.

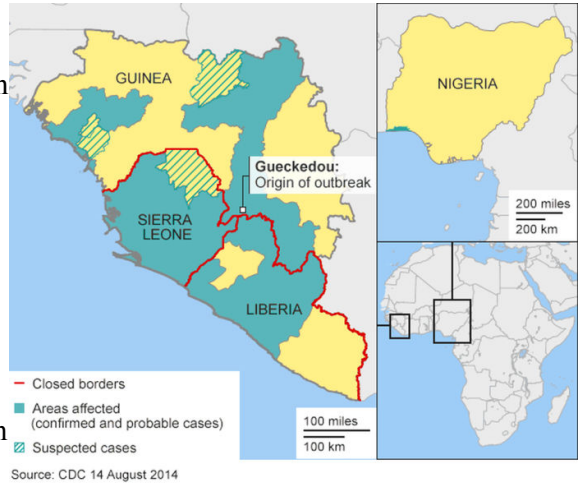
The charity Medecins Sans Frontieres has an isolation facility with 160 beds in Monrovia. But it says the queues are growing and they need another 800 beds to deal with the number of people who are already sick. This is not a scenario for containing an epidemic, but fuelling one.

Dr Dye's tentative forecasts are grim: "At the moment we're seeing about 500 new cases each week. Those numbers appear to be increasing. "I've just projected about five weeks into the future and if current trends persist we would be seeing not hundreds of cases per week, but thousands of cases per week and that is terribly disturbing. "The situation is bad and we have to prepare for it getting worse."

The World Health Organization is using an educated guess of 20,000 cases before the end, in order to plan the scale of the response. But the true potential of the outbreak is unknown and the WHO figure has been described to me as optimistic by some scientists.

International spread?

But it has spread significantly with the WHO reporting that "for the first time since the outbreak began" that the majority of cases in the past week were outside of that epicentre with the capital cities becoming major centres of Ebola. Additionally one person took the infection to Nigeria, where it has since spread in a small cluster and there has been an isolated case in Senegal.



The outbreak started in Gueckedou in Guinea, on the border with Liberia and Sierra Leone.

Prof Simon Hay, from the University of Oxford, will publish his scientific analysis of the changing face of Ebola outbreaks in the next week. He warns that as the total number of cases increases, so does the risk of international spread.

He told me: "I think you're going to have more and more of these individual cases seeding into new areas, continued flows into Senegal, Cote d'Ivoire, and all the countries in between, so I'm not very optimistic at the moment that we're containing this epidemic."

There is always the risk that one of these cases could arrive in Europe or North America. However, richer countries have the facilities to prevent an isolated case becoming an uncontrolled outbreak.

The worry is that other African countries with poor resources would not cope and find themselves in a similar situation to Guinea, Liberia and Sierra Leone.

"Nigeria is the one I look at with great concern. If things started to get out of control in Nigeria I really think that, because of its connectedness and size, that could be quite alarming," said Prof Hay.

End game?

It is also unclear when this outbreak will be over.

Officially the World Health Organization is saying the outbreak can be contained in six to nine months. But that is based on getting the resources to tackle the outbreak, which are currently stretched too thinly to contain Ebola as it stands.

There have been nearly 4,000 cases so far, cases are increasing exponentially and there is a potentially vulnerable population in Sierra Leone, Liberia and Guinea in excess of 20 million.

Prof Neil Ferguson, the director of the UK Medical Research Council's centre for outbreak analysis and modelling at Imperial College London, is providing data analysis for the World Health Organization. He is convinced that the three countries will eventually get on top of the outbreak, but not without help from the rest of the world.

"The authorities are completely overwhelmed. All the trends are the epidemic is increasing, it's still growing exponentially, so there's certainly no reason for optimism. "It is hard to make a long-term prognosis, but this is certainly something we'll be dealing with in 2015.

"I can well imagine that unless there is a ramp-up of the response on the ground, we'll have flare-ups of cases for several months and possibly years."

It is certainly a timeframe that could see an experimental Ebola vaccine, which began safety testing this week, being used on the front line. If the early trials are successful then healthcare workers could be vaccinated in November this year.

Here forever

But there are is also a fear being raised by some virologists that Ebola may never be contained.

Prof Jonathan Ball, a virologist at the University of Nottingham, describes the situation as "desperate". His concern is that the virus is being given its first major opportunity to adapt to thrive in people, due to the large number of human-to-human transmissions of the virus during this outbreak of unprecedented scale.

Ebola is thought to come from fruit bats; humans are not its preferred host.

But like HIV and influenza, Ebola's genetic code is a strand of RNA. Think of RNA as the less stable cousin of DNA, which is where we keep our genetic information. It means Ebola virus has a high rate of mutation and with mutation comes the possibility of adapting.

Prof Ball argues: "It is increasing exponentially and the fatality rate seems to be decreasing, but why? "Is it better medical care, earlier intervention or is the virus adapting to humans and becoming less pathogenic? As a virologist that's what I think is happening."

There is a relationship between how deadly a virus is and how easily it spreads. Generally speaking if a virus is less likely to kill you, then you are more likely to spread it - although smallpox was a notable exception.

Prof Ball said "it really wouldn't surprise me" if Ebola adapted, the death rate fell to around 5% and the outbreak never really ended. "It is like HIV, which has been knocking away at human-to-human transmission for hundreds of years before

eventually finding the right combo of beneficial mutations to spread through human populations."

Collateral damage

It is also easy to focus just on Ebola when the outbreak is having a much wider impact on these countries.

The malaria season, which is generally in September and October in West Africa, is now starting. This will present a number of issues. Will there be capacity to treat patients with malaria? Will people infected with malaria seek treatment if the nearest hospital is rammed with suspected Ebola cases? How will healthcare workers cope when malaria and Ebola both present with similar symptoms.

And that nervousness about the safety of Ebola-rife hospitals could damage care yet further. Will pregnant women go to hospital to give birth or stay at home where any complications could be more deadly.

The collateral damage from Ebola is unlikely to be assessed until after the outbreak. No matter where you look there is not much cause for optimism.

The biggest unknown in all of this is when there will be sufficient resources to properly tackle the outbreak.

Prof Neil Ferguson concludes: "This summer has there have been many globally important news stories in Ukraine and the Middle East, but what we see unfolding in West Africa is a catastrophe to the population, killing thousands in the region now and we're seeing a breakdown of the fragile healthcare system. "So I think it needs to move up the political agenda rather more rapidly than it has."

http://www.eurekalert.org/pub_releases/2014-09/asfm-edi090214.php

Each day in the hospital raises risk of multidrug-resistant infection

Likelihood of multidrug resistance increases by 1% per day of hospitalization

If a patient contracts an infection while in the hospital, each day of hospitalization increases by 1% the likelihood that the infection will be multidrug-resistant, according to research presented at the 54th Interscience Conference on Antimicrobial Agents and Chemotherapy (ICAAC) an infectious disease meeting of the American Society for Microbiology.

Researchers from the Medical University of South Carolina gathered and analyzed historical data from 949 documented cases of Gram-negative infection at their academic medical center. In the first few days of hospitalization the percentage of infections associated with Gram-negative bacteria classified as multidrug-resistant was about 20% and rose fairly steadily until four or five days, then jumped dramatically, peaking at over 35% at 10 days. Statistical analysis suggested an additional 1% risk per day of hospitalization.

Hospital-acquired infections represent a large and possibly preventable segment of hospital-related deaths and have been rising in recent years. A European study suggested that Gram-negative infections account for two thirds of the 25,000 hospital-acquired infection deaths each year. There is currently little data on how many infections and deaths are caused by Gram-negative bacteria, although in 2011 the CDC estimated that there were roughly 722,000 hospital-acquired infections that caused approximately 75,000 deaths. On any given day, about 1 in 25 hospital patients has at least one healthcare-associated infection and over a third of these infections are caused by Gram-negative bacteria, many of which are resistant to one or more classes of antibiotics. This study is the first to quantify the risks for patients over time.

"Our findings emphasize one of the risks of being in the hospital, acquiring a multidrug-resistant infection" said John Bosso, an author of the paper. "At the very least, this observation argues against both unnecessary hospitalization and unnecessarily long hospitalization."

The data revealed several other surprising findings. The chances that a patient would become infected with a multidrug-resistant pathogen varied from one organism to another. This could have implications for clinicians and others hoping to reduce dangerous hospital-acquired infections, says Bosso.

http://www.eurekalert.org/pub_releases/2014-09/elf-soa090314.php

Sleeping on animal fur in infancy found to reduce risk of asthma

Munich, Germany: Sleeping on animal fur in the first three months of life might reduce the risk of asthma in later childhood a new study has found.

The new research, presented at the European Respiratory Society (ERS) International Congress in Munich today (8 September 2014), suggests that exposure to the microbial environment in animal skin and fur could have a protective effect against asthma and allergies.

Previous studies have suggested that exposure to a wider range of environments fromyoung age could be protective against asthma and allergies. These findings have not been confirmed conclusively in urban settings. In this new study, researchers investigated children from a city environment who had been exposed to animal skin by sleeping on the material shortly after birth.

Data from a German birth cohort called Lisaplus were used. The cohort included over 3,000 healthy newborns who were mainly recruited in 1998.

The researchers collected information on exposure to animal skin during the first three months of life, along with information on the health of children until the age of 10 years. Information on 2,441 children was used in the study, with 55% of those included sleeping on animal skin in the first three months of life.

The results showed that sleeping on animal skin was associated with a reduced risk of a number of factors connected to asthma. The chance of having asthma at the age of 6 years was 79% lower in children who had slept on animal skin after birth compared with those who were not exposed to animal skin. The risk decreased to 41% by the age of 10.

Dr Christina Tischer, from the Helmholtz Zentrum München Research Centre, said: "Previous studies have suggested that microbes found in rural settings can protect from asthma. An animal skin might also be a reservoir for various kinds of microbes, following similar mechanisms as has been observed in rural environments. Our findings have confirmed that it is crucial to study further the actual microbial environment within the animal fur to confirm these associations."

http://www.eurekalert.org/pub_releases/2014-09/uos-6pc090414.php

61 percent fall in female genital warts due to free HPV vaccine

Since introduction of national (HPV) vaccination program Australia GPs face 61 % fewer cases of genital warts among young women

GPs in Australia are managing 61 per cent less cases of genital warts among young women since the introduction of the national human papillomavirus (HPV) vaccination program, a new study from the University of Sydney reveals.

The study, which reviewed more than a million patient encounters between 2000 and 2012, showed a significant year-on-year reduction in the management rate of genital warts in women aged 15-27 years since the vaccination program started. The findings are published in PLOS One journal.

"The results show that the program has been a widespread success," said lead author of the study Christopher Harrison of the University of Sydney.

The HPV vaccination program was introduced in 2007, and the rate of genital wart presentation fell dramatically from 4.33 per 1,000 encounters pre-program (2002-2006) to 1.67 per 1,000 encounters in the post-program period (2008-2012). Australia was one of the first countries to provide the HPV vaccine free to young women through a national immunisation program. The vaccine protects against two major viral causes of genital warts (HPV 6 and 11) and two major viral causes of cervical cancer (HPV 16 and 18). "This is the first study to report the impact of HPV vaccinations on genital warts management in general practice, which is where the majority of cases are treated," said Mr Harrison.

"We looked at women potentially covered by the vaccination program (15-27 years), and the data showed a 61 per cent decrease in the management rate of genital warts in the four years after the program started, compared with the four years before the program.

"This is an excellent result as not only do genital warts cause distress in affected patients, but treatment is at a substantial cost to the health system.

"For all other age-sex groups (who were not covered by the program) there was no significant change in the management rate of genital warts between the pre-program and post-program periods.

"There was also no significant decrease in other sexually transmitted infections over this period, which means that the decrease in genital warts was likely due to the vaccination program, not a change in the women's behaviour.

"The program has proved to be a great success and of huge benefit to the sexual health of Australia, and has clearly proven to be very worthwhile," Mr Harrison said.

Fast facts:

Human Papillomavirus (HPV) is a common virus that affects both males and females. Anyone who has ever had sexual contact could have HPV.

HPV doesn't usually cause symptoms so people infected with the virus may not know they have it.

Different kinds of HPV can affect different parts of the body, and some types are more harmful than others. The more harmful types of HPV can cause abnormal cells that lead to a range of cancers and disease such as genital warts.

Vaccinating against Human Papillomavirus (HPV) is the best way to prevent HPV-related cancers and disease. The vaccination is most effective when given before a person becomes sexually active.

The HPV vaccine is being provided free in Australian schools as part of the National Immunisation Program.

http://read.bi/1CHD2kA

'Meteorite' smashes into Nicaraguan capital

A mysterious explosion that rocked Nicaragua's crowded capital Managua, creating a large crater, appears to have been caused by a small meteorite, officials said Sunday.

Managua (AFP) - Amazingly, in a sprawling city of 1.2 million people, the impact near the international airport did not cause any known injuries, but it did leave a crater measuring 12 meters (39 feet) across and was felt throughout the capital late on Saturday.

Nicaraguan authorities believe it was a piece of the small asteroid dubbed "2014 RC," which passed very close to Earth on Sunday and was estimated by astronomers to be about 20 meters big, or the size of a house.

"We are convinced that this was a meteorite. We have seen the crater from the impact," said Wilfredo Strauss of the Seismic Institute.

The meteorite appeared to have hurtled into a wooded area near the airport around midnight and the hit was so large that it registered on the instruments Strauss's organization uses to size up earthquakes.

"You can see two waves: first, a small seismic wave when the meteorite hit earth, and then another stronger one, which is the impact of the sound," he said.

Government officials and experts visited the impact site on Sunday.

One of them, William Martinez, said it was not yet clear if the meteorite burned up completely or if it had been blasted into the soil.

"You can see mirror-like spots on the sides of the crater from where the meteorite power-scraped the walls," Martinez said.

Government spokeswoman, First Lady Rosario Murillo, said Managua would be in contact with the US Geological Service to try to get more information about "this fascinating event" in the Central American nation, one of Latin America's poorest countries.

***A Nicaraguan soldier checks the site where an alleged meteorite struck, in Managua, on September 7, 2014* © Presidencia - El 19 Digital/AFP German Miranda**

People who live near the crater told local media they heard a blast they took for an explosion, and that liquid, sand and dust were blown through the air, which smelled like something had burned.

There were no reported injuries because the impact was in a wooded spot, and flights at the airport were not affected.

NASA said last week that the asteroid 2014 RC, at the time of closest approach, would be approximately one-tenth the distance from the center of Earth to the moon, or about 25,000 miles (40,000 kilometers). It had been projected to be roughly over New Zealand at the time of its closest approach, which astronomers had calculated would be on Sunday at about 1818 GMT.

http://phys.org/news/2014-09-faraway-moon-mimics-earth-tectonics.html

Faraway moon mimics Earth tectonics

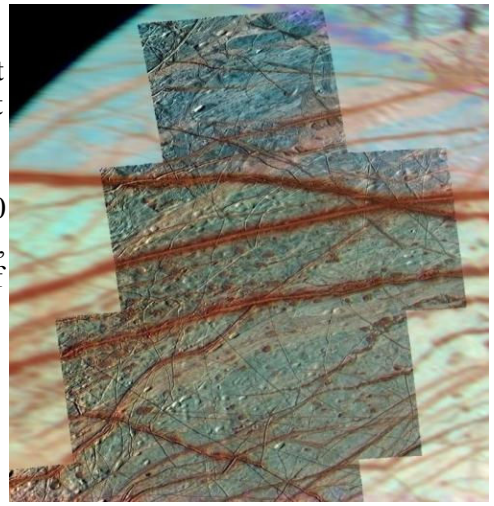
Jupiter's icy moon Europa may have active tectonic plates similar to those that shape the Earth, which had long been thought unique in this respect, scientists said Sunday.

They used images captured by NASA's Galileo spacecraft, which orbited Jupiter and its moons from 1995 to 2003, to study the criss-cross of ridges and fractures on Europa's ice shell.

The moon, slightly smaller than the one orbitting Earth, has one of the youngest surfaces in the Solar System, implying "rapid recycling", said the team.

They found evidence that a piece of the surface had disappeared along a boundary between two ice plates, possibly when one sunk under the other.

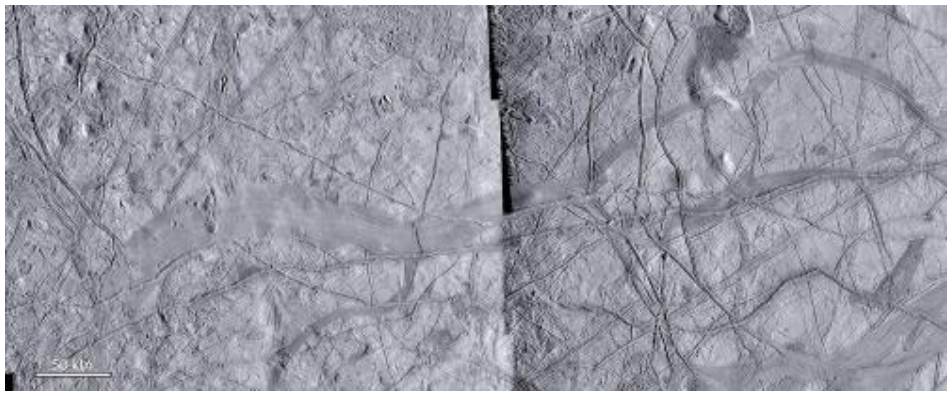
They took this as evidence of surface material being recycled into the moon's interior—similar to parts of Earth's crust which sink into the underlying mantle at so-called subduction zones where tectonic plates converge.



The team had studied an area of 134,000 square kilometres (51,700 square miles), using the images and a reconstruction of geological features. They found that a 20,000 km^2-portion of surface was missing. "We propose that Europa's ice shell has a brittle, mobile, plate-like system above convecting warmer ice," they wrote in the journal *Nature Geoscience*.

***False-color image of Europa's trailing northern hemisphere, where subduction zones are hypothesized to exist.* Credit: NASA/JPL/University of Arizona**

"Hence, Europa may be the only Solar System body other than Earth to exhibit a system of plate tectonics." Europa is one of the four largest moons of Jupiter, the fifth planet from the Sun and the largest in our Solar System.



***Close-up view of a proposed zone of mid-ocean-ridge-like plate spreading on Europa (unrelated to the region studied in this work). This dilational band called Phaidra Linea, located in Europa's trailing hemisphere near Argadnel Regio, shows internal striations related to spreading and bilateral symmetry about a central axis. Older geological features can be matched perfectly to either side of the spreading zone. Black strip in the center of the image is a narrow region where there is no image coverage.* Credit: NASA/JPL**

http://bit.ly/1CHDX4p

Taking short walking breaks found to reverse negative effects of prolonged sitting

An Indiana University study has found that three easy -- one could even say slow -- 5-minute walks can reverse harm caused to leg arteries during three hours of prolonged sitting.

BLOOMINGTON, Ind. - Sitting for long periods of time, like many people do daily at their jobs, is associated with risk factors such as higher cholesterol levels and greater waist circumference that can lead to cardiovascular and metabolic disease. When people sit, slack muscles do not contract to effectively pump blood to the heart. Blood can pool in the legs and affect the endothelial function of arteries, or the ability of blood vessels to expand from increased blood flow.

This study is the first experimental evidence of these effects, said Saurabh Thosar, a postdoctoral researcher at Oregon Health & Science University, who led the study as a doctoral candidate at IU's School of Public Health-Bloomington.

"There is plenty of epidemiological evidence linking sitting time to various chronic diseases and linking breaking sitting time to beneficial cardiovascular effects, but there is very little experimental evidence," Thosar said. "We have shown that prolonged sitting impairs endothelial function, which is an early marker of cardiovascular disease, and that breaking sitting time prevents the decline in that function."

The researchers were able to demonstrate that during a three-hour period, the flow-mediated dilation, or the expansion of the arteries as a result of increased blood flow, of the main artery in the legs was impaired by as much as 50 percent after just one hour. The study participants who walked for 5 minutes each hour of sitting saw their arterial function stay the same -- it did not drop throughout the three-hour period. Thosar says it is likely that the increase in muscle activity and blood flow accounts for this.

"American adults sit for approximately eight hours a day," he said. "The impairment in endothelial function is significant after just one hour of sitting. It is interesting to see that light physical activity can help in preventing this impairment."

The study involved 11 non-obese, healthy men between the ages of 20-35 who participated in two randomized trials. In one trial they sat for three hours without moving their legs. Researchers used a blood pressure cuff and ultrasound technology to measure the functionality of the femoral artery at baseline and again at the one-, two- and three-hour mark.

In the second trial, the men sat during a three-hour period but also walked on a treadmill for 5 minutes at a speed of 2 mph at the 30-minute mark, 1.5-hour mark and 2.5-hour mark. Researchers measured the functionality of the femoral artery at the same intervals as in the other trial.

The study "Effect of Prolonged Sitting and Breaks in Sitting Time on Endothelial Function" will be published in Medicine & Science in Sports & Exercise, the official journal of the American College of Sports Medicine, and is appearing online early.