

<http://bit.ly/1m4rtxO>

## Big Waves in Jet Stream Mean Extreme Weather

*Scientists pinpoint drivers of heat waves, droughts and flooding in a new study. Studies found jet stream increased the likelihood of hot months in western North America and central Asia, and extreme cold months in eastern North America.*

Jun 23, 2014 | By Gayathri Vaidyanathan and ClimateWire

In the messy, chaotic atmosphere of our planet meanders the jet stream, a wiggly belt of air circling the mid-latitudes. As the belt moves south, it pulls cool air from the Arctic toward the tropics. Then it switches direction, pulling warm air from the tropics toward the poles.

Sometimes, in response to natural climate patterns, the jet stream becomes abnormally wavy. Such amplified waves have coincided with heat and cold waves, droughts and flooding across the world, according to a [study published yesterday](#) in Nature Climate Change.

Take the past winter in North America, for example. The eastern and central United States were plunged into a deep freeze, Alaska was unusually warm and California was dry. Above the continent, the jet stream was indulging in some unusual behavior. Its northward swing was so big that it sucked warmer air right into Alaska, which was positively balmy in the wintertime.

Then, the wave turned toward the south with a big swing, bringing Arctic air into the central United States.

Weather watchers have always assumed that the jet stream might account for some weather extremes, but this is the first paper to demonstrate that conclusively.

"I think [the paper] has done a fabulous job of basically documenting a relationship that most people believed existed," said Jennifer Francis, an atmospheric scientist at Rutgers University, who was not affiliated with the new study. "[It] has shown that, indeed, many of the extreme events that have occurred in the past, going back to the late 1970s, are associated with very large waves in the jet stream."

The study is particularly relevant in the context of a controversial hypothesis championed by Francis that the jet stream will get more wavy in the future with climate change (ClimateWire, April 3).

Understanding the climate link requires knowledge of the jet stream's evolution, which most people do not have, because, "why would you?" asked James Screen, a climate researcher at the United Kingdom's University of Exeter and the lead author of the new study, with a laugh.

### A possible connection to Arctic warming?

The jet stream, also known as "Rossby waves," is result of the Earth spinning. As the planet turns, blobs of air begin moving from west to east. As the blobs

encounter accidents of topography - such as a mountain range - they deflect, sometimes toward the Equator.

Another little-known fact is that the Earth - and the air above - has more spin at the poles than at the Equator.

A blob from the north that is deflected south will find itself in a region with less spin. It then attempts to return to the latitude it belongs and curves back. But, it overshoots its mark and has to turn back southward.

A wavy jet stream forms.

When the waves get very large, they move more slowly. That means the weather they create also move more slowly, which leads to very extreme weather that hangs around oppressively for weeks.

Francis has suggested that the frequency of the wavy patterns in the jet stream is increasing as the Arctic warms due to climate change. But there is not enough data to prove this hypothesis.

"No one has come out and said this is wrong and presented results showing that it's wrong," Francis said. "But there is uncertainty at this point whether we can see this happening in the real world or not."

If the theory is true, then the new study would seem to suggest that heat and cold waves would occur more frequently in the future.

### Droughts, extreme rainfall and temperature extremes

Screen, the primary author, stressed that his new study does not deal with the controversial link between the Arctic, climate change and the jet stream. Rather, it simply uses historical weather data to connect the jet stream and extreme weather, which is the noncontroversial part of the equation.

Screen and his colleagues identified 40 extreme weather events, including heat waves, cold temperatures, droughts and heavy rainfall, that occurred since 1979 throughout the world. That date was chosen because satellites began providing quality meteorological data around then.

The scientists then used computer models to reconstruct the jet stream as it must have existed during those weather events. They found that, in general, extreme weather appeared to coincide with amplified jet streams.

The type of extreme weather appeared to differ with geography. This is because the jet stream is just one link in the chain of climatic events influencing local weather.

The study found that the jet stream increased the likelihood of hot months in western North America and central Asia, and extreme cold months in eastern North America. It also increased the likelihood of droughts in central North America, Europe and central Asia, and extreme rainfall in western Asia.

[http://www.eurekalert.org/pub\\_releases/2014-06/tes-ces062214.php](http://www.eurekalert.org/pub_releases/2014-06/tes-ces062214.php)

### **Cold exposure stimulates beneficial brown fat growth**

*Long-term mild cold exposure can stimulate brown fat growth and activity in humans and may benefit glucose and energy metabolism, a new study finds.*

Chicago, IL - The results were presented in a poster Sunday, June 22 at ICE/ENDO 2014, the joint meeting of the International Society of Endocrinology and the Endocrine Society in Chicago.

Brown fat, also known as brown adipose tissue (BAT), is a special kind of fat that burns energy and glucose to generate heat. It keeps small animals and babies warm, and animals with abundant brown fat are protected from diabetes and obesity. How brown fat is regulated in humans and how it relates to metabolism, though, remain unclear.

"Our research points to a simple and practical brown fat activating and growing strategy in humans through temperature exposure modulation. We show that long-term minimal manipulation of overnight ambient temperature - well within the range found in climate-controlled buildings - was able to modulate brown fat activity in humans. Mild cold exposure stimulated brown fat activity while mild warm exposure suppressed it. Brown fat increase was accompanied by improvement in insulin sensitivity and energy burning rate after food," said Paul Lee, MD, PhD, former research fellow at the National Institute of Diabetes and Digestive and Kidney Diseases (NIDDK) of the National Institutes of Health (NIH). In their Impact of Chronic Cold Exposure in Humans (ICEMAN) study, Dr. Lee and his colleagues explored the impact of controlled temperature acclimatization on BAT and energy balance by following 5 men between 19 and 23 years of age over a 4-month period. The volunteers engaged in their usual daytime activities but slept in a private room in which the air temperature varied monthly between 66°F (19°C) and 81°F (27°C). Personal temperature detectors monitored each volunteer's exposed temperature continuously over the entire 4 months.

At the end of each month, the researchers measured the men's BAT and energy metabolism and found that mild cold (19 C) increased the men's brown fat amount and activity while mild warmth (27 C) suppressed it.

"The improvement in insulin sensitivity accompanying brown fat gain may open new avenues in the treatment of impaired glucose metabolism in the future. On the other hand, the reduction in mild cold exposure from widespread central heating in contemporary society may impair brown fat function and may be a hidden contributor to obesity and metabolic disorders," Lee said.

The authors suggest that recruiting and activating BAT by manipulating temperature may be a promising therapeutic strategy in obesity and diabetes treatment.

The study was supported by the Intramural Research Program at the NIDDK and the NIH Clinical Center. Paul Lee was supported by an Australian National Health Medical Research Council (NHMRC) Early Career Fellowship, the Diabetes Australia Fellowship and Bushell Travelling Fellowship, and the School of Medicine, University of Queensland.

<http://bit.ly/1sKcWe4>

### **Cocoa extract may counter specific mechanisms of Alzheimer's disease**

*Insights into mechanisms behind cocoa's benefit may lead to new treatments or dietary regimens*

NEW YORK - A specific preparation of cocoa-extract called Lavado may reduce damage to nerve pathways seen in Alzheimer's disease patients' brains long before they develop symptoms, according to a study conducted at the Icahn School of Medicine at Mount Sinai and published June 20 in the Journal of Alzheimer's Disease (JAD).

Specifically, the study results, using mice genetically engineered to mimic Alzheimer's disease, suggest that Lavado cocoa extract prevents the protein  $\beta$ -amyloid- ( $A\beta$ ) from gradually forming sticky clumps in the brain, which are known to damage nerve cells as Alzheimer's disease progresses.

Lavado cocoa is primarily composed of polyphenols, antioxidants also found in fruits and vegetables, with past studies suggesting that they prevent degenerative diseases of the brain.

The Mount Sinai study results revolve around synapses, the gaps between nerve cells. Within healthy nerve pathways, each nerve cell sends an electric pulse down itself until it reaches a synapse where it triggers the release of chemicals called neurotransmitters that float across the gap and cause the downstream nerve cell to "fire" and pass on the message.

The disease-causing formation of  $A\beta$  oligomers – groups of molecules loosely attracted to each other – build up around synapses. The theory is that these sticky clumps physically interfere with synaptic structures and disrupt mechanisms that maintain memory circuits' fitness. In addition,  $A\beta$  triggers immune inflammatory responses, like an infection, bringing on a rush of chemicals and cells meant to destroy invaders but that damage our own cells instead.

"Our data suggest that Lavado cocoa extract prevents the abnormal formation of  $A\beta$  into clumped oligomeric structures, to prevent synaptic insult and eventually cognitive decline," says lead investigator Giulio Maria Pasinetti, MD, PhD, Saunders Family Chair and Professor of Neurology at the Icahn School of Medicine at Mount Sinai. "Given that cognitive decline in Alzheimer's disease is thought to start decades before symptoms appear, we believe our results have broad implications for the prevention of Alzheimer's disease and dementia."

Evidence in the current study is the first to suggest that adequate quantities of specific cocoa polyphenols in the diet over time may prevent the glomming together of A $\beta$  into oligomers that damage the brain, as a means to prevent Alzheimer's disease.

The research team led by Dr. Pasinetti tested the effects of extracts from Dutched, Natural, and Lavado cocoa, which contain different levels of polyphenols. Each cocoa type was evaluated for its ability to reduce the formation of A $\beta$  oligomers and to rescue synaptic function. Lavado extract, which has the highest polyphenol content and anti-inflammatory activity among the three, was also the most effective in both reducing formation of A $\beta$  oligomers and reversing damage to synapses in the study mice.

"There have been some inconsistencies in medical literature regarding the potential benefit of cocoa polyphenols on cognitive function," says Dr. Pasinetti. "Our finding of protection against synaptic deficits by Lavado cocoa extract, but not Dutched cocoa extract, strongly suggests that polyphenols are the active component that rescue synaptic transmission, since much of the polyphenol content is lost by the high alkalinity in the Dutching process."

Because loss of synaptic function may have a greater role in memory loss than the loss of nerve cells, rescue of synaptic function may serve as a more reliable target for an effective Alzheimer's disease drug, said Dr. Pasinetti.

The new study provides experimental evidence that Lavado cocoa extract may influence Alzheimer's disease mechanisms by modifying the physical structure of A $\beta$  oligomers. It also strongly supports further studies to identify the metabolites of Lavado cocoa extract that are active in the brain and identify potential drug targets. In addition, turning cocoa-based Lavado into a dietary supplement may provide a safe, inexpensive and easily accessible means to prevent Alzheimer's disease, even in its earliest, asymptomatic stages.

Researchers from Kanazawa University in Japan contributed to the study and the cocoa used in the study was a gift from Dr. Jeffrey Hurst of the Hershey Company.

[http://www.eurekalert.org/pub\\_releases/2014-06/nrao-rwd062314.php](http://www.eurekalert.org/pub_releases/2014-06/nrao-rwd062314.php)

### Remarkable white dwarf star possibly coldest, dimmest ever detected

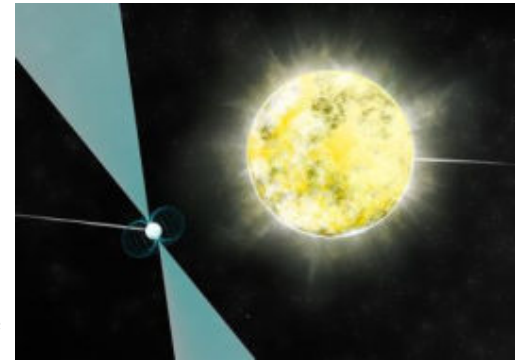
#### *Ancient stellar remnant forms an Earth-size diamond in space*

A team of astronomers has identified possibly the coldest, faintest white dwarf star ever detected. This ancient stellar remnant is so cool that its carbon has crystallized, forming - in effect - an Earth-size diamond in space.

"It's a really remarkable object," said David Kaplan, a professor at the University of Wisconsin-Milwaukee. "These things should be out there, but because they are so dim they are very hard to find."

Kaplan and his colleagues found this stellar gem using the National Radio Astronomy Observatory's (NRAO) Green Bank Telescope (GBT) and Very Long Baseline Array (VLBA), as well as other observatories.

White dwarfs are the extremely dense end-states of stars like our Sun that have collapsed to form an object approximately the size of the Earth. Composed mostly of carbon and oxygen, white dwarfs slowly cool and fade over billions of years. The object in this new study is likely the same age as the Milky Way, approximately 11 billion years old.



*This is an artist impression of a white dwarf star in orbit with pulsar PSR J2222-0137. It may be the coolest and dimmest white dwarf ever identified. B. Saxton (NRAO/AUI/NSF)*

Pulsars are rapidly spinning neutron stars, the superdense remains of massive stars that have exploded as supernovas. As neutron stars spin, lighthouse-like beams of radio waves, streaming from the poles of its powerful magnetic field, sweep through space. When one of these beams sweeps across the Earth, radio telescopes can capture the pulse of radio waves.

The pulsar companion to this white dwarf, dubbed PSR J2222-0137, was the first object in this system to be detected. It was found using the GBT by Jason Boyles, then a graduate student at West Virginia University in Morgantown.

These first observations revealed that the pulsar was spinning more than 30 times each second and was gravitationally bound to a companion star, which was initially identified as either another neutron star or, more likely, an uncommonly cool white dwarf. The two were calculated to orbit each other once every 2.45 days.

The pulsar was then observed over a two-year period with the VLBA by Adam Deller, an astronomer at the Netherlands Institute for Radio Astronomy (ASTRON). These observations pinpointed its location and distance from the Earth - approximately 900 light-years away in the direction of the constellation Aquarius. This information was critical in refining the model used to time the arrival of the pulses at the Earth with the GBT.

By applying Einstein's theory of relativity, the researchers studied how the gravity of the companion warped space, causing delays in the radio signal as the pulsar passed behind it. These delayed travel times helped the researchers determine the orientation of their orbit and the individual masses of the two stars. The pulsar has a mass 1.2 times that of the Sun and the companion a mass 1.05 times that of the Sun.

These data strongly indicated that the pulsar companion could not have been a second neutron star; the orbits were too orderly for a second supernova to have taken place.

Knowing its location with such high precision and how bright a white dwarf should appear at that distance, the astronomers believed they should have been able to observe it in optical and infrared light. Remarkably, neither the Southern Astrophysical Research (SOAR) telescope in Chile nor the 10-meter Keck telescope in Hawaii was able to detect it.

"Our final image should show us a companion 100 times fainter than any other white dwarf orbiting a neutron star and about 10 times fainter than any known white dwarf, but we don't see a thing," said Bart Dunlap, a graduate student at the University of North Carolina at Chapel Hill and one of the team members. "If there's a white dwarf there, and there almost certainly is, it must be extremely cold."

The researchers calculated that the white dwarf would be no more than a comparatively cool 3,000 degrees Kelvin (2,700 degrees Celsius).

Astronomers believe that such a cool, collapsed star would be largely crystallized carbon, not unlike a diamond. Other such stars have been identified and they are theoretically not that rare, but with a low intrinsic brightness, they can be deucedly difficult to detect. Its fortuitous location in a binary system with a neutron star enabled the team to identify this one.

*A paper describing these results is published in the Astrophysical Journal.*

*The National Radio Astronomy Observatory is a facility of the National Science Foundation, operated under cooperative agreement by Associated Universities, Inc.*

[http://www.eurekalert.org/pub\\_releases/2014-06/pf-ntf062314.php](http://www.eurekalert.org/pub_releases/2014-06/pf-ntf062314.php)

## **Nonsurgical treatment for enlarged prostate on the horizon**

### ***Pulsed electromagnetic therapy found to be highly effective in dogs***

You just cannot ignore your symptoms any longer. You find yourself getting up many times every night with the urgency to urinate. Saw palmetto, even high doses of the highest-quality type, didn't work.

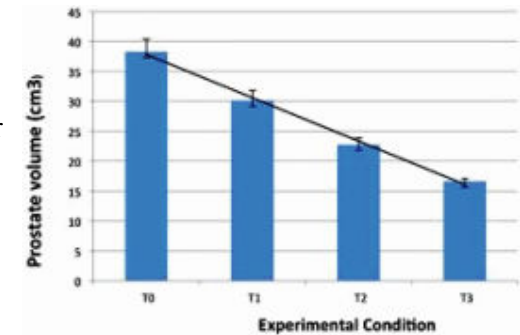
A trip to the urologist results in bad news: a recommendation for surgery to treat your enlarged prostate (technically known as benign prostatic hyperplasia or BPH). A bit of Internet research on the proposed "transurethral resection of the prostate" makes you even more concerned – this surgery can result in sexual dysfunction and even impotence. Aren't there non-invasive options to treat an enlarged prostate? A number of drugs can treat BPH but their side effects are worrisome.

A recent study on dogs with BPH offers hope. Just published in the online version of *The Prostate*, and coming out in print in August, researchers from the University

of Bari, Italy report that pulsed electromagnetic field therapy – or PEMF – significantly reduced the size of the prostate starting after just one week of treatment. It is totally non-invasive, drug-free and the treatment is quick and painless. Finally, an alternative to surgery could be on the horizon!

### **BENIGN PROSTATIC HYPERPLASIA (BPH)**

If you are a man over 50, you probably already know about BPH. It's one of the most frequently diagnosed medical disorders in older men, affecting quality of life for a third of men over 50. And it gets even more common as men age. BPH can result in serious problems over time, including frequent urinary tract infections, sexual dysfunction, the inability to urinate at all, and even bladder stones. In the U.S. alone, we spend \$3.9 billion annually on its complications.



***Decrease in prostate volume in 20 dogs treated with pulsed electromagnetic field therapy.***

***T0=baseline, T1-T3=weeks 1-3 after treatment. Prostate volume was significantly lower than baseline at each week of treatment. Leoci, et al., 2014***

"Benign prostatic hyperplasia is an important and under-recognized health issue for men. There is a great need for development of effective and safe alternatives to current treatment options," noted Abraham Morgentaler, MD, FACS, Director of Men's Health Boston and Associate Clinical Professor of Urology at Harvard Medical School.

### **TREATMENT WITH PEMF**

Pulsed electromagnetic field therapy is very low frequency pulsed energy waves, also described as a weak non-thermal electromagnetic field.

PEMF is often used to speed recovery or to reduce post-surgical side effects. The energy comes from a handheld device – a little wider than a TV remote control – and is simply placed over the affected area. It has been used safely and effectively in humans for other conditions, such as circulatory problems, although exactly how it works is still unknown.

The lead scientist on the study, Dr. Raffaella Leoci, says "Previous studies have suggested that reduced blood flow to the prostate gland and resulting inflammation contribute to the development of BPH. We know that PEMF has positive effects on similar conditions, so we thought it might also heal BPH or maybe even prevent BPH from developing."

Just as in men, older male dogs often get BPH. According to VetSci, more than 80% of unneutered male dogs over 5 years old have BPH. Many cases go undiagnosed until the owner notices bloody urine. BPH may even result in obstruction of the colon in dogs, which may prevent defecation.

Scientists treated 20 affected dogs with PEMF for 5 minutes, twice a day, for three weeks. The size of the prostate gland decreased on average by 57% over the course of treatment, an impressive result. The researchers also found no side effects or impact on libido, semen quality, or testosterone levels.

"Traditionally, dogs affected by symptomatic BPH were treated like men, using drugs or surgery," explains Dr. Leoci. "Reproduction becomes impossible as both therapies, pharmacological or surgical, arrest the production of testosterone. This can be a problem for working or breeding dogs."

By contrast, the PEMF therapy did not affect reproduction. She adds that, "Dogs are not stressed by the therapy. Since it's applied as if it were a belly rub, dogs accept the PEMF application as a relaxing moment with the owner."

#### **NEXT STEPS**

Will men with BPH soon be able to get relief using PEMF treatment?

"Many men are interested in minimally invasive therapies for lower urinary tract symptoms," noted Alan Shindel, MD, Assistant Professor of Urology at UC Davis Health System. "It would be great to have a new option such as pulsed electromagnetic field therapy for BPH. This preliminary study in an animal model is promising, but more research is needed to determine how effective (and safe) this procedure would be in human men."

<http://nyti.ms/1yUpjFh>

### **Oral Vaccine for Cholera Found Effective in Africa**

*A new, inexpensive, easy-to-use cholera vaccine that is stockpiled for emergencies worked very well during a cholera outbreak in Africa, Doctors Without Borders reported recently.*

By DONALD G. McNEIL Jr.

Two doses of the oral vaccine called Shanchol, invented in Vietnam and produced in India, provided 86 percent protection against cholera, which causes diarrhea and dehydration so severe that it can kill, a study published in The New England Journal of Medicine last month found.

The study was done by Epicentre, the research arm of Doctors Without Borders, and the Health Ministry of Guinea, during a large 2012 outbreak there. More than 316,000 doses were given out, and about 75 percent of the residents of cholera-affected areas got two doses, which is good coverage for an outbreak already underway.

Two vaccines have been stockpiled by the World Health Organization since 2013. But the older vaccine, Dukoral, made by a subsidiary of Johnson & Johnson, was invented mostly for the wealthy travel market.

Dukoral costs over \$5 a dose and must be given with a glass of alkaline soda as a buffer against stomach acid. Carrying soda and clean cups slows vaccinators down. Shanchol, which costs less than \$2, comes in a vial smaller than an energy shot. It was developed with support from the Bill and Melinda Gates Foundation, and its maker, Shantha Biotechnics, has said that large orders could push the price below \$1 a dose.

It took until 2010 for the W.H.O. to accept the idea of fighting cholera with vaccines, "but now that seems mostly from the school of the overwhelmingly obvious," said Rebecca F. Grais, Epicentre's epidemiology director and an author of the study.

<http://nyti.ms/TDYUuA>

### **Herpes Infected 'Since Before We Were Human'**

*HSV-1 and HSV-2 have been infecting humans longer than six million years*

By DOUGLAS QUENQUA

About two-thirds of people are infected with one of two herpes simplex viruses, oral (HSV-1) or genital (HSV-2). New research says both viruses have been infecting humans and our ancestors for longer than previously thought. HSV-1 has been infecting hominids since before they split from the chimpanzee lineage six million years ago, a new study says. HSV-2 was introduced more recently, the researchers said, making the jump from chimpanzees to human ancestors about 1.6 million years ago.

"If you think of humans as Homo sapiens proper, then both viruses have been with us since before we were human," said Joel O. Wertheim, a virologist at the University of California, San Diego, and lead author of the study.

Dr. Wertheim and his colleagues set out to discover why humans are the only primates known to contract two different simplex viruses (most are limited to one). They compared the HSV-1 and HSV-2 gene sequences to the family tree of simplex viruses from eight monkey and ape host species, including chimpanzees and baboons. Taking into account the effect of natural selection on viral evolution, they were able to pinpoint when both HSV-1 and HSV-2 split from the other primate strains.

While the findings, which were published in the journal *Molecular Biology and Evolution*, may not have much impact on herpes treatment, they could provide perspective on how viruses are introduced to humans, Dr. Wertheim said.

"We know a lot about viruses that have jumped in recently," he said, "and it's useful to have a point of comparison."

<http://bit.ly/1lvYiLY>

## Half the Natural Gas Extracted in America Now Comes from Shale

### *Shale gas is growing in importance faster than anyone expected*

By Colin Schultz

The shale gas boom, spurred by fracking and horizontal drilling, is bigger than anyone thought it would be. According to the U.S. Energy Information Administration, natural gas derived from shale now makes up a full half of U.S. natural gas production, says Scientific American. Shale gas wasn't supposed to make up such a large portion of our gas supply for another ten to twenty years. Almost all of the natural gas produced in the U.S. is burned in the U.S., and the development of technologies to pull gas from shale has created a glut of cheap energy.\* America's cheap gas is drawing foreign companies to U.S. soil, and it's helping the country hit carbon emissions reductions targets. Shale gas' rising significance is partly due to increasing amounts of the gas being extracted and partly due to declining production from other sources of gas.

Earlier this month the Environmental Protection Agency proposed new rules to help fight climate change. The draft rules outline how states will need to cut the carbon emissions coming from the energy sector by 30 percent below 2005 emissions levels.

At the time, journalists pointed out that the recent widespread turn within the American energy sector to burning natural gas rather than coal means that, for many places, carbon emissions have already dropped by as much as 15 percent below 2005 levels. The gas glut has already helped the U.S. energy sector halfway to the EPA's proposed goal.

Continued production of this cheap gas is key to the EPA's carbon reduction plan, says Scientific American. Like it or not, fracking, horizontal drilling and the shale gas boom are now a core component of America's energy system. But the idea that such a heavy reliance on shale gas can (or should) last has its own problems. Some of the best-producing wells are already facing depletion, says Scientific American, and as the gas gets harder to extract prices could go up. Fracking and shale gas also have their own issues, largely environmental, which Smart News has explored previously.

[http://www.eurekalert.org/pub\\_releases/2014-06/uob-bpf062414.php](http://www.eurekalert.org/pub_releases/2014-06/uob-bpf062414.php)

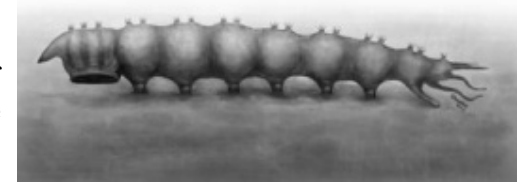
### **Bizarre parasite from the Jurassic**

*Researchers from the University of Bonn and from China have discovered a fossil fly larva with a spectacular sucking apparatus*

Around 165 million years ago, a spectacular parasite was at home in the freshwater lakes of present-day Inner Mongolia (China): A fly larva with a thorax formed entirely like a sucking plate. With it, the animal could adhere to salamanders and

suck their blood with its mouthparts formed like a sting. To date no insect is known that is equipped with a similar specialised design. The international scientific team is now presenting its findings in the journal "eLIFE".

The parasite, an elongate fly larva around two centimeters long, had undergone extreme changes over the course of evolution: The head is tiny in comparison to the body, tube-shaped with piercer-like mouthparts at the front. The mid-body (thorax) has been completely transformed underneath into a gigantic sucking plate; the hind-body (abdomen) has caterpillar-like legs. The international research team believes that this unusual animal is a parasite which lived in a landscape with volcanoes and lakes what is now northeastern China around 165 million years ago. In this fresh water habitat, the parasite crawled onto passing salamanders, attached itself with its sucking plate, and penetrated the thin skin of the amphibians in order to suck blood from them.



*Unusual parasite: the head of Qiyia jurassica is tiny in comparison to the body with tube-shaped and piercer-like mouthparts at the front. The thorax onto which the abdomen with the caterpillar-like legs is connected has been transformed into a sucking plate underneath.* Graphic: Yang Dinghua, Nanjing

"The parasite lived the life of Reilly", says Prof. Jes Rust from the Steinmann Institute for Geology, Mineralogy and Palaeontology of the University of Bonn. This is because there were many salamanders in the lakes, as fossil finds at the same location near Ningcheng in Inner Mongolia (China) have shown. "There scientists had also found around 300,000 diverse and exceptionally preserved fossil insects", reports the Chinese scientist Dr. Bo Wang, who is researching in palaeontology at the University of Bonn as a PostDoc with sponsorship provided by the Alexander von Humboldt Foundation. The spectacular fly larva, which has received the scientific name of "Qiyia jurassica", however, was a quite unexpected find. "Qiyia" in Chinese means "bizarre"; "jurassica" refers to the Jurassic period to which the fossils belong.

A fine-grained mudstone ensured the good state of preservation of the fossil. For the international team of scientists from the University of Bonn, the Linyi University (China), the Nanjing Institute of Geology and Palaeontology (China), the University of Kansas (USA) and the Natural History Museum in London (England), the insect larva is a spectacular find: "No insect exists today with a comparable body shape", says Dr Bo Wang. That the bizarre larva from the Jurassic has remained so well-preserved to the present day is partly due to the fine-grained mudstone in which the animals were embedded. "The finer the sediment, the better

the details are reproduced in the fossils", explains Dr Torsten Wappler of the Steinmann-Institut of the University of Bonn. The conditions in the groundwater also prevented decomposition by bacteria.

Astonishingly, no fossil fish are found in the freshwater lakes of this Jurassic epoch in China. "On the other hand, there are almost unlimited finds of fossilised salamanders, which were found by the thousand", says Dr Bo Wang. This unusual ecology could explain why the bizarre parasites survived in the lakes: fish are predators of fly larvae and usually hold them in check. "The extreme adaptations in the design of *Qiyia jurassica* show the extent to which organisms can specialise in the course of evolution", says Prof. Rust.

As unpleasant as the parasites were for the salamanders, their deaths were not caused by the fly larvae. "A parasite only sometimes kills its host when it has achieved its goal, for example, reproduction or feeding", Dr Wappler explains. If *Qiyia jurassica* had passed through the larval stage, it would have grown into an adult insect after completing metamorphosis. The scientists don't yet have enough information to speculate as to what the adult it would have looked like, and how it might have lived.

Publication: *Extreme adaptations for aquatic ectoparasitism in a Jurassic fly larva*, "eLIFE" journal, DOI: 10.7554/elife.02844

[http://www.eurekalert.org/pub\\_releases/2014-06/ku-ctr062414.php](http://www.eurekalert.org/pub_releases/2014-06/ku-ctr062414.php)

## **Cancer: The roots of evil go deep in time**

### ***Discovery of a primordial cancer in a primitive animal***

Every year around 450,000 people in Germany are diagnosed with cancer. Each one of them dreams of a victory in the battle against it. But can cancer ever be completely defeated? Researchers at Kiel University (CAU) have now reached a sobering conclusion: "cancer is as old as multi-cellular life on earth and will probably never be completely eradicated", says Professor Thomas Bosch in his latest research results. The study by an international team led by Bosch was published today (Monday, June 24) in the prestigious scientific journal *Nature Communications*.

### **The so-called cancer genes are ancient**

The causes of tumours are the so-called cancer genes. As from when evolution started producing tumours is an issue that the scientists Tomislav Domazet-Lošo and Diethard Tautz from the Max Planck Institute for Evolutionary Biology in Plön have been investigating for several years, using bio-informational methods and databases that they have developed in-house. "During the search for the origin of the cancer gene, we unexpectedly made a discovery in the ancient group of animals", explains Domazet-Lošo. He is one of the authors of the present study and is currently working at the Ruder Bošković Institute and the Catholic University of

Croatia in Zagreb. "Our data predicted that the first multi-cellular animals already had most of the genes which can cause cancer in humans." What was missing until now was, on the one hand, evidence that these animals can actually suffer from tumours and, on the other, the molecular understanding of the mechanisms of tumour formation in these simple animals.

### **Cause of tumours: error in the programming of cell death**

The research team led by the evolutionary biologist Professor Thomas Bosch from the Zoological Institute of Kiel University have now achieved an impressive understanding of the roots of cancer. Bosch has been investigating stem cells and the regulation of tissue growth in *Hydra*, a phylogenetic old polyp, for many years. "Now we have discovered tumour-bearing polyps in two different species of *Hydra*, an organism very similar to corals", emphasises Bosch regarding the first result of the new study. This provides proof that tumours indeed exist in primitive and evolutionary old animals.

The team also tracked down the cellular cause of the tumours along the entire body axis. For the first time they were able to show that the stem cells, which are programmed for sex differentiation, accumulate in large quantities and are not removed naturally by programmed cell death. Interestingly, these tumours affect only female *Hydra* polyps and resemble ovarian cancers in humans.



**Image caption: Tumour-bearing Hydra-Polyp (right) next to a healthy animal (left). Klimovich/ CAU**

"When undertaking more detailed molecular analyses of the tumours we found a gene that becomes active dramatically in tumour tissue and that normally prevents the programmed cell death", explains Alexander Klimovich, a scholarship student at the Alexander-von-Humboldt Foundation at the Zoological Institute of Kiel University and co-lead author of the current study regarding the second finding of the study. "As a non-functioning cell death mechanism is also made responsible for the growth and spread of tumours in many types of human cancer, striking similarities appear here to cancer in humans", continues Klimovich.

The third finding of the scientists was to show that tumour cells are invasive. This means that if tumour cells are introduced into a healthy organism, they can trigger tumour growth there. Therefore Bosch reaches the following conclusion from his research into *Hydra* species: "The invasive characteristic of cancer cells is also an evolutionary old feature."

## Tumours have deep roots in evolution

The funds that are being deployed throughout the world in the campaign against cancer are enormous. It was estimated that in the US alone, more than 500 billion dollars were invested in cancer research by 2012. The worldwide research has led to improved preventative, diagnostic and treatment methods, which can definitely record successes. However it is precisely as far as some frequent tumours are concerned where only slow progress has been achieved. Every second person affected by cancer still succumbs to the disease today. In Germany alone every fourth person dies of cancer and this trend is rising. (World Cancer Report 2014) These figures were an incentive for the National Institute of Health in the US to launch a network of Physical Science-Oncology Centers, a new initiative that seeks to bridge intellectual barriers between diverse scientific disciplines. Paul Davies, a well-known theoretical physicist and popular science writer who now leads one such center in Phoenix, Arizona, recently concluded: "Clearly, we will fully understand cancer only in the context of biological history." (The Guardian, 2012) According to the research team led by Bosch, the findings of primordial tumours in Hydra are a breakthrough step in that direction: "Our research reconfirms that primordial animals such as Hydra polyps provide an enormous amount of information to help us understand such complex problems as 'cancer'. Our study also makes it unlikely that the 'War on Cancer' proclaimed in the 1970s can ever be won. However, knowing your enemy from its origins is the best way to fight it, and win many battles", says Bosch.

*Original publication:*

Tomislav Domazet-Lošo, Alexander Klimovich, Boris Anokhin, Friederike Anton-Erxleben, Mailin J. Hamm, Christina Lange & Thomas C.G. Bosch (2014) Naturally occurring tumours in the basal metazoan Hydra. *Nature Communications*

[http://www.eurekalert.org/pub\\_releases/2014-06/nlmc-tac062314.php](http://www.eurekalert.org/pub_releases/2014-06/nlmc-tac062314.php)

## To advance care for patients with brain metastases: Reject five myths

*Leading experts from renowned academic centers join in one voice to encourage new perspectives in addressing brain cancer*

New York, NY – A blue-ribbon team of national experts on brain cancer says that professional pessimism and out-of-date "myths," rather than current science, are guiding - and compromising - the care of patients with cancers that spread to the brain.

In a special article published in the July issue of *Neurosurgery*, the team, led by an NYU Langone Medical Center neurosurgeon, argues that many past, key clinical trials were designed with out-of-date assumptions and the tendency of some physicians to "lump together" brain metastases of diverse kinds of cancer, often

results in less than optimal care for individual patients. Furthermore, payers question the best care when it deviates from these misconceptions, the authors conclude.

"It's time to abandon this unjustifiable nihilism and think carefully about more individualized care," says lead author of the article, Douglas S. Kondziolka, M.D., MSc, FRCSC, Vice Chair of Clinical Research and Director of the Gamma Knife Program in the Department of Neurosurgery at NYU Langone. The authors - who also say medical insurers help perpetuate the myths by denying coverage that deviates from them - identify five leading misconceptions that often lead to poorer care:

- 1. All tumor cell types act the same way once they spread to the brain. This oversimplification means that doctors assume that histologically diverse cancers respond the same way to chemotherapy and are equally sensitive (or insensitive) to radiation. It also means that patients are all assumed to be at the same risk of subsequent brain cancer relapses, and development of additional metastatic lesions; and that survival rates are similar as well. The authors point out that this type of thinking overlooks important biological differences in brain metastases resulting from different types of cancer, such as those originating in the lung, breast or skin.***
- 2. The number of brain metastases is the best indicator for guiding management of the disease. Such strict adherence to quantity, the authors say, can wrongly limit treatment options. Physicians should look at total tumor burden, including the size and scope of metastases, rather than just how many metastases occur.***
- 3. All cancers detectable in the brain already reflect the presence of micrometastases, or smaller, newly formed tumors too miniscule to detect. Evidence, the authors say, suggests otherwise, and aggressively monitoring for, and treating, individual brain metastases can, in fact, improve tumor control and patient survival.***
- 4. Whole brain radiation (WBR) is generally unjustified because it will cause disabling cognitive dysfunction if a patient lives long enough. Dr. Kondziolka and his co-authors say the risks and benefits of WBR should be evaluated for each patient, and that new studies examining the cognitive impact of WBR on thinking and learning are underway.***
- 5. Most brain metastases cause obvious symptoms, making regular screening for them unnecessary, and unlikely to affect survival. The authors counter that advances in screening allow metastases to be detected earlier, and treated sooner, before symptoms occur.***

"We are in an era of personalized medicine," Dr. Kondziolka says, "and we need to begin thinking that way." The authors further write: "It is time for fresh thinking and new critical analyses," urging consideration of updated clinical trial designs that include comparison of matched cohorts and cost effectiveness factors. In addition to research that pays more attention to specific cell types and overall tumor burden, investigators should focus on tools available from advances in molecular biology and genetic subtyping and on efforts to learn "why some patients with a



given primary cancer develop brain tumors and others do not." Ultimately, the authors hope better stratifying patients will improve care for patients with diverse brain metastases.

*In addition to Dr. Kondziolka from NYU Langone Medical Center, the co-authors represent other major academic medical centers with national reputations in the field of neurosurgery, radiation oncology and neuro-oncology: Steven Kalkanis, MD (Henry Ford Health System), Minesh Mehta, MD (University of Maryland Medical Center), Manmeet Ahluwalia, MD (Cleveland Clinic) and Jay Loeffler, MD (Harvard Medical School).*

[http://www.eurekalert.org/pub\\_releases/2014-06/ps-vkt062414.php](http://www.eurekalert.org/pub_releases/2014-06/ps-vkt062414.php)

### **Virus kills triple negative breast cancer cells, tumor cells in mice** *A virus not known to cause disease kills triple-negative breast cancer cells and killed tumors grown from these cells in mice*

A virus not known to cause disease kills triple-negative breast cancer cells and killed tumors grown from these cells in mice, according to Penn State College of Medicine researchers. Understanding how the virus kills cancer may lead to new treatments for breast cancer.

Adeno-associated virus type 2 (AAV2) infects humans but is not known to cause sickness. In prior studies, the researchers tested the virus on a variety of breast cancers that represent degrees of aggressiveness and on human papillomavirus-positive cervical cancer cells. The virus initiated apoptosis - natural cell death - in cancer cells without affecting healthy cells.

"Treatment of breast cancer remains difficult because there are multiple signaling pathways that promote tumor growth and develop resistance to treatment," said Craig Meyers, Ph.D., Distinguished Professor of Microbiology and Immunology. Signaling pathways involve molecules in a cell that control cell functions - such as cell division - by cooperation. For example, the first molecule in the process receives a signal to begin. It then tells another molecule to work, and so on.

Treatment of breast cancer differs by patient due to differences in tumors. Some tumors contain protein receptors that are activated by the hormones estrogen or progesterone. Others respond to another protein called human epidermal growth factor receptor 2, or HER2. Each of these is treated differently.

A triple-negative breast cancer does not have any of these protein receptors and is typically aggressive.

"There is an urgent and ongoing need for the development of novel therapies which efficiently target triple-negative breast cancers," Meyers said. In the current study, the researchers tested AAV2 on a cell-line representative of triple-negative breast cancer. The researchers report their results in *Cancer Biology & Therapy*.

The AAV2 killed 100 percent of the cells in the laboratory by activating proteins called caspases, which are essential for the cell's natural death. In addition,

consistent with past studies, AAV2-infected cancer cells produced more Ki-67, an immunity system activating protein and c-Myc, a protein that helps both to increase cell growth and induce apoptosis. The cancer cell growth slowed by day 17 and all cells were dead by day 21. AAV2 mediated cell killing of multiple breast cancer cell lines representing both low and high grades of cancer and targeted the cancer cells independent of hormone or growth factor classification.

The researchers then injected AAV2 into human breast cancer cell line-derived tumors in mice without functioning immune systems. Mice that received AAV2 outlived the untreated mice and did not show signs of being sick, unlike the untreated mice. Tumor sizes decreased in the treated mice, areas of cell death were visible and all AAV2 treated mice survived through the study, a direct contrast to the untreated mice.

"These results are significant, since tumor necrosis - or death - in response to therapy is also used as the measure of an effective chemotherapeutic," Meyers said. Future studies should look at the use of AAV2 body-wide in mice, which would better model what happens in humans, according to Meyers.

*Other researchers on this project are Samina Alam, research associate, Penn State; Brian Bowser, PPD Vaccines and Biologics Laboratory; Mohd Israr, Feinstein Institute for Medical Research; and Michael Conway, Central Michigan University College of Medicine. The Pennsylvania Breast Cancer Coalition funded this research.*

<http://bit.ly/1rHfyFu>

### **Alzheimer's Could Be a Form of Down Syndrome** *Scientists are studying them together to find underlying causes*

Jun 17, 2014 | By Lisa Marshall

Is Alzheimer's disease an acquired form of Down syndrome? When neurobiologist Huntington Potter first posed the question in 1991, Alzheimer's researchers were skeptical. They were just beginning to explore the causes of the memory-robbing neurological disease. Scientists already knew that by age 40, nearly 100 percent of patients with Down syndrome, who have an extra copy of chromosome 21, had brains full of beta-amyloid peptide - the neuron-strangling plaque that is a hallmark of Alzheimer's. They also knew that the gene that codes for that protein lives on chromosome 21, suggesting that people acquire more plaque because they get an extra dose of the peptide. Potter, though, suggested that if people with Down syndrome develop Alzheimer's because of an extra chromosome 21, healthy people may develop Alzheimer's for the same reason. A quarter of a century later mounting evidence supports the idea.

"What we hypothesized in the 1990s and have begun to prove is that people with Alzheimer's begin to make molecular mistakes and generate cells with three copies of chromosome 21," says Potter, who was recently appointed director of

Alzheimer's disease research at the University of Colorado School of Medicine, with the express purpose of studying Alzheimer's through the lens of Down syndrome.

He is no longer the only one exploring the link. In recent years dozens of studies have shown Alzheimer's patients possess an inordinate amount of Down syndrome-like cells. One 2009 study by Russian researchers found that up to 15 percent of the neurons in the brains of Alzheimer's patients contained an extra copy of chromosome 21. Others have shown Alzheimer's patients have 1.5 to two times as many skin and blood cells with the extra copy as healthy controls. Potter's own research in mice suggests a vicious cycle: when normal cells are exposed to the beta-amyloid peptide, they tend to make mistakes when dividing, producing more trisomy 21 cells, which, in turn, produce more plaque. In August, Potter and his team published a paper in the journal *Neurobiology of Aging* describing why those mistakes may occur: the inhibition of a specific enzyme.

Meanwhile University of Kentucky researchers have been collecting brain scans, blood tests and lifestyle surveys from dozens of adults with Down syndrome over the past five years. They aim to understand why - even though nearly all patients develop plaque - only 60 to 80 percent develop dementia.

National Institutes of Health director Francis Collins recently told a Senate subcommittee that there is "intense interest" in studying the two conditions together. And in 2013 the Alzheimer's Association teamed up with the Linda Crnic Institute for Down Syndrome to fund work examining the link.

In general, by studying Alzheimer's in a smaller population guaranteed to develop the pathology, scientists can learn more, faster, says Dean Hartley, director of science initiatives for the Alzheimer's Association. He and others say it is too early to conclude that Alzheimer's is indeed a form of Down syndrome: "But we need new ideas like this in the field to help us better understand the underlying pathways of the disease."

<http://dnainfo.com/1sKq17s>

## 'Elixir of Long Life' Recreated From 1800s Bottle Unearthed on Bowery

*Archaeologists tracked down the German recipe after finding a tiny glass bottle beneath a Bowery site.*

By Irene Plagianos on June 16, 2014 6:39am

Lower East Side - Archaeologists have dug up a 19th-century recipe for fending off death. During a recent excavation beneath a hotel site at 50 Bowery, Chrysalis Archaeology discovered a tiny, greenish glass bottle that once contained the "Elixir of Long Life."

The bottle found amid a cache of 150-year-old liquor bottles beneath what was once a German beer garden sparked the archaeologists' curiosity, and they decided to hunt down the original recipe so they could try the elixir themselves.

"We decided to engage in our own brand of experimental archaeology," said Alyssa Loorya, the president of Chrysalis, a company regularly hired by the city to oversee excavation projects. "We wanted to know what this stuff actually tasted like."



**Elixir of Long Life** *The finished elixir, bright orange from the saffron and turmeric, sits next to the original bottle of the elixir found at 50 Bowery. It's garnished with the tip of an aloe leaf - one of the ingredients in the bitter drink. It's likely that only a few drops are meant to be consumed at a time.* DNAinfo/Irene Plagianos, Chrysalis

Loorya enlisted colleagues in Germany to help her track down the recipe in a 19th-century medical guide. After they translated it for her, she discovered it contained ingredients still used by modern-day herbalists: aloe, which is anti-inflammatory, and gentian root, which aids digestion. Mostly, though, the elixir was made of alcohol.

"These types of cure-alls were pretty ubiquitous in the 19th century, and always available at bars," Loorya said. "Similar bitters and ingredients are still used today, in cocktails, and in health stores, but I guess we don't know if it was the copious amounts of alcohol or the herbs that perhaps made people feel better."

Loorya and her team are gathering the ingredients for the elixir and plan to try making it within the next couple of weeks.

They also plan to recreate Dr. Hostetters Stomach Bitters, a once-popular 19th-century medicine, after finding two of those bottles at the 50 Bowery site and seeking out that recipe as well.

The Hostetters recipe is a bit more complex, containing Peruvian bark, also known as cinchona, which is used for its malaria-fighting properties and is still used to make bitters for cocktails, and gum kino, a kind of tree sap that is antibacterial. It also contains more common ingredients, including cinnamon and cardamom seeds, which are known to help prevent gas.

When DNAinfo New York showed the recipes to herbalist Lata Kennedy, who's owned the East Village herb shop Flower Power for 19 years, she said many are still used to naturally treat ailments.

"All those ingredients are about your digestive health, and that's really a key to good health in general," Kennedy said of both the Elixir of Life and Hostetters recipes. "Those ingredients make a liver tonic, one that soothes your stomach, and also helps you poop - get out the toxins."

Using alcohol to extract the beneficial properties of herbs and roots is still a common practice used by herbalists today, Kennedy said. She sells many of the ingredients used in the recipes, both in raw form and alcohol-based tinctures, and she believes they improve people's health - and could even prolong their life.

"Long life has a lot to do with how healthy our guts are, so it makes sense to see these used back then," she said. "We should all be eating more bitters."

Chris Marshall, a bartender at Apotheke in Chinatown, agrees.

He specializes in creating cocktails inspired by the apothecaries of yore, and said the Dr. Hostetters recipe is not far off from some of the bar's own bitters blends - as well as those commonly used by liquor brands Aperol and Angostura.

"With the rise in popularity of the cocktails in general, you've seen a resurgence in the use of bitters," Marshall said. "They add an interesting flavor to cocktails, but there's a reason there's a long history of these bitters - they've been used as digestives for centuries in countries around the world."

Since Marshall started using bitters made from ingredients like orange peel and rhubarb, he has taken to using them for their original medicinal purposes, mixing them with soda water to drink before he eats a meal.

"Most people probably like them in cocktails for the flavor, but I think there's something to the digestive benefits," Marshall said.

Here are the two recipes Loorya's team discovered, with a couple of caveats. She's not sure how much people drank at a time, but the Elixir of Life bottle the archaeologists found could hold less than an ounce. Also, the quantities are approximate, and the raw ingredients can be substituted with either powdered or alcohol-based versions.

### **Elixir of Long Life:**

*Aloes - 13 grams*

*Rhubarb - 2.3 grams*

*Gentian - 2.3 grams*

*Zedoary (white turmeric) - 2.3 grams*

*Spanish saffron - 2.3 grams*

*Water - 4 ounces*

*Grain alcohol (vodka, gin) - 12 ounces*

Squeeze out the liquid from the aloe and set aside. Crush the rhubarb, gentian, zedoary and Spanish saffron (for a modern twist, use a blender for this part), and mix them with the aloe liquid, water and alcohol. Let the mixture sit for three days,

shaking frequently. Then filter it using a cheesecloth or coffee filter, and serve. Be careful with the liquid - the saffron can dye your hands or other kitchen items.

### **Dr. Hostetters Stomach Bitters:**

*Gentian root - 1 1/2 ounces*

*Orange peel - 2 1/2 ounces*

*Cinnamon - 1/4 ounce*

*Anise - 1/2 ounces*

*Coriander seed - 1/2 ounce*

*Cardamom seed - 1/8 ounce*

*Un-ground Peruvian bark (cinchona) - 1/2 ounce*

*Gum kino - 1/4 ounce*

*Grain alcohol (vodka, gin) - 1 quart*

*Water - 4 quarts*

*Sugar - 1 pound*

Mash together the gentian, orange peel, cinnamon, anise, coriander, cardamom and Peruvian bark. Mix the crushed ingredients with the gum kino and the alcohol. Let the mixture sit in a closed container for two weeks, shaking occasionally. Strain the mixture, add the sugar and water to the strained liquid and serve.

[http://www.eurekalert.org/pub\\_releases/2014-06/p-ohp062014.php](http://www.eurekalert.org/pub_releases/2014-06/p-ohp062014.php)

### **Oldest human poop provides dietary insights**

*Neanderthals from Spain may have consumed more vegetables than previously thought*

Neanderthals from Spain may have consumed more vegetables than previously thought, according to research published June 25 in the open access journal PLOS ONE by Ainara Sistiaga from Massachusetts Institute of Technology and University of La Laguna and colleagues.

Neanderthal diet reconstruction remains difficult. Current methods of dietary analysis use isotopes and focus on the role of meat in the diet, which may be overemphasized. For instance, some evidence suggests that plants may have contributed to their diet. To better understand contributions to the Neanderthal diet, the authors of this study used analytical techniques to quantify faecal biomarkers from five samples found in El Salt, Spain, dating back to about 50,000 years ago. These biomarkers can help researchers identify dietary sources by the way dietary sterols are broken down in the mammalian gut.

The samples in this study may be the oldest known human faecal matter. The analysis suggests that Neanderthals predominantly consumed meat, as indicated by high proportions of a one faecal biomarker formed by the bacterial reduction of cholesterol in the gut (coprostanol), but the authors also found evidence of significant plant intake, as shown by the presence of a compound often found in

plant sources (5 $\beta$ -stigmastanol). In support of the finding, microscopic examination of sediment from the same context yielded the identification of human coprolites. The authors hope that future studies using this biomarker approach may provide further insights into the role of vegetables in the Neanderthal diet.

Ainara Sistiaga added, "This study represents the first approach to Neanderthal diet through the analysis of fecal markers found in archaeological sediment."

*In your coverage please use this URL to provide access to the freely available paper:*

<http://dx.plos.org/10.1371/journal.pone.0101045>

*Citation: Sistiaga A, Mallol C, Galvan B, Summons RE (2014) The Neanderthal Meal: A New Perspective Using Faecal Biomarkers. PLOS ONE 9(6): e101045.*

*doi:10.1371/journal.pone.0101045*

*Funding: Archaeological research at El Salt is funded by the Spanish Government I+D project (HAR2012-32703 MEC-FEDER), and a Canarian Government predoctoral grant and EAOG travel award to A.S. Research at MIT was supported by a grant (NNA13AA90A) from the NASA Astrobiology Institute to R.E.S. The funders had no role in study design, data collection and analysis, decision to publish, or preparation of the manuscript.*

*Competing Interest: The authors have declared that no competing interests exist.*

[http://www.eurekalert.org/pub\\_releases/2014-06/mu-suw062314.php](http://www.eurekalert.org/pub_releases/2014-06/mu-suw062314.php)

## Scientists unearth what may be secret weapon against antibiotic resistance

### *Fungus Nova Scotia soil offers hope in battling drug-resistant germs*

HAMILTON, ON - A fungus living in the soils of Nova Scotia could offer new hope in the pressing battle against drug-resistant germs that kill tens of thousands of people every year, including one considered a serious global threat.

A team of researchers led by McMaster University has discovered a fungus-derived molecule, known as AMA, which is able to disarm one of the most dangerous antibiotic-resistance genes: NDM-1 or New Delhi Metallo-beta-Lactamase-1, identified by the World Health Organization as a global public health threat.

"This is public enemy number one," explains Gerry Wright, director of the Michael G. DeGroote Institute for Infectious Disease Research at McMaster University.

"It came out of nowhere, it has spread everywhere and has basically killed our last resource of antibiotics, the last pill on the shelf, used to treat serious infections," he says.

Discovering the properties of the fungus-derived molecule is critical because it can provide a means to target and rapidly block the drug-resistant pathogens that render carbapenem antibiotics - a class of drugs similar to penicillin - ineffective.

"Simply put, the molecule knocks out NDM-1 so the antibiotics can do their job," says Wright.

Seeking an answer to the riddle of resistance in the natural environment is a far more promising approach than trying to discover new antibiotics, a challenge which

has perplexed scientists for decades. No new classes of antibiotics have been discovered since the late 1980s, leaving physicians with very few tools to fight life-threatening infections.

"Not only do we have the emergence of an antibiotic resistance gene that is targeting the last drug resource we have left, but it is carried by organisms that cause all sorts of challenging diseases and are multi-drug-resistant already. It has been found not only in clinics but in the environment - in contaminated water in South Asia - which has contributed to its spread over the globe," explains Wright. "Our thinking was that if we could find a molecule that blocks NDM-1 then these antibiotics would be useful again."

Wright and his team from McMaster, University of British Columbia and Cardiff University in Wales created a sophisticated screening method to take the NDM-1 gene, combine it with harmless E. coli bacteria and then isolate a molecule capable of stopping NDM-1 in its tracks.

NDM-1 requires zinc to thrive but finding a way to remove zinc from it without causing a toxic effect in humans was a daunting task, until the discovery of the fungal molecule, which appears to perform the job naturally and harmlessly. Scientists then tested the theory on mice infected with an NDM-1 expressing superbug. The mice that received a combination of the AMA molecule and a carbapenem antibiotic survived, while those that received either an antibiotic or AMA alone to fight the infection did not survive.

"This will solve one aspect of a daunting problem. AMA rescues the activity of carbapenem antibiotics, so instead of having no antibiotics, there will be some," says Wright. "This is a made-in-Canada solution for a global problem."

"Antibiotic resistance may be the most urgent and perplexing challenge facing health-care researchers today," says Dr. John Kelton, dean of the Michael G. DeGroote School of Medicine and vice-president of the Faculty of Health Sciences at McMaster. "This research provides new hope by showing us a completely new way to approach this problem, and none too soon, given the growing risk that superbugs pose to all of us."

The findings are published online in the current edition of the journal Nature. "Antibiotic resistance is one of the top public health concerns in Canada and internationally and it represents a research priority for the Canadian Institutes of Health Research (CIHR). It is exciting to see Canadian researchers finding innovative strategies to overcome antimicrobial resistance," says Dr. Marc Ouellette, scientific director of the CIHR Institute of Infection and Immunity.

*The research was funded in part by the Canadian Institute of Health Research, the Natural Sciences and Engineering Research Council and by Canada Research Chairs in Infectious Disease Pathogenesis and Antibiotic Biochemistry.*

[http://www.eurekalert.org/pub\\_releases/2014-06/tnam-whb062514.php](http://www.eurekalert.org/pub_releases/2014-06/tnam-whb062514.php)

## **Women having babies later in life more likely to live longer**

*Nested, case-control study confirms association between older maternal age at birth of last child and exceptional longevity*

CLEVELAND, Ohio - Women who had their children later in life will be happy to learn that a new study suggests an association between older maternal age at birth of the last child and greater odds for surviving to an unusually old age. That's according to a nested case-control study published online today in *Menopause*, the journal of The North American Menopause Society (NAMS).

In this study which used Long Life Family Study data, 311 women who survived past the oldest fifth percentile of survival (according to birth cohort-matched life tables) were identified as cases, along with 151 women who died at ages younger than the top fifth percentile of survival who were identified as controls. Looking at the cases of all 462 women, the study found a significant association for older maternal age, whereby women who had their last child beyond age 33 years had twice the odds for survival to the top fifth percentile of survival for their birth cohorts compared with women who had their last child by age 29 years. More specifically, women between the ages of 33 and 37 having their last child had an odds ratio of 2.08. The odds ratio for older women was 1.92.

Several previous studies had observed a similar association. For example, an analysis of New England Centenarian Study cohort data revealed that women who gave birth to a child after age 40 years had four times greater odds for being a centenarian compared with women from the same birth cohort who had their last child at a younger age.

In this latest study, it was observed that having more children (identified as three or more) tempered the association between increased maternal age and later survival. Mortality was not assessed for women who had no children.

According to the authors, the fact that numerous studies have documented the same relationship between older maternal age at birth and exceptional survival provides evidence for sustained reproductive fitness, with age as a selective force for genetic variants conducive to longer life.

"While this documented relationship is noteworthy, what is more meaningful is that these findings support the need to conduct additional studies that identify the various genetic influences on reproductive fitness, as these could also influence the rate of aging and a woman's susceptibility to age-related diseases," says NAMS Executive Director Margery Gass, MD.

*The study, "Extended maternal age at birth of last child and women's longevity in the Long Life Family Study," will be published in the January 2015 print edition of Menopause. The Long*

*Life Family Study was funded by the US National Institute on Aging/National Institutes of Health.*

[http://www.eurekalert.org/pub\\_releases/2014-06/uotm-ros062314.php](http://www.eurekalert.org/pub_releases/2014-06/uotm-ros062314.php)

## **Researchers 1 step closer to countering deadly Nipah virus**

*Human antibody therapy successfully combats virus 5 days after infection*

GALVESTON, Texas – An interdisciplinary research team from the University of Texas Medical Branch at Galveston, the Uniformed Services University of the Health Sciences and three groups within the National Institutes of Health reports a new breakthrough in countering the deadly Nipah virus. The human monoclonal antibody known as m102.4 is the first effective antiviral treatment for Nipah that has the potential for human therapeutic applications.

Nipah and the closely related Hendra virus are highly infectious agents that emerged from Pteropid fruit bats in the 1990s, causing serious disease outbreaks in a variety of domestic animals and humans in Australia, Malaysia, Singapore, Bangladesh and India. Recent Nipah outbreaks have resulted in acute respiratory distress syndrome and encephalitis, person-to-person transmission and greater than 90 percent fatality rates among people. These properties make both Nipah and Hendra viruses a concern to human and livestock health.

Previous studies conducted by these researchers have found that the patented m102.4 antibody therapy could protect nonhuman primates from a deadly Hendra infection. In a paper appearing in *Science Translational Medicine* on June 25, the group describes the human monoclonal antibody therapy that protected nonhuman primates from disease at several time points after Nipah exposure, including the onset of clinical illness in this lethal disease.

"What makes this study unique is that we have achieved complete protection against death even in animals that received treatment five days after being infected with the Nipah virus when they otherwise would have succumbed within 8-10 days of infection," according to UTMB professor Thomas Geisbert, first author of the paper. "This recent success of the antibody therapy against Nipah virus disease in a nonhuman primate is a key step towards its development as a therapeutic for use in people."

Christopher Broder, USU professor and Geisbert's fellow senior author, stated that because of the new data and previous work with this antibody with Hendra virus experiments, "there was sufficient interest for the Queensland government in Australia to initiate a phase I clinical safety trial with m102.4 that is set to commence later this year."

*Other authors of this paper include Chad Mire, Joan Geisbert, Krystle Agans, Karla Fenton and Katharine Bossart from UTMB; Yee-Peng Chan from USU; and Friederike Feldmann,*

Zhongyu Zhu, Dimiter Dimitrov, Dana Scott and Heinz Feldmann from NIH. This research was supported by the Department of Health and Human Services and the NIH.

[http://www.eurekalert.org/pub\\_releases/2014-06/uosc-usc062514.php](http://www.eurekalert.org/pub_releases/2014-06/uosc-usc062514.php)

## USC scientists create new battery that's cheap, clean, rechargeable... and organic

*Scientists at USC have developed a water-based organic battery that is long lasting, built from cheap, eco-friendly components.*

The new battery – which uses no metals or toxic materials – is intended for use in power plants, where it can make the energy grid more resilient and efficient by creating a large-scale means to store energy for use as needed.

"The batteries last for about 5,000 recharge cycles, giving them an estimated 15-year lifespan," said Sri Narayan, professor of chemistry at the USC Dornsife College of Letters, Arts and Sciences and corresponding author of a paper describing the new batteries that was published online by the Journal of the Electrochemical Society on June 20. "Lithium ion batteries degrade after around 1,000 cycles, and cost 10 times more to manufacture."

Narayan collaborated with Surya Prakash, Prakash, professor of chemistry and director of the USC Loker Hydrocarbon Research Institute, as well as USC's Bo Yang, Lena Hooper-Burkhardt, and Fang Wang.

"Such organic flow batteries will be game-changers for grid electrical energy storage in terms of simplicity, cost, reliability and sustainability," said Prakash.

The batteries could pave the way for renewable energy sources to make up a greater share of the nation's energy generation. Solar panels can only generate power when the sun's shining, and wind turbines can only generate power when the wind blows. That inherent unreliability makes it difficult for power companies to rely on them to meet customer demand.

With batteries to store surplus energy and then dole it out as needed, that sporadic unreliability could cease to be such an issue.

"'Mega-scale' energy storage is a critical problem in the future of the renewable energy, requiring inexpensive and eco-friendly solutions," Narayan said.

The new battery is based on a redox flow design – similar in design to a fuel cell, with two tanks of electroactive materials dissolved in water. The solutions are pumped into a cell containing a membrane between the two fluids with electrodes on either side, releasing energy.

The design has the advantage of decoupling power from energy. The tanks of electroactive materials can be made as large as needed – increasing total amount of energy the system can store – or the central cell can be tweaked to release that energy faster or slower, altering the amount of power (energy released over time) that the system can generate.

The team's breakthrough centered around the electroactive materials. While previous battery designs have used metals or toxic chemicals, Narayan and Prakash wanted to find an organic compound that could be dissolved in water. Such a system would create a minimal impact on the environment, and would likely be cheap, they figured.

Through a combination of molecule design and trial-and-error, they found that certain naturally occurring quinones – oxidized organic compounds – fit the bill. Quinones are found in plants, fungi, bacteria, and some animals, and are involved in photosynthesis and cellular respiration. "These are the types of molecules that nature uses for energy transfer," Narayan said.

Currently, the quinones needed for the batteries are manufactured from naturally occurring hydrocarbons. In the future, the potential exists to derive them from carbon dioxide, Narayan said. The team has filed several patents in regards to design of the battery, and next plans to build a larger scale version.

*This research was funded by the ARPA-E Open-FOA program (DE-AR0000337), the University of Southern California, and the Loker Hydrocarbon Research Institute.*

[http://www.eurekalert.org/pub\\_releases/2014-06/gcrc-fpr062514.php](http://www.eurekalert.org/pub_releases/2014-06/gcrc-fpr062514.php)

## First positive results toward a therapeutic vaccine against brain cancer

*A clinical phase I trial to examine the safety of the vaccine against gliomas based on mutant IDH1 in human patients is planned*

Astrocytomas and oligodendrogliomas are subtypes of a brain cancer called 'glioma'. These incurable brain tumors arise from glial cells, a type of support cell found in the central nervous system. "Low-grade gliomas", which grow comparatively slowly, spread in a diffuse manner across the brain and are very difficult to completely eliminate through surgery. In many cases, the effectiveness of treatments with chemotherapy and radiotherapy is very limited. Gliomas can develop into extremely aggressive glioblastomas.

Low-grade gliomas have a particular feature in common: more than 70% of the cases exhibit the same gene mutation in tumor cells. An identical "typo" in the DNA causes the exchange of a single, specific protein building block (amino acid) in an enzyme called isocitrate dehydrogenase 1 (IDH1). As a result, most cancer cells do not follow the original building plan for the protein; at the 132nd position in the molecule's sequence, they insert the amino acid histidine instead of arginine. "This frequent and highly specific mutation immediately aroused our attention as immunologists: In the cancer cells, the exchange of amino acids lends the protein novel properties that can be recognized by the body's own immune cells," says Prof. Dr. Michael Platten, who heads the Clinical Cooperation Unit "Neuroimmunology

and Brain Tumor Immunology" at the DKFZ; he also works as a senior consultant in the Department of Neurooncology of Heidelberg University Hospital.

No other type of tumor displays the same mutation with such frequency. The mutant protein can reliably be detected using a highly specific antibody developed by Prof. Dr. Andreas von Deimling, a neuropathologist at the University Hospital and the DKFZ. This form of IDH1 is present on the surface of all tumor cells and is completely specific to the tumor. "This suggested that we might be able to use a vaccine to alert the patient's immune system to mutant IDH1, fighting the tumor without damaging healthy cells," Platten explains.

In collaboration with a team of physicians and scientists from Heidelberg University Hospital, DKFZ and the Universities of Mainz, Tübingen and Hamburg, Platten and his co-workers have now made the first successful step toward a vaccine that specifically targets the mutation in the tumor.

The researchers constructed an artificial version of the segment of IDH1 with the characteristic mutation using individual amino acids. This version of the peptide, which consisted of 15 building blocks, exactly matched one of the presentation molecules on the surface of the tumor cells. This is essential, because immune cells only respond to a target that is presented on so-called "MHC molecules" on the cell surface. If there is no such matching presentation, the body will not amount an immune response.

To draw conclusions about the human immune system from the vaccination experiments, the researchers used mice whose cells were equipped with human MHC molecules. "After vaccinating the animals with the peptide, we were able to detect immune cells and antibodies that specifically recognized the altered IDH1 of tumor cells rather than the normal form of the enzyme in healthy cells," says Dr. Theresa Schumacher, first author of the study.

In the experimental animals, this specific immune response induced by the vaccination arrested the growth of cancer cells that exhibited the characteristic IDH1 mutation. As hoped, the vaccination did not disrupt the functioning of the normal IDH1 enzyme, which plays a role in the energy metabolism of all healthy cells in the body.

"In some patients with low-grade glioma we also found spontaneous immune responses against altered IDH1," Platten says. "This is a good sign; it suggests that vaccinations based on the peptide can in fact support the body's own immune system in fighting cancer cells." This gives a "vaccination therapy" good chances of success, according to the Heidelberg physicians. In a clinical trial scheduled to start early next year, with the support of the German Consortium for Translational Cancer Research (DKTK), they plan to examine the safety of the vaccine against gliomas based on mutant IDH1 in human patients, for the first time.

"Most low-grade gliomas cannot be removed completely by surgery and thus often recur," says Prof. Wolfgang Wick, Medical Director of the Department of Neurooncology and head of the Clinical Cooperation Unit "Neurooncology" at the DKFZ. "Patients would therefore benefit tremendously from a vaccine that prevents this from happening."

*Theresa Schumacher, Lukas Bunse, Stefan Pusch, Felix Sahn, Benedikt Wiestler, Jasmin Quandt, Oliver Menn, Matthias Osswald, Iris Oezen, Martina Ott, Melanie Keil, Jörg Balß, Katharina Rauschenbach, Agnieszka K. Grabowska, Isabel Vogler, Jan Diekmann, Nico Trautwein, Stefan B. Eichmüller, Jürgen Okun, Stefan Stevanović, Angelika B. Riemer, Ugur Sahin, Manuel A. Friese, Philipp Beckhove, Andreas von Deimling, Wolfgang Wick und Michael Platten: A vaccine targeting mutant IDH1 induces antitumour immunity. Nature 2014, DOI: 10.1038/nature13387*

[http://www.eurekalert.org/pub\\_releases/2014-06/nsfc-nsm062514.php](http://www.eurekalert.org/pub_releases/2014-06/nsfc-nsm062514.php)

## **NASA's STEREO maps much larger solar atmosphere than previously observed**

### *Scientists used observations of the sun's atmosphere*

Surrounding the sun is a vast atmosphere of solar particles, through which magnetic fields swarm, solar flares erupt, and gigantic columns of material rise, fall and jostle each other around. Now, using NASA's Solar Terrestrial Relations Observatory, scientists have found that this atmosphere, called the corona, is even larger than thought, extending out some 5 million miles above the sun's surface -- the equivalent of 12 solar radii. This information has implications for NASA's upcoming Solar Probe Plus mission, due to launch in 2018 and go closer to the sun than any man-made technology ever has before.

These STEREO observations provide the first direct measurements of the inner boundary of the heliosphere -- the giant bubble sparsely filled with solar particles that surrounds the sun and all the planets. Combined with measurements from Voyager 1 of the outer boundary of the heliosphere, we have now defined the extent of this entire local bubble.

"We've tracked sound-like waves through the outer corona and used these to map the atmosphere," said Craig DeForest of the Southwest Research Institute in Boulder, Colorado. "We can't hear the sounds directly through the vacuum of space, but with careful analysis we can see them rippling through the corona."

The results were published in The Astrophysical Journal on May 12, 2014. The researchers studied waves known as magnetosonic waves, and they are a hybrid of sound waves and magnetic waves called Alfvén waves. Unlike sound waves on Earth, which oscillate several hundred times per second, these waves oscillate about once every four hours -- and are about 10 times the length of Earth.

Tracking magnetosonic waves showed DeForest and his team that the material throughout this extended space remained connected to the solar material much further in. That is to say that even out to 5 million miles from the sun, giant solar storms or coronal mass ejections can create ripple effects felt through the corona. Beyond that boundary, however, solar material streams away in a steady flow called the solar wind -- out there, the material has separated from the star and its movement can't affect the corona.

Realizing that the corona extends much further than previously thought has important consequences for NASA's Solar Probe Plus because the mission will travel to within 4 million miles of the sun. Scientists knew the mission would be gathering information closer to the sun than ever before, but couldn't be sure it would travel through the corona proper.

"This research provides confidence that Solar Probe Plus, as designed, will be exploring the inner solar magnetic system," said Marco Velli, a Solar Probe Plus scientist at NASA's Jet Propulsion Laboratory in Pasadena, California. "The mission will directly measure the density, velocity and magnetic field of the solar material there, allowing us to understand how motion and heat in the corona and solar wind are generated."

With direct access to the sun's atmosphere, Solar Probe Plus will provide unprecedented information on how the solar corona is heated and revolutionize our knowledge of the origin and evolution of the solar wind.

<http://phys.org/news/2014-06-climate-profoundly-great-lakes-region.html>

## **Climate change to profoundly alter Great Lakes region, summary report says**

*Intense rainstorms, floods and heat waves will become more common in the Great Lakes region due to climate change in the coming decades*

Jun 25, 2014 by Jim Erickson

Phys.org - Intense rainstorms, floods and heat waves will become more common in the Great Lakes region due to climate change in the coming decades, and ice-cover declines will lengthen the commercial navigation season on the lakes, according to a new summary report released today at the start of a three-day climate-adaptation conference at the University of Michigan.

In the next few decades, longer growing seasons and rising carbon dioxide levels will increase some crop yields in the region, but those benefits will be progressively offset by extreme weather events, according to the report prepared by the Great Lakes Integrated Sciences and Assessments Center (GLISA), a federally funded collaboration between the University of Michigan and Michigan State University. GLISA's 13-page "synthesis report" summarizes the key Great Lakes-region impacts of climate change detailed in the latest U.S. National Climate Assessment,

which was released last month by the federal government. The 840-page national assessment is widely regarded as the most comprehensive evaluation of current and future impacts of climate change on the United States.

"Climate impacts how we live, work and play. The mission of GLISA is to provide people in the Great Lakes region with useful and useable information on how our climate is changing and what that means for our way of life," said Elizabeth Gibbons, GLISA program manager.

"Our hope is that this report will demonstrate that there is an urgent need for all of us to begin building resilience into our communities, natural systems and water management planning practices. The impacts of climate change are already being felt and will only increase in the years and decades to come."

GLISA is one of the sponsors of the three-day "Adaptation in the Great Lakes Region" conference at U-M. The meeting - which is free and open to the public today but is for registered conference participants afterward - will examine the process behind the National Climate Assessment, the expected impacts of climate change on the region, as well as the climate-adaptation efforts that will be needed to address those changes.

The GLISA summary report, "Synthesis of the Third National Climate Assessment for the Great Lakes Region," states that:

***Increased heat wave intensity and frequency, increased humidity, degraded air quality and changes in mosquito- and tick-borne disease patterns in the region will increase public health risks.***

***Extreme rainfall events and flooding have increased in the region during the last century and are expected to continue. Those trends could lead to increased erosion, declining water quality and negative impacts on transportation, agriculture, human health and infrastructure.***

***Climate change will exacerbate a range of risks to the Great Lakes, including changes in the range and distribution of certain fish species, increased invasive species, more frequent harmful algae blooms and declining beach health.***

***The composition of forests in the Great Lakes region is changing as the climate warms. Many tree species are shifting northward, with more southerly varieties replacing them.***

The GLISA summary report is largely a synthesis of information contained in the Midwest and Northeast chapters of the latest National Climate Assessment. U-M's Don Scavia, director of the Graham Sustainability Institute, was a lead convening author of the Midwest chapter.

Dan Brown of the School of Natural Resources and Environment was a lead convening author of the NCA chapter on changes in land use and land cover.

Rosina Bierbaum of SNRE and the School of Public Health was a lead convening author of the chapter on climate change adaptation. Missy Stults, a doctoral student



at the Taubman College of Architecture and Urban Planning, was a contributing author on the adaptation chapter.

In addition, Bierbaum and Marie O'Neill of the School of Public Health served on the 60-person advisory committee that oversaw development of the report, which was the work of more than 250 scientists, engineers, government officials and other experts.

*Great Lakes evaporation study dispels misconceptions, need for expanded monitoring program Full agenda for the Great Lakes climate change conference:*  
[graham.umich.edu/glaac/capstone2014](http://graham.umich.edu/glaac/capstone2014).

<http://bit.ly/1IZvHVO>

## **DNA analysis reveals butterfly and moth evolutionary relationship**

### ***A through genetic analysis of butterflies and moths has revealed some of their evolutionary history***

Phys.org - A pair of researchers with the Florida Museum of Natural History at the University of Florida has conducted a through genetic analysis of butterflies and moths and in the process has revealed some of their evolutionary history. In their paper published in Proceedings of the Royal Society B: Biological Sciences, Akito Kawahara and Jesse Breinholt describe the DNA analysis they undertook of the insects and the results they found in doing so.

Butterflies and moths are among the most cherished of insects, the researchers note, due to their beauty and relationship to equally lovely flowers. All told there are approximately 160,000 known species of the insect, though many more have not been identified - some scientists suggest there could be half a million. Despite their widespread popularity, the evolutionary relationship between the two (moths and butterflies) has been difficult to estimate - very few fossils exist due to their extremely fragile body and wing structures and the lack of thorough DNA studies. In this new effort, the team in Florida set out to more firmly establish the evolutionary tree of the wispy creatures.

The two researchers sequenced almost 3000 genes creating in the process a dataset that included 46 taxa that combined 33 new transcriptomes with 13 genomes, expressed sequence tags and transcriptomes. They used a technique known as HaMStR (a next-generation sequencing approach) to identify 2,696 genes for inclusion into their phylogenomic analysis.

Their study showed that butterflies all share a single common ancestor and give credence to the theory that butterflies are more closely related to very small (micro) moths, rather than those of larger species, contradicting previous studies that had found the opposite to be true. More specifically, they found evidence that suggests plume and geometroid moths are likely the first relatives of butterflies. Also, the

research showed that insects known as hedyliids, commonly known as butterfly-moths are in fact true butterflies, not moths at all.

The overall result of the work was what the duo describe as the "first robust, transcriptome-based tree of Lepidoptera" - one that strongly contradicts the placement of butterflies in the historical context. It also provides an evolutionary framework, they note, for future research efforts - be they developmental, genomic, or ecological - for both butterflies and moths.

*More information: Phylogenomics provides strong evidence for relationships of butterflies and moths, Proceedings of the Royal Society B, [rspb.royalsocietypublishing.or.../doi/10.1098/rsob.20140970](http://rsob.royalsocietypublishing.org/doi/10.1098/rsob.20140970)*

### **Abstract**

*Butterflies and moths constitute some of the most popular and charismatic insects. Lepidoptera include approximately 160 000 described species, many of which are important model organisms. Previous studies on the evolution of Lepidoptera did not confidently place butterflies, and many relationships among superfamilies in the megadiverse clade Ditrysia remain largely uncertain. We generated a molecular dataset with 46 taxa, combining 33 new transcriptomes with 13 available genomes, transcriptomes and expressed sequence tags (ESTs). Using HaMStR with a Lepidoptera-specific core-orthologue set of single copy loci, we identified 2696 genes for inclusion into the phylogenomic analysis. Nucleotides and amino acids of the all-gene, all-taxon dataset yielded nearly identical, well-supported trees. Monophyly of butterflies (Papilionoidea) was strongly supported, and the group included skippers (Hesperiidae) and the enigmatic butterfly-moths (Hedyliidae). Butterflies were placed sister to the remaining obtectomeran Lepidoptera, and the latter was grouped with greater than or equal to 87% bootstrap support. Establishing confident relationships among the four most diverse macroheteroceran superfamilies was previously challenging, but we recovered 100% bootstrap support for the following relationships: ((Geometroidea, Noctuoidea), (Bombycoidea, Lasiocampoidea)). We present the first robust, transcriptome-based tree of Lepidoptera that strongly contradicts historical placement of butterflies, and provide an evolutionary framework for genomic, developmental and ecological studies on this diverse insect order.*

<http://www.medscape.com/viewarticle/827267>

### **Is Hugging Patients Appropriate?**

***How important is a physician's touch? In a recent all-physician discussion on Medscape Connect, the question of when and how to touch patients yielded insights on physical exams, handshakes, and hugs.***

**Brandon Cohen**

"Do you make a point of touching your patients? Do you hear about it when you don't?" asked a primary care physician, beginning the discussion. Right away, several doctors spoke up in favor of frequent and meaningful touch. An internist clearly had thought it through:

*[Touch] is a social expectation; it is an integral component of the patient-physician relationship. I have had new patients tell me that they left the previous practice for a variety of reasons, but lack of examination in general and lack of focused exam leads the list.*

A neurologist agreed:

*Every new patient I see gets a nearly complete physical exam and a complete neurological examination. As for subsequent visits, the examination, if indicated, is a focused one. But it's not just touching a patient, but how you touch. I've always auscultated with my right hand and use my left hand to cradle their upper back and pull the patient close to me. This intimate sharing of interpersonal space in a safe environment does a lot to win trust.*

A dermatologist also saw great benefit in the hands-on approach and mourned the lack of touch in colleagues:

*Unfortunately, many dermatologists (I guess up to half) do not touch patients. They learn diagnosis by pictures and photos and do not combine sight and touch... I can't do my job without my fingers... Am I stupid? I don't think so.*

"I've always been convinced that the popularity of chiropractic is solely due to the fact that chiropractors actually touch their marks -- excuse me -- patients," added the neurologist.

An internist also had strong feelings on the topic:

*There is a tremendous symbolic value of touch as a healing power. Patients often feel better after a routine physical examination: a key part of how to establish an environment of trust. Other tips on the Art of Medicine: Smile -- you cannot convey a sense of warmth without a smile; learn to appear relaxed, as an aura of calmness builds confidence and shows you care.*

But touching outside of the formal examination process was also up for discussion. "Does shaking hands count?" inquired a curious internist. Shaking hands most definitely did count. Several colleagues swore by the handshake as a simple way to develop strong bonds with patients.

A neurologist described a useful technique in detail:

*When I shake hands with most patients, as our right hands grasp, I place my left hand on the dorsum of their hand and squeeze their right hand between both of my hands. It's a less formal, less standoffish, and more intimate way of greeting someone. Body language and touch have a large impact on how comfortable another person feels when they are consulting with you.*

A pediatrician advocated a gentle touch when shaking hands. "My neurologist made me want to cry out in pain this week when he squeezed my painfully arthritic hand hard while shaking hands!"

An internist then took the discussion past handshakes and on to the delicate issue of hugs.

*I shake hands with males. But females quite often want a hug, especially the young ones. I bet they feel like daughters or granddaughters, being my patients for years."*

A pediatrician quickly piped up with a warning:

*Hug a female? I wouldn't dare! At warp speed I'd be before the board. Some mothers don't even want me hugging their kids. I feel it's safer to keep a professional distance. But a neurologist was undeterred and advocated the healing powers of the embrace:*

*It's tragic that we have to think twice about hugging patients. That said, for many of my long-term patients, a hug is usually expected. In neurology, as in much of medicine, there are times that the patient in front of you may have a diagnosis where a hug is the most human of all therapeutic interventions.*

A primary care physician largely agreed but had developed a system to avoid misunderstandings:

*I do lots of hugging (usually older ladies), and they typically appreciate it. Occasionally I misread a person and hug someone who doesn't seem to appreciate the kindness. I write "No hugs" on the chart to avoid making the mistake again.*

An internist had more of a wait-and-see approach:

*I will hug back if someone initiates a hug, and occasionally initiate if body language and previous relationship suggest appropriateness. A hand on a shoulder, holding another's hand clasped with both of my hands, other small gestures as part of a gentle conversation that validates feelings and is direct and honest.*

A cardiologist seemed a bit bemused by all of this in-office cuddling:

*I can recall no occasion in many years when I have embraced a patient of either gender, or wanted to, or expected to be embraced. Maybe I have been much too cautious, but none has ever complained that I neglected them by not laying on of hands.*

The final word goes to an internist who provided a comical take on a doctor's touch: "Ew! Isn't that how you pass on germs?"

The full discussion of this topic is available [online](http://www.bbc.com/news/health-28013585). Please note that this is open to physicians only.

<http://www.bbc.com/news/health-28013585>

### **Jab 'protects mice against brain tumours'**

*Scientists have developed a vaccine that they say provides some protection against brain tumours in mice.*

By Helen Briggs Health editor, BBC News online

The vaccine works by boosting the immune system to attack abnormal cells. The approach has not been tested on humans, but clinical trials could begin next year in Germany, say researchers.

Brain tumours are difficult to treat so more research is urgently needed to give patients better options, said a cancer charity. A team at the National Centre for Tumour Diseases in Heidelberg developed a vaccine that targets brain tumour cells.

It is based on the natural ability of some patients with brain tumours to mount an immune response against the disease - although this is not enough to stop the tumour growing. The mouse experiment showed that a vaccine may be able to boost this natural approach, the researchers said.

"We can induce an immune response that is similar to what we see in some brain tumour patients who have a natural immunity but it is not strong enough to take care of the tumour," said Prof Michael Platten. The team is applying for approval to start a human clinical trial in Germany next year.

### 'Exciting approach'

"It's still too early to know if the vaccine will be efficacious in humans," he added. The charity [Cancer Research UK](#) described the research, published in [Nature](#), as "exciting".

"Using the immune system to attack cancer is an exciting approach to tackling the disease and this research is another step forward in finding new treatments," said Dr Emma Smith, senior science information officer.

"But this is a very early-stage study and was carried out in mice, so much more research is needed before we know if the vaccine is safe or effectively boosts an immune response against brain tumours in people. "Brain tumours are a diverse group of cancers and are difficult to treat, so we urgently need more research to give people better options."

Other researchers around the world are looking into similar vaccines to stimulate the immune system to fight off cancer. A trial started in the UK last year into a similar vaccine to fight brain tumours. The approach, known as immunotherapy, is also being tested in the US.

<http://www.medscape.com/viewarticle/827333>

### Routine Ultrasound Scans May Detect Autism in Utero

*Children with autism spectrum disorder (ASD) may have more rapidly growing brains and bodies at the beginning of the second trimester than children without the disorder, new research suggests.*

Deborah Brauser

LONDON - A small retrospective study examining fetal anomaly ultrasound scans showed that the children who went on to develop ASD had significantly greater head and abdominal circumference and cerebellar diameter at around 20 weeks' gestation than did their healthy peers.

"This gave us a small window into the fetal development of these children, and it looked like something about autism was happening at that 20-week mark," lead author Lois Salter, a medical student at the University of Edinburgh in Scotland, told *Medscape Medical News*.

"If we could explore this further, it might help with diagnosing earlier and treating earlier. It just opens a whole range of possibilities if autism is detectable this early on," said Salter. The results were presented here at the International Congress of the Royal College of Psychiatrists (RCPsych) 2014.

### Early Detection

"Previous research suggests that autism may be detectable from infancy," write the investigators, adding that they wanted to evaluate whether it could be detectable even earlier.

Fetal anomaly scans have been routinely performed since December 2008 in the Lothians, a region of the Scottish Lowlands. The researchers sought to examine these scans for 40 children who were later diagnosed with ASD and for 120 children who did not develop the disorder (healthy control participants). Fetal data from the scans for head circumference, cerebellar diameter, femur length, abdominal circumference, and ventricular atrial width were assessed.

In addition, researchers controlled for maternal age and other demographic factors. Results showed a "significant interaction of group" between head circumference, cerebellar diameter, femur length, and abdominal circumference (all,  $P < .05$ ), suggesting that the children who had autism were growing at a faster rate at the 18- to 24-week gestational point than were the healthy control individuals.

There were no significant between-group differences in ventricular atrial width.

"These results suggest that children with autism grow at a different rate to controls in the beginning of the second trimester; notably, both their brains and bodies appear to grow faster at this stage," write the researchers. "Autism may thus be detectable much earlier in development, allowing for targeted early detection and treatment of the condition," they add.

Salter noted that this could also lead to earlier and better education. "We're not waiting for symptoms to show up at age 3 or 4, when you've lost years of potential education for parents and for children," she said.

She reported that the investigative team hopes to keep following up with these data as more children are diagnosed with ASD and more scans are added into the system.

"It would also be great to look into a bit of a wider window of the gestation, but that would have to be prospective, possibly scanning high-risk mothers throughout their pregnancy," said Salter.

For now, she is excited by these results. "We didn't really have a clue what to expect," she said. "Postnatal data about brain size in autism is really mixed, with nothing massively conclusive. So to find something in utero is great."

### "Furthers Our Understanding"

Bernice Knight, MBChB, MRCPsych, academic clinical lecturer in intellectual disability psychiatry at the University of Bristol, in the United Kingdom, and

executive committee member of the Faculty of the Psychiatry of Learning Disability for the Royal College of Psychiatrists, told *Medscape Medical News* that these findings dovetail nicely with a study she and her colleagues recently completed that looked at traits that might predict ASD later in childhood.

Dr. Knight, who was not involved with the current study, noted that the complementary findings were interesting. In addition, she said that these new results have the potential to be very helpful to clinicians and others.

"There is so much that we don't understand about autism and about autism spectrum disorder. And given that it's clearly a neurodevelopmental disorder, I think looking at those early stages of development are going to be fundamental to improving our understanding," she said. "So concentrating research into that area is likely to be fruitful and helpful, ultimately, for patients."

*The study authors have disclosed no relevant financial relationships.*

*International Congress of the Royal College of Psychiatrists (RCPsych) 2014. Poster 39. Presented June 25, 2014.*

<http://www.bbc.com/news/science-environment-27987827>

### **Researchers develop cheaper way of making solar cells**

*Researchers have developed a new manufacturing method which could bring down the cost of making a type of solar cell.*

**By Pallab Ghosh Science correspondent, BBC News**

A team at Liverpool University has found a way of replacing the toxic element in the process with a material found in bath salts.

The scientists say that this could have a "massive, unexpected cost benefit".

The research has been published in the *Journal Nature* and unveiled at the ESOF conference in Copenhagen.

Dr Jon Major, who led the research said that his team's work might be the development that brings the cost down to the level of fossil fuel," he told BBC News. More than 90% of the solar cells are made from silicon.

Around 7% are made from a material called cadmium telluride. The cadmium telluride cells are thinner than silicon and these are popular because they are also lighter and cheaper.

#### **Toxic ingredient**

They have the drawback that a toxic chemical, cadmium chloride, is needed to manufacture them. Cadmium chloride is also expensive.

A significant proportion of the manufacturing cost of cadmium telluride cells is to protect the workforce from toxins and to dispose of contaminated waste products safely, according to the research team.

Dr Major discovered that a cheaper, non-toxic alternative, magnesium chloride, could be used instead of the toxic compound and work just as well.

Magnesium chloride is completely safe. It is used to make tofu and is found in bath salts. It also extracted from sea water and so is a small fraction of the price of cadmium chloride.

Dr Major's boss, Prof Ken Durose, who is the director of the Stephenson Institute for Renewable Energy at Liverpool University, believes that his colleague's discovery has the potential to transform the economics of solar energy.

"One of the big challenges with solar energy is to make it cheap enough to compete with conventional power generation," he told BBC News.

"Solar will progressively get cheaper until it will become more and more feasible for solar power to be produced from solar electricity farms."

Comparing the relative costs of different energy technologies is extremely difficult because they are so different and the results are contentious.

But when pressed, Prof Durose made his best guess to assess the potential impact of the new technique, stressing that his figures were rough and ready and contained assumptions that could and probably would be challenged.

#### **Cost debate**

That said, he estimated that the cost of electricity produced from current cadmium telluride technology is very approximately 10 pence per unit, significantly higher than the 8.25 pence per unit for electricity produced from gas.

But he thought that the benefits of cheaper materials and the cost saving from not having to deal with toxic materials could bring the cost of cadmium telluride cells to 8.2 pence per unit - lower than gas.

However, Dr Nigel Mason of PV Consulting believes that the researchers are being very optimistic in their assessment of the impact their development will have on the price of solar energy.

"The development is great for the environmental management and safety of the production process but the cost of cadmium chloride material and dealing with its safe disposal is a relatively small fraction of production cost," he told BBC News.

A key factor is that tellurium is one of the rarest elements on Earth so there would not be enough of the chemical to make enough solar cells if the technology took off, according to Dr Mason.

But Dr Major believes that solar energy could eventually meet the world's energy needs.

"There is enough sunlight that falls on the Earth every hour to generate enough electricity for the planet for a year," he said.

"The way solar is progressing it will just be a matter of time before it becomes competitive with fossil fuels and eventually replace them."

<http://www.medscape.com/viewarticle/827345>

## Ketamine Metabolite Has Promise in Depression

*By-product of ketamine may treat symptoms of depression just well but without side effects*

Megan Brooks

Hydroxynorketamine (HNK), a by-product of the psychoactive drug ketamine, may treat symptoms of depression just well as ketamine without the unwanted side effects, new research suggests.

HNK also has therapeutic potential for treating neurodegenerative disorders such as Alzheimer's disease (AD) and Parkinson's disease (PD), the researchers say. Several studies have shown that ketamine has rapid [antidepressant effects](#) in people with treatment-refractory major depression. It has also [shown promise](#) in posttraumatic stress disorder.

But the clinical use of ketamine is "limited because the drug is administered intravenously and may produce adverse effects, such as hallucinations and sedation to the point of anesthesia," Irving Wainer, PhD, senior investigator with the Intramural Research Program at the National Institute on Aging, in Baltimore, Maryland, notes in a statement.

"We found that the HNK compound significantly contributes to the antidepressive effects of ketamine in animals but doesn't produce the sedation or anesthesia, which makes HNK an attractive alternative as an antidepressant in humans," he said.

The study [is published](#) in the July issue of *Anesthesiology*. Dr. Wainer is listed as a coinventor on a patent application for the use of ketamine metabolites in the treatment of bipolar disorder and major depression.

### "Attractive" Ketamine Alternative

There are a number of key differences between ketamine and HNK, the researchers note.

"HNK targets a specific subtype of the nicotinic acetylcholine receptors, the alpha-7 nicotinic receptor, that are located at the nerve junctions, while ketamine targets the N-methyl-D-aspartate (NMDA) receptor, which is located throughout the body," Dr. Wainer explained. "The effect of ketamine on the NMDA receptor is the source of the drug's anesthetic activity as well as its unwanted side effects."

He and his colleagues used a rat model to see whether HNK could produce the same beneficial effects attributed to ketamine without ketamine's unwanted side effects. They gave rats intravenous doses of ketamine, HNK, and another ketamine by-product called norketamine.

HNK, like ketamine, not only produced potent and rapid antidepressant effects but also stimulated neuroregenerative pathways and initiated the regrowth of neurons in rats' brains, the researchers report.

HNK also reduced production of the endogenous compound D-serine, overproduction of which is associated with neurodegenerative disorders such as AD and PD.

"The body makes D-serine from L-serine, and HNK stops this process," Dr. Wainer explained. "D-serine is a key coagonist and a necessary trigger for the NMDA receptors located at the nerve junctions. By reducing D-serine, you reduce the activity of the NMDA receptor and the neuroinflammation associated with a number of CNS [central nervous system] diseases."

Increased D-serine blood and brain levels have been detected in patients with AD and PD, he added, "and we think that HNK is a novel and potentially effective way of reducing D-serine in these patients."

He noted that inhibition of NMDA receptor activity is "an accepted therapeutic approach to the treatment of AD, as demonstrated by the use of memantine [*Namenda*, Forest Laboratories, Inc]. We feel that HNK, which can be given as a pill, will be at least as effective as memantine, with less side effects. The next step in the process is to test this hypothesis in animal models of these diseases," he said.

### Growing Understanding

"This study contributes to a growing understanding of the antidepressant mechanisms of action of ketamine at the cellular level," James W. Murrough, MD, assistant professor, Departments of Psychiatry and Neuroscience, and associate director, Mood and Anxiety Disorders Program, Icahn School of Medicine at Mount Sinai in New York City, who was not involved in the study, told *Medscape Medical News*.

"The authors replicated a previous finding that ketamine administered to animals increased the activity of the mTOR pathway, thereby promoting protein synthesis," he explained. "Prior research has shown that this stimulation of the TOR pathway is important for synaptogenesis — essentially, the creation or strengthening of synapses in the brain."

"This synaptogenesis effect of ketamine is opposed to the effects of stress and is believed to underlie ketamine's antidepressant action, at least in part. The authors extended this work in the current article by showing that certain metabolites of ketamine, in addition to ketamine itself, had stimulatory effects on mTOR," Dr. Murrough said.

*Dr. Wainer and several of the study's authors are listed as coinventors on a patent application for the use of ketamine metabolites in the treatment of bipolar disorder and major depression. Dr. Murrough has disclosed no relevant financial relationships.*

*Anesthesiology*. 2014;121:149-159. [Full text](#)

<http://bit.ly/THnZVx>

## To avoid interbreeding, monkeys have undergone evolution in facial appearance

### *Best evidence to date for the role of visual cues as a barrier to breeding across species*

Old World monkeys have undergone a remarkable evolution in facial appearance as a way of avoiding interbreeding with closely related and geographically proximate species, researchers from New York University and the University of Exeter have found. Their research provides the best evidence to date for the role of visual cues as a barrier to breeding across species.

"Evolution produces adaptations that help animals thrive in a particular environment, and over time these adaptations lead to the evolution of new species," explains James Higham, an assistant professor in NYU's Department of Anthropology and the senior author of the study, which appears in the journal *Nature Communications*. "A key question is what mechanisms keep closely related species that overlap geographically from inter-breeding, so that they are maintained as separate species.

"Our findings offer evidence for the use of visual signals to help ensure species recognition: species may evolve to look distinct specifically from the other species they are at risk of inter-breeding with. In other words, how you end up looking is a function of how those around you look. With the primates we studied, this has a purpose: to strengthen reproductive isolation between populations."

The study's lead author was William Allen, who undertook the work while a post-doctoral researcher in NYU's Department of Anthropology. The researchers studied guenons - a group of more than two dozen species of monkeys indigenous to the forests of Central and West Africa. Many different species of guenons are often sympatric - they live in close proximity to each other, with multiple species often traveling, feeding, and sleeping side-by-side. Therefore interbreeding, which could result in afflicted infertile offspring, remains an unwelcome possibility.

In the 1980s, Oxford zoologist Jonathan Kingdon tried to explain the diversity in facial appearance of guenons, which show markings such as differently colored eyebrow patches, ear tufts, nose spots, and mouth patches. He hypothesized that sympatric guenon species had undergone facial changes that visually reinforced differences among their species in order to avoid the risks of hybridizing. However, Kingdon's ideas were primarily based on observations with the naked eye, and he failed to find evidence for his hypotheses. The NYU and University of Exeter scientists sought to test Kingdon's conclusions quantitatively using

sophisticated methods - facial recognition algorithms that can identify and quantify detailed features in faces.

To do this, they photographed nearly two dozen species of guenons in various settings, over an 18-month period: in zoos in the United States and the United Kingdom and in a wildlife sanctuary in Nigeria. Armed with more than 1,400 standardized photographs, the researchers employed what is known as the eigenface technique, which has been used in the field of computer vision for machine recognition of faces, in order to distinguish primate features and then to determine whether the appearance of each guenon species was related to the appearance of other species.

Their results showed that, as predicted, the face patterns of guenon species have evolved to become more visually distinctive - specifically from those guenon species they overlap with geographically - and hence those that they are risk of hybridizing with.

"These results strongly suggest that the extraordinary appearance of these monkeys has been due to selection for visual signals that discourage hybridization," observes lead author Allen, now at the University of Hull. "This is perhaps the strongest evidence to date for a role for visual signals in the key evolutionary processes by which species are formed and maintained, and it is particularly exciting that we have found it in part of our own lineage."

[http://www.eurekalert.org/pub\\_releases/2014-06/gvsu-yct062614.php](http://www.eurekalert.org/pub_releases/2014-06/gvsu-yct062614.php)

## You can't teach speed: Sprinters break 10-year rule

### *New research shows world-class sprinters are born, not created*

ALLENDALE, Mich. - New research shows world-class sprinters are born, not created. Grand Valley State University researchers found that exceptional speed prior to formal training is a prerequisite for becoming a world-class sprinter. The findings are published in the online journal *PeerJ*, <https://peerj.com/articles/445/>.

The research, conducted by Michael Lombardo, professor of biology, and Robert Deaner, associate professor of psychology, shows that the developmental histories of elite sprinters contradict the popular deliberate practice model of expertise. According to this model, there is no such thing as innate talent. Instead, 10 years of deliberate practice (roughly 10,000 hours) are necessary and sufficient for anyone to become an expert in any field, including sports.

The researchers studied biographies of 26 world-class sprinters, including 15 Olympic gold medalists and the eight fastest men in U.S. history. The first major finding was that every expert sprinter, male or female, was recognized as exceptionally fast prior to beginning formal training. This contradicts the deliberate practice model, which assumes that initial performance and final performance in a domain will be unrelated. A second key finding was that, contrary to the 10-year

rule, most sprinters achieved world class performances in less than five years, and more than half of the Olympic champions reached this level in three years or fewer. In addition, Lombardo and Deaner surveyed 64 sprinters and throwers (i.e., shot put, javelin, discus) who qualified for the 2012 NCAA collegiate track and field outdoor championships. Sprinters recalled being faster as children, while throwers recalled greater strength and overhand throwing ability. Another key finding was that the collegiate sprinters' best performances in their first season of high school competition, generally the beginning of formal training or deliberate practice, were consistently faster than 95-99 percent of their peers.

"Rob and I both ran track in college, and we follow the sport pretty closely," said Lombardo. "So we expected that most sprint champions' biographies would indicate that they were always the fastest kid in their neighborhood, even before they did any formal training or received any coaching. But the consistency of the pattern was surprising – from Helen Stephens, a 1936 Olympian, to Usain Bolt, there were no exceptions. Gathering the data systematically allowed us to see how strong the patterns were. It also allowed us to test and rule out alternative explanations."

The authors noted that because speed is crucial for many sports, the new results imply that talent is important for many sports besides track and field. The authors also pointed out that their behavioral data complement many genetic and physiological studies indicating individual variation in athletic talent.

"Our results won't come as a surprise to most biologists, sports scientists, or coaches - all of the previous data pointed to this conclusion," said Deaner. "But our results are important because the deliberate practice model and its '10-year rule' remains enormously popular among many social scientists and intellectuals. Our results are clear-cut and should require no scientific training to understand. So we hope they will finally put an end to the debate."

The researchers stressed that their results support an interactive model of expertise development. "Our point is not that talent trumps everything," said Lombardo.

"Training is crucial, especially the kinds of training highlighted by the deliberate practice model. But in sports, innate talent is required too."

[http://www.eurekalert.org/pub\\_releases/2014-06/msu-see062614.php](http://www.eurekalert.org/pub_releases/2014-06/msu-see062614.php)

### Sequencing electric eel genome unlocks shocking secrets

*For the first time, the genome of the electric eel has been sequenced.*

EAST LANSING, Mich. - This discovery has revealed the secret of how fishes with electric organs have evolved six times in the history of life to produce electricity outside of their bodies. The research, published in the current issue of Science, sheds light on the genetic blueprint used to evolve these complex, novel organs. It

was co-led by Michigan State University, University of Wisconsin-Madison, University of Texas-Austin and the Systemix Institute.

"It's truly exciting to find that complex structures like the electric organ, which evolved completely independently in six groups of fish, seem to share the same genetic toolkit," said Jason Gallant, MSU zoologist and co-lead author of the paper. "Biologists are starting to learn, using genomics, that evolution makes similar structures from the same starting materials, even if the organisms aren't even that closely related."



*For the first time, the genome of the electric eel has been sequenced.* Courtesy of MSU

Worldwide, there are hundreds of species of electric fish in six broad lineages.

Their diversity is so great that Darwin himself cited electric fishes as critical examples of convergent evolution, where unrelated animals independently evolve similar traits to adapt to a particular environment or ecological niche.

All muscle and nerve cells have electrical potential. Simple contraction of a muscle will release a small amount of voltage. But between 100 and 200 million years ago, some fish began to amplify that potential by evolving electrocytes from muscle cells, organized in sequence and capable of generating much higher voltages than those used to make muscles work.

"Evolution has removed the ability of muscle cells to contract and changed the distribution of proteins in the cell membrane; now all electrocytes do is push ions across a membrane to create a massive flow of positive charge," said Lindsay Traeger, U-W graduate student and co-author of the study.

The "in-series alignment" of the electrocytes and unique polarity of each cell allows for the "summation of voltages, much like batteries stacked in series in a flashlight," said Michael Sussman, U-W biochemist. The additional current required for the power comes from the fact that an eel body contains many millions of such "batteries" working together and firing their electrical discharge simultaneously.

The new work provides the world's first electric fish genome sequence assembly. It also identifies the genetic factors and developmental pathways the animals use to grow an organ that, in the case of the electric eel, can deliver a jolt several times more powerful than the current from a standard household electrical outlet. Other electric fishes use electricity for defense, predation, navigation and communication. Future MSU research will focus on testing the role of these genes in the development of electric organs, using state-of-the-art transgenic techniques in Gallant's newly constructed laboratory.

The research was funded by the National Science Foundation, the W.M. Keck Foundation and the National Institutes of Health.

[http://www.eurekalert.org/pub\\_releases/2014-06/tum-vis062614.php](http://www.eurekalert.org/pub_releases/2014-06/tum-vis062614.php)

## Virus infection supports organ acceptance

*A question of tolerance: Liver transplants in patients with hepatitis C*

*This news release is available in [German](#).*

Over 150 million people throughout the world suffer from chronic infection with the hepatitis C virus (HCV), which causes massive damage to the liver. Advanced liver diseases often necessitate liver transplants. In the new clinical study Dr. Felix Bohne and his colleagues studied together with Prof. Alberto Sánchez-Fueyo from King's College London 34 hepatitis C patients at the Liver Unit of the University Hospital Clínic de Barcelona who had received new livers.

The researchers had two objectives here: first, they wanted to gain a better understanding of the mechanisms that enable the body's own immune system to tolerate the new organ despite the HCV infection; second, they were looking for factors that could act as biomarkers for tolerance in the patients.

"If tolerance could be reliably predicted based on certain markers, many patients could stop taking immunosuppressants after a certain period of time," explains Dr. Felix Bohne, lead scientist of the study. Patients must take these strong drugs after transplants. They suppress the immune system so that the body does not identify the new organ as foreign and reject it. For patients with hepatitis C, this is a particular burden, as they need a stable immune system after the transplant to control their chronic HCV infection.

### Markers for tolerance

During the study, the patients stopped taking the immunosuppressants. They were observed for twelve months to see which of them could also tolerate the new organ without the drugs, and which of them did not. The scientists took liver and blood samples from the patients prior to and after the cessation of the drugs. Detailed immunological tests on these patient samples were carried out under the leadership of Prof. Ulrike Protzer of the "Immunmonitoring Platform" at the Institute of Virology. The scientists compared the patients with each other and looked for any differences that arose in tolerant patients only.

And the scientists struck gold: a certain group of genes was very active only in the livers of tolerant patients. The genes in question belonged to the type I interferon system, which targets viruses like HCV as part of the innate immune system. As the results showed, an anti-viral mechanism does actually enable the patients to better tolerate a foreign organ.

Ulrike Protzer provides a possible explanation for this: "When the interferon system is constantly activated as is the case in some chronically-infected patients, it

downregulates other immune reactions in order to protect the body. This state could act like a natural immunosuppressant and reduce the rejection of the organ."

In addition to the genes of the type I interferon system, a second factor was considered as a possible marker. This was discovered by the researchers in a previous study on liver recipients who did not have a HCV infection. Patients were very likely to be tolerant if they had a certain ratio of two different subgroups of immune cells in their blood. This ratio was also a reliable predictor of tolerance in the new study involving HCV patients.

*Dr. Tanja Bauer and Carolina Russo from the Immunmonitoring Platform at the Helmholtz Zentrum München were also involved in the study as cooperation partners. Felix Bohne was awarded a DFG (German Research Foundation) grant for his research work.*

### Original publication

*Felix Bohne, María-Carlota Londoño, Carlos Benítez, Rosa Miquel, Marc Martínez-Llordella, Carolina Russo, Cecilia Ortiz, Eliano Bonaccorsi-Riani, Christian Brander, Tanja Bauer, Ulrike Protzer, Elmar Jaeckel, Richard Taubert, Xavier Forn, Miquel Navasa, Marina Berenguer, Antoni Rimola, Juan-José Lozano, und Alberto Sánchez-Fueyo, HCV-induced immune responses influence the development of operational tolerance following liver transplantation in humans, Science Translational Medicine, 2014.*

DOI: [10.1126/scitranslmed.3008793](https://doi.org/10.1126/scitranslmed.3008793)

<http://bit.ly/1r06X36>

## Nearby super-Earth is best habitable candidate so far, astronomers say

*On a clear night, you might be able to spot the red dwarf star Gliese 832 through a backyard telescope, as it is just 16 light years away. Today, astronomers announced the discovery of super-Earth planet orbiting this nearby star and say it might be the best candidate yet for habitable world.*

Gliese 832c was spotted by an international team of [astronomers](#), led by Robert A. Wittenmyer from UNSW Australia. They used high-precision radial-velocity data from HARPS-TERRA, the Planet Finder Spectrograph and the UCLES echelle spectrograph. This star is already known to have one additional planet, a cold Jupiter-like planet, Gliese 832 b, discovered in 2009.

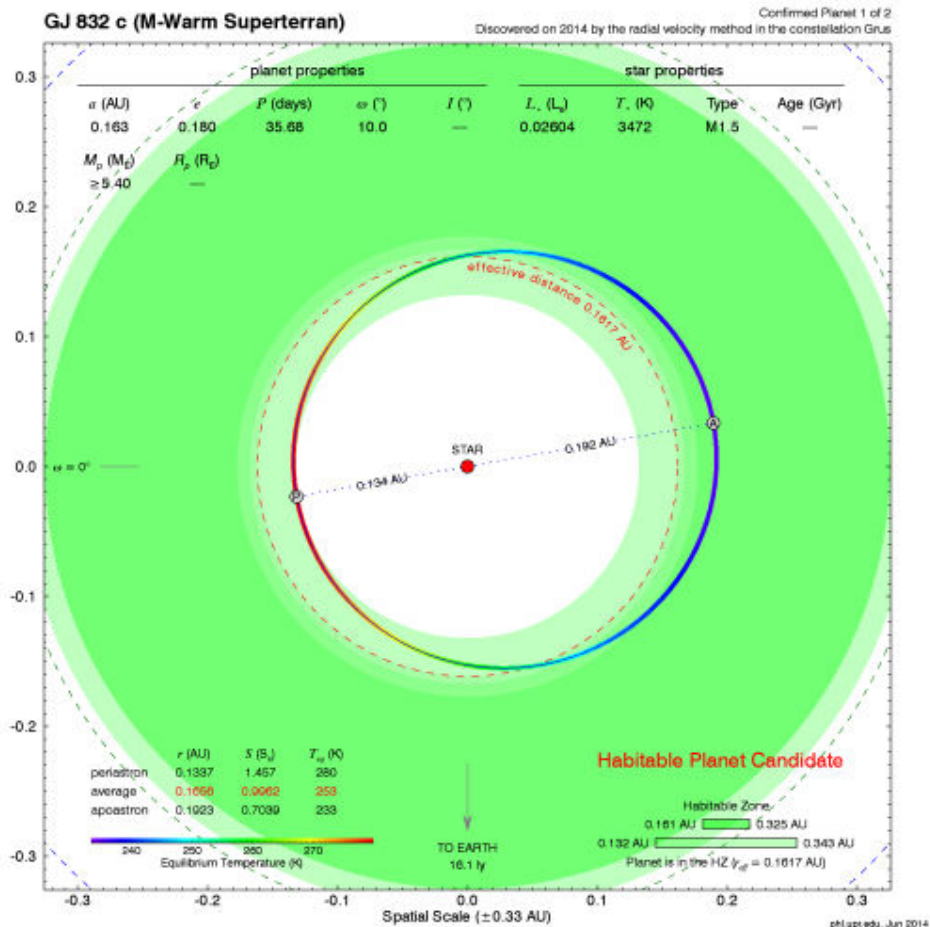
Since [red dwarf stars](#) shine dimly, the habitable zones around these [stars](#) would be very close in. Gliese 832c complies with an orbital period of 36 days (it's orbital companion Gliese 832 b orbits the star in 9.4 years.)

The newly found super-Earth has a mass at least five times that of Earth's and the astronomers estimate it receives about the same average energy as Earth does from the Sun. "The planet might have Earth-like temperatures, albeit with large seasonal shifts, given a similar terrestrial atmosphere," says a [press release](#) from the Planetary Habitability Laboratory. "A denser atmosphere, something expected for



Super-Earths, could easily make this planet too hot for life and a 'Super-Venus' instead."

Using the Earth Similarity Index (ESI)—a measure of how physically similar a planetary mass object is to Earth, where 1 equals the same qualities as Earth—Gliese 832 c has an ESI of 0.81. This is comparable to Gliese 667C c (ESI = 0.84) and Kepler-62 e (ESI = 0.83).



**Orbital analysis of Gliese 832 c, a potentially habitable world around the nearby red-dwarf star Gliese 832. Gliese 832 c orbits near the inner edge of the conservative habitable zone. Its average equilibrium temperature (253 K) is similar to Earth (255 K) but with large shifts (up to 25K) due to its high eccentricity (assuming a similar 0.3 albedo). Planetary Habitability Laboratory.**

"This makes Gliese 832c one of the top three most Earth-like [planets](#) according to the ESI (i.e. with respect to Earth's stellar flux and mass) and the closest one to Earth of all three, a prime object for follow-up observations. However, other unknowns such as the bulk composition and atmosphere of the planet could make this world quite different to Earth and non-habitable."

In their [paper](#), Wittenmyer and his colleagues noted that while Solar Systems like our own appear—so far—to be rare, the Gliese 832 system is like a scaled-down version of our own Solar System, with an inner potentially Earth-like planet and an outer Jupiter-like giant planet.

They added that the giant outer planet may have played a similar dynamical role in the Gliese 832 system to that played by Jupiter in our Solar System.

Certainly, astronomers will be attempting to observe this system further to see if any additional planets can be found.



*Artistic representation of the potentially habitable exoplanet Gliese 832 c as compared with Earth. Gliese 832 c is represented here as a temperate world covered in clouds. The relative size of the planet in the figure assumes a rocky composition but could be larger for a ice/gas composition. Credit: Planetary Habitability Laboratory.*

If you're interested in trying to see this star, [here's our guide on red dwarf stars that are visible in backyard telescopes.](#)

**More information:** "GJ 832c: A super-earth in the habitable zone." R.A. Wittenmyer, et al. *arXiv:1406.5587 [astro-ph.EP] Sat, 21 Jun 2014.* [arxiv.org/abs/1406.5587](http://arxiv.org/abs/1406.5587)

<http://bit.ly/1pCkFdd>

## Leaky Methane Makes Natural Gas Bad for Global Warming

*If leaks continue at present rates, natural gas may not help combat climate change*

By Gayathri Vaidyanathan and ClimateWire

Natural gas fields globally may be leaking enough methane, a potent greenhouse gas, to make the fuel as polluting as coal for the climate over the next few decades, according to a pair of studies published last week.

An even worse finding for the United States in terms of greenhouse gases is that some of its oil and gas fields are emitting more methane than the industry does, on average, in the rest of the world, the research suggests.

"I would have thought that emissions in the U.S. should be relatively low compared to the global average," said Stefan Schwietzke, a researcher at the National Oceanic and Atmospheric Administration's Earth Systems Research Laboratory in Boulder, Colo., and lead author of the studies. "It is an industrialized country, probably using good technology, so why are emissions so high?"

The natural gas industry globally was leaking between 2 and 4 percent of the gas produced between 2006 and 2011, the studies found. Leakage above 3 percent is enough to negate the climate benefits of natural gas over coal, so the findings indicate there is probably room for the industry to lower emissions.

The studies were published in the journals *Environmental Science & Technology* and *ACS Sustainable Chemistry and Engineering*.

### **Leakage equal to the emissions of 112M cars?**

The insights go to the heart of the debate surrounding the use of natural gas in the United States today. The nation is in an oil and gas boom due to technological advances that have unlocked vast new reserves and vaulted the nation beyond energy behemoths like Russia and Saudi Arabia.

The Obama administration has supported the natural gas industry, in part for the fuel's climate benefits. Gas emits about half as much carbon dioxide as coal in the power plant, so the government has promoted gas as a transition fuel to a post-carbon future.

The fine print, however, is that natural gas may be as detrimental to the climate as coal in many ways. Its climate challenge lies not during electricity generation, but further upstream—during extraction, processing and distribution of gas from the oil and gas wells to gas burners.

From wellheads, pipes, valves, compressors and various other equipment, gas wells leak raw methane, a greenhouse gas that is 86 times as potent as carbon dioxide over a 20-year time scale, according to the Intergovernmental Panel on Climate Change. While CO<sub>2</sub> persists in the atmosphere for centuries, wreaking climate havoc slowly, methane works more rapidly for a short while before decaying into less virulent gases. For the climate equation, both CO<sub>2</sub> and methane emissions matter, scientists say.

So far, no one—not industry, academia or government—has a good grasp on how much methane is leaking from natural gas production. Scientists have been racing to find out, but the fact-finding process has been slow, partially because of the relative opacity of the industry.

The natural gas industry says its emissions are close to zero. It also maintains that regulations are unnecessary to cut down on leaks, as companies have an economic incentive to capture methane. "The industry has led efforts to reduce emissions of methane by developing new technologies and equipment," Howard Feldman,

director of regulatory and scientific affairs at the American Petroleum Institute, said earlier this year.

Scientists who have measured methane emissions over gas fields in the Uinta Basin of Utah say emissions are close to 9 percent (*ClimateWire*, Aug. 7, 2013). U.S. EPA suggests a leakage rate of 1.2 percent—equal to the annual emissions of 112 million cars. Schwietzke's studies jump into the fray with a more global perspective.

### **Revamping an inventory**

NOAA scientists sometimes go down to the Port in Los Angeles and attach air monitors to ships that can measure the levels of methane, CO<sub>2</sub>, ethane and other gases in the atmosphere. These are part of NOAA's network of monitoring sites, composed of ships, aircraft and tall towers sprinkled throughout the world, from the depths of the Amazon to frigid Antarctica.

Over the past two decades, the network has measured an average 550 teragrams of methane emitted to the atmosphere per year. The gas is emitted by wetlands (plants decaying in swamps emit the gas), rice fields, animals, the burning of wood or biomass, and oil and gas fields. The researchers wanted to figure out how much of the total methane was emitted by the natural gas industry.

Their task was complicated because natural gas, oil and coal are all roughly similar. Extraction of all three releases similar byproducts—methane and ethane, among others—to the atmosphere, albeit in different quantities.

So Schwietzke used inventories from EPA, the IPCC and other sources to estimate oil field and coal emissions. This partitioning had been done previously, but Schwietzke redid the inventory, driven by the understanding that all scientific findings are plagued by uncertainty. The previous inventories partitioning oil and coal had not stated how certain they were in their results.

Schwietzke found this problematic, since EPA and other inventories are known to be somewhat fallible (*EnergyWire*, Feb. 24).

Once he had his uncertainties, Schwietzke input his oil and coal numbers into a computer model. He also input methane emissions from wetlands, landfills, biomass burning and agriculture, all derived from previous scientific studies. The only missing link was emissions from the natural gas industry.

The computer model subtracted the range of emissions Schwietzke input from the real-world NOAA measurement of methane in the atmosphere. Its output was the average global methane leakage from the natural gas industry. This was at most 5 percent of global annual natural gas production.

### **High Utah rates not the norm**

To further refine his results, Schwietzke input the data into a more complicated three-dimensional atmospheric model. This model further constrained the global average emissions rate of methane to 2 to 4 percent.

Using real-world global data, his models suggest that natural gas producers are leaking to the atmosphere, on average, between 2 and 4 percent of the natural gas they produce.

That is enough to negate the climate benefits of gas over coal in the next two decades, the studies find. Various life-cycle analyses have found that in order for gas to be better than coal for the climate, the methane leakage rate has to be less than 3 percent. That overlaps the leakage found by Schwietzke.

Schwietzke's studies also suggest that the highest emissions rates in literature, such as the 9 percent recorded in the Uinta Basin of Utah, are not the norm across the United States. These fields deviate very significantly from the global norm, and likely from the national norm, Schwietzke said. He expressed surprise that such fields could occur in a technologically advanced nation like the United States.

"It could be that the industry practices they use in this basin are really bad," he said.

<http://wrd.cm/1yZnyGS>

### Changing Smell of Corpses Measures Time of Death

*Aromatic chemicals released by dead bodies change at certain times, and this can help forensic scientists and train cadaver sniffing dogs*

Jun 26, 2014 | By Ruth Knowles and ChemistryWorld

Not many of us like to consider the complex chemical processes that begin after we die. But new research into the chemical odors released by decomposing bodies is providing forensic scientists with a powerful tool to determine how long a person has been dead, a term known as post-mortem interval (PMI). Understanding this 'smell of death' also helps scientists understand how sniffer dogs discover buried disaster victims and locate clandestine graves.

An international research team used two-dimensional gas chromatography time-of-flight mass spectrometry to characterise the odours that create this smell of death: volatile organic compounds (VOCs). By measuring the VOCs released from pig carcasses the team identified a cocktail of several different families of molecules, including carboxylic acids, aromatics, sulfurs, alcohols, nitro compounds, as well as aldehydes and ketones. The combination and quantities of these VOCs change as a function of time as a cadaver goes through different stages of decomposition.

Author Jean-François Focant from the University of Liege, Belgium, tells Chemistry World: 'The use of state-of-the-art multi-dimensional techniques has allowed us to drastically improve our understanding of the VOC mixtures released during cadaveric decomposition. An odour fingerprint can be created for each stage of decomposition and possibly be used as an additional tool to estimate the PMI.'

Current PMI estimation is limited to assessing things like body cooling, how advanced decomposition is and the size of insects that have colonised the body. However, these do not always give an accurate answer. 'Charting the changes to

VOCs won't provide a 100% reliable way of estimating PMI but it might improve the situation enormously,' explains Anna Williams, a forensic anthropologist at the University of Huddersfield, UK.

The research could also help with the training of 'human remains detection canines'. 'We know very little about what compounds or combinations of compounds are recognised by sniffer dogs,' says Williams. 'Understanding this helps to improve their work in the field and with training aids. However, research on pigs as analogues for humans is compromised from the start. A human taphonomy facility (where the decomposition of human remains are studied) would boost forensic research.'

The development of a VOC profile for decomposing bodies should help scientists working to create an electronic nose, which are harder than dogs and do not need costly training and upkeep. Sniffer dogs are more adaptable than their e-nose counterparts, however, and by entering dangerous places alone they help to keep their handlers safe. 'Several groups are working on e-noses at the moment,' Focant says, 'but we are not sure if this technology will ever make sniffer dogs obsolete.'

<http://www.bbc.com/news/health-28044151>

### Big jump in Mers cases reported

*More than 100 more cases and 34 deaths from the new respiratory disease Mers-coronavirus have been reported by officials in Saudi Arabia.*

By James Gallagher Health editor, BBC News online

The cases date back to February and came to light after an analysis of hospital records. The World Health Organization says there have now been 820 cases of Mers and 286 deaths. The exact source of the novel infection is still uncertain, but camels are a prime suspect. The virus is from the same family as the common cold, but can lead to kidney failure and pneumonia. It was first detected in June 2012. The update from the Saudi authorities said there were 113 additional cases - 76 of the patients recovered, three are still in hospital and 34 have died. Cases have also been confirmed in Jordan, Qatar, the United Arab Emirates, France, Germany, Italy, Tunisia, Egypt, the UK and the US - usually after travel to Saudi Arabia.

### Source?

Researchers believe the coronavirus that causes the infection crossed over from animals. Earlier this month, a report in the New England Journal of Medicine found "identical" Mers viruses in camels and their owner. However, the link had not been conclusively proven and some researchers argue there may be another source.

The figures do show that nearly half of the cases were spread between people. It seems to have spread after close contact with family member or medical staff.

The World Health Organization does not recommend restrictions on trade or travel, but does warn people to avoid raw camel milk, camel urine and to ensure meat is properly cooked.

<http://bit.ly/1jzbiXz>

## 5 Scientists Weigh in on Acupuncture

*Despite its popularity, opinions on acupuncture are divided*

Jun 12, 2014 | By [Victoria Stern](#)

Millions of Americans turn to acupuncture each year to treat chronic pains [and even depression](#). Recently, researchers at Rutgers University reported that combining the acupuncturist's needle [with an electric current](#) could yield a new treatment for severe inflammation. Yet many scientists look skeptically at the practice.

There may not be a clear verdict yet but *Scientific American MIND* has brought together several experts to share their views. These include acupuncturist [Hugh MacPherson](#), senior research fellow at the University of York in England; [Edzard Ernst](#), emeritus professor of complementary medicine at the University of Exeter; [Shu-Ming Wang](#) of the Department of Anesthesiology and Perioperative Care at the University of California, Irvine, School of Medicine; pharmacologist [David Colquhoun](#) at University College London, also author of the blog DC's Improbable Science; and [Harriet Hall](#), a retired family physician and U.S. Air Force flight surgeon who writes the SkepDoc column in *Skeptical* magazine.

### What's your opinion on the evidence for acupuncture's effectiveness in medicine and specifically depression?

**MacPherson:** Strong evidence exists that acupuncture is effective for chronic pain conditions. For depression, we have evidence that acupuncture is a useful adjunct to conventional care. In one recent trial patients on antidepressants who received acupuncture did significantly better than those who just took medication. Patients who received counseling in addition to their medication received a similar benefit to the acupuncture group.

**Ernst:** Most studies examining the effectiveness of acupuncture are not rigorous. Those that are more rigorous fail to show that acupuncture is more than a placebo in managing depression.

**Wang:** My opinion is that acupuncture stimulations trigger the release of beneficial hormones and, theoretically, can serve as a mood stabilizer.

**Colquhoun:** Acupuncture does not work, which means all discussions of how it does work are irrelevant. I'm not aware of any evidence that acupuncture works for depression.

**Hall:** The published evidence on acupuncture indicates that it might be helpful for pain and possibly for postoperative nausea and vomiting, but not for any other

indications. All the evidence is compatible with the hypothesis that acupuncture is no more than a placebo.

### Why is it so hard to figure out whether acupuncture works or not?

**MacPherson:** Trials on acupuncture involve a lot of variability, especially in relation to depression, which is unlikely to be a single disease entity. Depression is commonly experienced with other symptoms. For example, the population of patients with depression we recruited in one study included around 50 percent in chronic pain. This variability creates what we could call "noise," making it more difficult to see whether an intervention works. The benefit one can ascribe to the placebo effect is not an important clinical question because in the real world patients benefit from simply consulting an acupuncturist.

**Ernst:** Studies are fraught with methodological problems such as finding a good placebo as well as logistical obstacles such as finding funding to conduct high-quality trials.

**Wang:** There are various stimulating techniques, follow-up period and study designs used by the researchers in clinical trials; thus, when we lump all the data from one illness, the significance may not be there. Furthermore, the belief of the participants significantly affects the results of the intervention.

**Colquhoun:** There is a lot of money at stake for those who sell acupuncture—and a certain amount of fascination with New Age thinking. There are excellent controls such as retractable needles. Almost all experiments show no difference between real and sham acupuncture.

**Hall:** Researcher bias tends to intrude because acupuncturists are the ones providing the therapy. Patients who don't believe in acupuncture are not likely to volunteer for an acupuncture study; those who accept the possibility that acupuncture will work may be biased. Also, the very nature of acupuncture insures that there will be a strong placebo component and it is impossible to do double-blind studies. For instance, patients will notice if you stick needles in them and acupuncturists know whether they are doing sham or real acupuncture.

### Why would targeting the body with a physical intervention help depression?

**MacPherson:** Acupuncture is a mind-body intervention. It does not just target physical symptoms. One of the reasons acupuncture may have a useful role for depression is that depression is experienced physically and emotionally. An intervention that incorporates an integrated approach to mental and physical symptoms would appear appropriate and, according to our depression trial, also evidenced-based.

**Ernst:** One theory holds that acupuncture increases endorphin levels in the brain. If this were true, it might help explain how acupuncture reduces depression.

**Wang:** Similar to physical activities, acupuncture can improve depression. It also has hormonal effects.

**Colquhoun:** Nobody has the slightest idea what causes depression. Experiments find acupuncture doesn't work any better than a control situation, at least not to any extent that a patient would notice.

**Hall:** In studies of depression any intervention may be helpful, even talking with a friend, so it is difficult to tease out the specific contribution of acupuncture. There appears to be no specific effect of the needles, only nonspecific treatment effects. For instance, patients get to relax for half an hour or so with personal, hands-on attention by someone who is convinced he or she is helping.

<http://www.medscape.com/viewarticle/827497?>

**EMA Advisory Panel Recommends First Biosimilar Insulin**  
*Committee for Medicinal Products for Human Use has recommended approval of a biosimilar version of insulin glargine for treatment of type 1 or 2 diabetes*

Miriam E. Tucker

The European Medicines Agency Committee for Medicinal Products for Human Use (CHMP) has recommended approval of a biosimilar version of insulin glargine (Abasria, Eli Lilly/Boehringer Ingelheim) for the treatment of type 1 or type 2 diabetes in adults and children as young as 2 years of age.

Abasria is a basal insulin with the same amino-acid sequence as the familiar Lantus (insulin glargine) developed by Sanofi, which has been available in the European Union since June 9, 2000. "Studies have shown Abasria to have a comparable quality, safety, and efficacy profile to Lantus (insulin glargine)," according to a CHMP statement.

Filed through the EMA's biosimilar pathway, Lilly/Boehringer Ingelheim's insulin glargine is the first biosimilar insulin recommended for approval in the European Union. The product is considered a biosimilar in some regions, including Europe, but not in others, including the United States.

According to the EMA, "Biosimilars can be authorized for use only once the period of data exclusivity on the original 'reference' biological medicine has expired. In general, this means that the biological reference medicine must have been authorized for at least 10 years before a similar biological medicine can be made available by another company."

The CHMP's recommendation for Lilly/Boehringer Ingelheim's insulin glargine is based on the companies' nonclinical and clinical development program, which included pharmacokinetic and pharmacodynamic studies, as well as phase 3 studies in patients with type 1 and type 2 diabetes. The European Commission's final decision is expected in approximately 2 months. A pharmacovigilance plan for Abasria will be implemented as part of the marketing authorization.

<http://bit.ly/1qo0YoW>

**Titan's Building Blocks Might Pre-date Saturn**

*Firm evidence that nitrogen in Titan's atmosphere originated in conditions similar to the cold birthplace of the most ancient comets from the Oort cloud*

A combined NASA and European Space Agency (ESA)-funded study has found firm evidence that nitrogen in the atmosphere of Saturn's moon Titan originated in conditions similar to the cold birthplace of the most ancient comets from the Oort cloud. The finding rules out the possibility that Titan's building blocks formed within the warm disk of material thought to have surrounded the infant planet Saturn during its formation.

The main implication of this new research is that Titan's building blocks formed early in the solar system's history, in the cold disk of gas and dust that formed the sun. This was also the birthplace of many comets, which retain a primitive, or largely unchanged, composition today.

The research, led by Kathleen Mandt of Southwest Research Institute in San Antonio, was published this week in the *Astrophysical Journal Letters*. Co-authors on the study include colleagues from France's National Center for Scientific Research (CNRS) and Observatoire de Paris.

Nitrogen is the main ingredient in the atmosphere of Earth, as well as on Titan. The planet-sized moon of Saturn is frequently compared to an early version of Earth, locked in a deep freeze.

The paper suggests that information about Titan's original building blocks is still present in the icy moon's atmosphere, allowing researchers to test different ideas about how the moon might have formed. Mandt and colleagues demonstrate that a particular chemical hint as to the origin of Titan's nitrogen should be essentially the same today as when this moon formed, up to 4.6 billion years ago. That hint is the ratio of one isotope, or form, of nitrogen, called nitrogen-14, to another isotope, called nitrogen-15.

The team finds that our solar system is not old enough for this nitrogen isotope ratio to have changed significantly. This is contrary to what scientists commonly have assumed.

"When we looked closely at how this ratio could evolve with time, we found that it was impossible for it to change significantly. Titan's atmosphere contains so much nitrogen that no process can significantly modify this tracer even given more than four billion years of solar system history," Mandt said.

The small amount of change in this isotope ratio over long time periods makes it possible for researchers to compare Titan's original building blocks to other solar system objects in search of connections between them.

As planetary scientists investigate the mystery of how the solar system formed, isotope ratios are one of the most valuable types of clues they are able to collect. In planetary atmospheres and surface materials, the specific amount of one form of an element, like nitrogen, relative to another form of that same element can be a powerful diagnostic tool because it is closely tied to the conditions under which materials form.

The study also has implications for Earth. It supports the emerging view that ammonia ice from comets is not likely to be the primary source of Earth's nitrogen. In the past, researchers assumed a connection between comets, Titan and Earth, and supposed the nitrogen isotope ratio in Titan's original atmosphere was the same as that ratio is on Earth today. Measurements of the nitrogen isotope ratio at Titan by several instruments of the NASA and ESA Cassini-Huygens mission showed that this is not the case — meaning this ratio is different on Titan and Earth — while measurements of the ratio in comets have borne out their connection to Titan. This means the sources of Earth's and Titan's nitrogen must have been different. Other researchers previously had shown that Earth's nitrogen isotope ratio likely has not changed significantly since our planet formed.

"Some have suggested that meteorites brought nitrogen to Earth, or that nitrogen was captured directly from the disk of gas that formed the sun. This is an interesting puzzle for future investigations," Mandt said.

Mandt and colleagues are eager to see whether their findings are supported by data from ESA's Rosetta mission, when it studies comet 67P/ Churyumov-Gerasimenko beginning later this year. If their analysis is correct, the comet should have a lower ratio of two isotopes — in this case of hydrogen in methane ice — than the ratio on Titan. In essence, they believe this chemical ratio on Titan is more similar to Oort cloud comets than comets born in the Kuiper Belt, which begins near the orbit of Neptune (67P/ Churyumov-Gerasimenko is a Kuiper Belt comet).

"This exciting result is a key example of Cassini science informing our knowledge of the history of solar system and how the Earth formed," said Scott Edgington, Cassini deputy project scientist at NASA's Jet Propulsion Laboratory, Pasadena, California.

<http://www.bbc.com/news/health-27984883>

### 'Most dangerous day of their life'

*The day a premature baby is born is the most dangerous of its life.*

By Paula McGrath Health check, BBC World Service

That's when the risk of death and disability is greatest. But doctors around the world are working to help more babies survive that day. Of the 15m premature babies born every year around the world, one million will die. Babies born too soon are vulnerable to infection and breathing can be difficult because of their

underdeveloped lungs. It's not always fully understood why babies are born early - but things which increase the likelihood include the age of the mother, some infections and if the woman has already had a premature baby.

Pre-term labour - defined as three weeks or more before the usual 40 weeks' gestation - is also higher in women from poor backgrounds, in multiple births (twins or more) or a condition called pre-eclampsia which causes high blood pressure and the only treatment is to deliver the baby.

Malaria can also cause a baby to be born early.

### The 'survival gap'

The first report on the global toll of prematurity was published just two years ago. [Born Too Soon](#) estimated that low-cost interventions could prevent up to three quarters of premature baby deaths each year.

Modern medicine has helped, but the current limit of survival appears to be around 23 weeks - just over halfway through the length of a normal pregnancy.

There is a stark divide between rich and poor countries. Two thirds of all premature births happen in [just 15 countries](#). Half of premature babies born at 24 weeks in developed countries survive, whereas half of babies born in developing countries at 32 weeks will die. This has been dubbed the "survival gap".

Joy Lawn, professor of maternal, reproductive and child health and director of [MARCH Centre](#) at the London School of Hygiene and Tropical Medicine is a Ugandan-born paediatrician who has worked in countries like Ghana.

She says the stubbornly high number of deaths of premature babies is limiting success in trying to achieve the fourth [Millennium Development Goal](#) - to reduce the number of deaths of children under five by two thirds.

"We've seen a fantastic progress for reducing deaths for children under five but with much less attention to newborns, particularly preterm babies", says Prof Lawn.

"So now 44% of child deaths globally are in the first month."

### Low cost measures

India tops the list of countries where most premature babies are born - and 60% of deaths in under-fives are newborns. But at Goa's Medical College in India, medics

### 15 countries account for two-thirds of the world's preterm births

1. India
2. China
3. Nigeria
4. Pakistan
5. Indonesia
6. United States of America
7. Bangladesh
8. Philippines
9. Dem. Rep. of Congo
10. Brazil
11. Ethiopia
12. United Republic of Tanzania
13. Uganda
14. Sudan
15. Kenya

Source: March of Dimes

are working to reverse the trend by introducing basic measures aimed at preventing infections.

Dr Mimi Silveira insists all visitors to the neonatal intensive care unit wash their hands thoroughly and wear aprons and indoor shoes. The staff even sterilise the babies' clothes. The measures appear to be helping.

Dr Silveira says: "Five years back our mortality rate was around 14% but last year it came down to 9.2% which I think is quite good. "Also babies born at 28 weeks and below had a mortality rate of almost 90%. Last year we had come down to 50%."

One other low-cost method of improving the chances of premature babies is by giving their mothers [corticosteroid injections](#) - costing just 60 cents - to help mature the baby's lungs before it birth, which can halve the risk of the baby having breathing problems.

### **Overcrowding**

Families often feel bewildered by the shock of a premature birth and bonding can be more difficult than with a full-term baby. Kangaroo care - where a baby is "worn" next to the mother's breast with direct skin-to-skin contact - helps to maintain a vulnerable baby's temperature, promotes breastfeeding and reduces the risk of infection. Importantly it [reduces the mortality rate](#) in stable preterm babies. The technique was pioneered by the Colombian doctor Edgar Rey Sanabria in the late 1970's - in response to overcrowding - there were too few incubators, so more than one baby had to be placed in each increasing the risk of infections spreading. Kangaroo care is now proved to save lives - helping to enable babies to gain the strength to go home more quickly.

It also helps with bonding during those first few weeks when a hospital environment can feel strange and stressful to new parents.

### **'The loveliest feeling'**

When Jo James gave birth to her daughter Molly at 28 weeks she weighed just under a kilo. Jo had been pregnant with twins after four miscarriages. But during a 3D ultrasound scan at 24 weeks she was told that Molly's sister, Lily, had died. She continued to carry both babies for a further four weeks. "But then there was no movement at all, so I thought right, I am going up [to the hospital] to get looked at. I was in slow labour." Both girls were delivered by Caesarean section.

"Lily was coming out first. If I'd gone into labour properly Lily would have come out and Molly followed - but she was too traumatised. "When she was born she wasn't breathing. But the doctors were brilliant. I saw her little head but it was five minutes before she breathed." Molly was "so small there were no clothes to fit her". Jo was unable to hold her daughter for nine days - but then tried kangaroo care. It was "the loveliest feeling", says Jo.

Molly, now three, only experiences minor effects after her birth says Jo.

"When she gets a cough she does get a bad chest infection. She's still on iron medicine to give her a bit of a boost, which she'll take until she's five at least."

Babies who are born very early - before 28 weeks - can often be left with lung problems, cerebral palsy and learning difficulties.

Even babies born just a few weeks early have higher rates of hospitalisation and illness than full-term infants. In addition to the human costs, preterm birth also costs \$26 billion annually, [according to the Institute of Medicine](#).

In the UK researchers have been following the progress of premature babies since 1995 in the [EPICure study](#). Many of the common difficulties like cerebral palsy - characterised by abnormal muscle tone like spasms - have begun to reduce according to Neil Marlow, professor of neonatal medicine at University College Hospital, London and one of the principal investigators of EPICure.

"We've seen that cerebral palsy has reduced quite dramatically over the last 10 to 15 years such that now we're beginning to see improvements for those babies who are most at risk which are those who are born very, very prematurely", he says.

### **Monitoring**

As well as intellectual impairment, another disability which can affect very premature babies is blindness. Immature blood vessels at the back of the baby's eye can grow in a disorganised manner, resulting in scarring and detachment of the light-sensitive retina. Oxygen therapy - given to babies born early who have problems breathing - increases the risk of this happening. So careful monitoring of babies is crucial, Prof Marlow says.

"In terms of vision loss and retinopathy we've now been able to do trials which tell us exactly how much oxygen to give and how to monitor that oxygen.

"And we think this is going to lead to a reduction further, together with some new therapies that are coming along."

Now that doctors understand more about what helps to give a premature baby the best chance of survival the next challenge - to reduce the amount of disability in the children who do survive being born early - is one which parents like Jo James will follow with interest.

She now campaigns for the premature baby charity [Bliss](#), along with the rest of her family. Jo says: "Since I had Molly, all of my aunts and friends knit for me.

"And I take hampers to the Birmingham Women's Hospital where she was born every Christmas, along with a hat and cardigan for every baby, because I know how helpless it feels when all you want is for your baby to be all right."

<http://bit.ly/1go3A61>

### **Clever copters developed at Sheffield can learn as they fly**

*Flying robots that can show true autonomy – and even a bit of politeness – in working together and venturing into hostile environments are being developed by engineers at the University of Sheffield.*

The research paves the way for robots to work intelligently alongside humans in ways that are currently familiar only through science fiction films.

The robots could play important roles in crisis situations such as search and rescue missions, or operate in environments where it would be dangerous for humans to work.

Using simple flying robots, called Quadcopters, the team, based in Sheffield's Department of Automatic Control and Systems Engineering (ACSE), has created software that enables the robot to learn about its surroundings using a forward facing camera mounted at the front of the machine.

The robot starts with no information about its environment and the objects within it. By overlaying different frames from the camera and selecting key reference points within the scene, it builds up a 3D map of the world around it. Other sensors pick up barometric and ultrasonic data, which give the robot additional clues about its environment.

All this information is fed into autopilot software to allow the robot to navigate safely, but also to learn about the objects nearby and navigate to specific items.

"We are used to the robots of science fiction films being able to act independently, recognise objects and individuals and make decisions," explains Professor Sandor Veres, who is leading the research.

"In the real world, however, although robots can be extremely intelligent individually, their ability to co-operate and interact with each other and with humans is still very limited.

"As we develop robots for use in space or to send into nuclear environments – places where humans cannot easily go – the goal will be for them to understand their surroundings and make decisions based on that understanding."

Another key task for these robots is to be able to interact and co-operate with each other without overloading communications networks – a vital ability in emergency situations where networks will already be overloaded.

Programming developed by the team enables the Quadcopters to work out how to 'politely' fly past each other without colliding. The robots start off flying at the same altitude and then need to collaborate to work out which robot would fly higher and which would fly lower so they are able to pass.

"The learning process the robots use here is similar to when two people meet in the street and need to get round each other," explains ACSE research fellow, Dr

Jonathan Aitken. "They will simultaneously go to their left or right until they coordinate and avoid collision."

The researchers used a computer concept called game theory to programme the quadcopters. In this framework, each robot is a player in the game and must complete its given task in order to 'win' the game.

If the robots play the game repeatedly they start to learn each other's behaviour. They can then perform their task successfully – in this case getting past the other robot – by using previous experience to estimate the behaviour of the other robot.

"These simple tasks are part of a major research effort in the field of robotics at Sheffield University," says Professor Veres. "The next step is to extend the programming capability so that multiple robots can collaborate with each other, enabling fleets of machines to interact and collaborate on more complex tasks."

<http://bit.ly/1x01FoP>

### **CDC recommends testing procedure that can detect HIV four weeks earlier**

*CDC recommending a new HIV testing approach that can diagnose HIV three to four weeks earlier than the previous recommended procedure*

By Arielle Duhaime-Ross

Today is National HIV testing day, so it's only fitting that the CDC announced on Thursday that it was recommending a new HIV testing approach that can diagnose HIV three to four weeks earlier than the previous recommended testing procedure.

Currently, most tests can only detect HIV about one or two months after the initial infection, because detectable levels of antibodies take time to build in the body.

But with this new, more sensitive procedure, individuals who test positive for HIV will finally become aware of their status at a time when they are most likely to pass it on. "Today, CDC is recommending a new approach for HIV testing in

laboratories that capitalizes on the latest technology to improve diagnosis" during the "earliest stage of HIV infection," said Jonathan Mermin, director of the CDC's National Center for HIV/AIDS, Viral Hepatitis, STD, and TB Prevention, in a statement.

"With consistent and widespread use of this new testing method, we can diagnose people several weeks earlier than before."

The new method consists of a series of three tests, reports Medscape. If the result of the first test — a fourth generation HIV test that detects the HIV p-24 antigen — is negative, no further tests are required. But if the test is positive, then the CDC recommends a second test, which can differentiate between HIV-1 antibodies and HIV-2 antibodies. Being able to tell the difference between the two can have

"important treatment implications," the CDC said.



If the results of the second test are negative, however, a third and final test will be necessary to ensure "accurate detection of early infection" or to indicate "a false positive from the fourth generation test," the CDC explained.

"Nearly 1 in 6 people living with HIV in the United States do not know they have HIV, meaning that they are missing out on essential care and may unknowingly transmit the virus," Mermin said. And about half of the estimated 50,000 new HIV infections that happen each year are transmitted by people who don't know their HIV status. So, the CDC is urging laboratories to adopt the new approach as quickly as possible.

"On National HIV Testing Day," Mermin said, "I urge all Americans to take the test and take control of their health."

<http://bit.ly/1nWdsxR>

## Sneezes Travel Even Farther Than We Thought

*Up to 200 Times Farther...*

Jun 17, 2014 | By Rachel Nuwer

This cloud has nothing to do with the weather. It's a cloud of snot, and when propelled by a sneeze, it can carry droplets 200 times farther than experts previously thought, according to research published in the *Journal of Fluid Mechanics*.

After filming people coughing and sneezing at high speed, mathematicians and engineers at the Massachusetts Institute of Technology ran mathematical models and simulations to investigate the cloud's role.

Approaching the violent respiratory event from a fluid mechanics perspective, the researchers found that some previous assumptions about sneezes were wrong. The largest mucus and spittle particles, for example, do not travel the farthest, even though that is what momentum would predict.

Unexpectedly, the tiniest droplets all interact with the gas instead of operating individually. Caught up in the cloud, they behave more like a whiff of smoke than the spray of a garden hose. As a result, whereas the large droplets travel up to four feet, the small droplets can reach eight feet.

This finding may be fundamental to our ability to control the spread of disease. A gaseous cloud of hitchhiking microbes could travel far enough to reach ventilation units, meaning its dispersal potential is much greater than had been assumed.

The work could help researchers estimate the disease-spreading potential of various air conditioners and map how pathogens may ultimately float around an office, airplane or home.

*From "Violent Expiratory Events: On Coughing And Sneezing," By Lydia Bourouiba, Eline Dehandschoewercker And John W. M. Bush, In Journal Of Fluid Mechanics, Vol. 745; April 2014*

[http://www.eurekalert.org/pub\\_releases/2014-06/niob-nre062614.php](http://www.eurekalert.org/pub_releases/2014-06/niob-nre062614.php)

## NIH-funded researchers extend liver preservation for transplantation

*Livers successfully stored for three days in animal study*

Researchers have developed a new supercooling technique to increase the amount of time human organs could remain viable outside the body. This study was conducted in rats, and if it succeeds in humans, it would enable a world-wide allocation of donor organs, saving more lives.

The research is supported by National Institute of Biomedical Imaging and Bioengineering (NIBIB) and the National Institute of Diabetes and Digestive and Kidney Disease (NIDDK), both parts of the National Institutes of Health.

The first human whole organ transplant 60 years ago—a living kidney transplant—changed the landscape of the medical world. Since then, transplants of skin, kidneys, hearts, lungs, corneas, and livers have become commonplace but due to a shortage of donor organs, more than 120,000 patients are still on waitlists for organ transplantation in the United States alone.

Current technology can preserve livers outside the body for a maximum of 24 hours using a combination of cold temperatures and a chemical solution developed by scientists at the University of Wisconsin-Madison in 1983. The solution helps keep the liver tissue from dying while in transit to the recipient site. This has helped increase the number of successful liver transplants—but extending even further the time a liver can survive outside the body would provide many benefits. It would allow for more time to prepare the patient and ease logistics at the donor hospital site, reduce the urgency of rushing the organ to its destination, and expand the donation area to allow for transcontinental and intercontinental transplantations—thus increasing the chances of patients finding better matches while simultaneously significantly reducing costs.

The difficulty with long-term preservation of human organs stems mostly from the extensive tissue damage that occurs when organs are cryopreserved, frozen at temperatures of -320.8 degrees Fahrenheit. While successful for single cells and simple tissues, the problem is exacerbated with whole organs because of the multiple cell types and other structures that react differently to cold. To combat these problems, Martin Yarmush, M.D., Ph.D., and Korkut Uygun, Ph.D., investigators in the Center for Engineering in Medicine at Massachusetts General Hospital (MGH), Boston, have developed a four-step preservation technique that has tripled the amount of time that rat livers can be stored before transplantation. In the June 29 online issue of *Nature Medicine*, the researchers describe their process. The first step is to employ the use of machine perfusion—a way of

delivering oxygen and nutrients to capillaries in biological tissues while outside the body—to supercool the liver tissue without causing irreversible damage to the cells. In order to accomplish this, the MGH team added 3-OMG (3-O-methyl-D-glucose), a non-toxic, modified glucose compound, to the solution being delivered to the liver. The 3-OMG is taken up and because it cannot be metabolized by cells, accumulates in the hepatocytes (liver cells), acting as a protectant against the cold. The team also modified the solution by adding PEG-35kD (polyethylene glycol) to specifically protect cell membranes. Ethylene glycol is the active ingredient in anti-freeze, and it works by lowering the freezing point of a solution.

The livers were then slowly cooled below the freezing point, to 21 degrees Fahrenheit, without inducing freezing—thereby supercooling the organ for preservation. After storing the organs for several days, the researchers again used machine perfusion to rewarm the organ, while also delivering oxygen and other nutrients to prepare the organ for transplantation.

Using this new technique, the researchers were able to store the supercooled rat livers for three days (72 hours) and four days (96 hours) at 21 degrees Fahrenheit. All the rats who had supercooled livers stored for three days survived three months, but none of the rats who had transplants using current methods did. The survival rate for animals receiving livers stored for four days was 58 percent. When testing to see if all the steps in their method were essential, the researchers found that if they eliminated the supplemental components PEG-35kD or 3-OMG, none of the rats survived for even a week. If they did not use machine perfusion or supercooling, death occurred within an hour of transplantation.

"The next step will be to conduct similar studies in larger animals," said Rosemarie Hunziker, Ph.D., program director of Tissue Engineering and Regenerative Medicine at NIBIB. "It is exciting to see such an achievement in small animals, by recombining and optimizing existing technology. The main point here is that using all of these approaches at once was what led to success. Halfway measures did not do. Such a tour de force reflects this team's very deep understanding of the complex processes at work here, and how they relate simultaneously to each other."

The process must go through extensive testing and refinement before it could be considered for use in humans. But the technique's achievement in being the first method to have a successful survival rate after the livers had been stored for three days and possible potential for four-day storage has broad implications for the future of liver transplantation.

"The longer we are able to store donated organs, the better the chance the patient will find the best match possible, with both doctors and patients fully prepared for surgery," said Hunziker. "This is a critically important step in advancing the practice of organ storage for transplantation."

*Among the researchers contributing to this project are Tim Berendsen, M.D., who performed the transplants, and Bote Bruinsma, an M.D., PhD. student at University of Amsterdam conducting his graduate studies with Drs. Yarmush and Uygun. The team was comprised of 10 engineers, scientists and surgeons at the Center for Engineering in Medicine at the Massachusetts General Hospital/Harvard Medical School, Boston.*

*This work was supported by NIH's National Institute of Biomedical Imaging and Bioengineering and the National Institute of Diabetes and Digestive and Kidney Disease under award numbers R01EB008678, R01DK096075, R00DK080942, R00DK088962; the authors also gratefully acknowledge Shriners Hospitals for Children.*