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Study finds connection between cardiac blood test before surgery and adverse outcomes

Doctors can predict who is at greater risk of heart attacks and other negative vascular events after surgery

HAMILTON, ON - A common cardiac blood test done before surgery can predict who will experience adverse outcomes after most types of surgery, says an international study led by Hamilton researchers.

Globally, of the 200 million adults who undergo major surgery, 18 percent will experience serious cardiac and vascular complications including death within 30 days following their intervention, such as hip and knee replacements, bowel resections and abdominal aortic aneurysm repair.

"Any type of surgery has the potential to cause damage to heart tissue, through blood clot formation, long periods of inflammation, or bleeding," said study lead, Dr. PJ Deveraux, professor of medicine, cardiologist at Hamilton Health Sciences (HHS) and scientific lead for perioperative research at McMaster University and HHS' Population Health Research Institute (PHRI).

The VISION study looked at whether levels of a cardiac blood test, NT-proBNP, measured before surgery can predict cardiac and vascular complications.Higher levels of NT-proBNP, which can be caused by various anomalies in the cardiac muscle, such as stress, inflammation or overstretch, can help identify which patients are at greatest risk of cardiac complications after surgery.

The study included 10,402 patients aged 45 years or older having non-cardiac surgery with overnight stay from 16 hospitals in nine countries. "As a result of these findings, doctors can predict who is at greater risk of heart attacks and other negative vascular events after surgery," said Dr. Devereaux. This phase of the VISION study builds upon six years of research studies to understand pre- and post-operative factors that lead to cardiac complications.

"This simple blood test can be done quickly and easily as part of patient's pre-operative evaluation and can help patients better understand their risk of post-operative complications and make informed decisions about their surgery," said first author of the publication, Dr. Emmanuelle Duceppe, internist and researcher at the Centre Hospitalier de l'Universite de Montreal (CHUM), PhD candidate in clinical epidemiology at McMaster University, and associate researcher at PHRI. "This blood test is twenty times cheaper than more time-consuming tests such as cardiac stress tests and diagnostic imaging."

Results of this simple blood test may inform the type of surgery the patient will undergo, such as laparoscopic or open surgery, the type of anesthesia used during surgery and who will require more intense monitoring post-operatively. Blood test results can also reduce the need for pre-surgical medical consultations for patients that show no risk for cardiac complications.

"Heart injury after non-cardiac surgery is emerging as an important health issue requiring attention. Using CIHR funding, the research group led by PHRI and Dr. Devereaux, has clarified the association between an elevation of a common biomarker and the risk of per-operative morbidity and mortality," said Dr. Brian H. Rowe, Scientific Director, Institute of Circulatory and Respiratory Health, Canadian Institutes for Health Research. Study data was published today in *Annals of Internal Medicine*.

http://bit.ly/2ZojOS2

'Lost crops' could have fed as many as maize

Experimental cultivation of seed crops lost to history reveals much higher yields than expected

Make some room in the garden, you storied three sisters: the winter squash, climbing beans and the vegetable we know as corn. Grown together, newly examined "lost crops" could have produced enough seed to feed as many indigenous people as traditionally grown

maize, according to new research from Washington University in St. Louis.

But there are no written or oral histories to describe them. The domesticated forms of the lost crops are thought to be extinct.

Writing in the *Journal of Ethnobiology*, Natalie Muellert, assistant professor of archaeology in Arts & Sciences, describes how she painstakingly grew and calculated yield estimates for two annual plants that were cultivated in eastern North America for thousands of years -- and then abandoned.

Growing goosefoot (*Chenopodium,* sp.) and erect knotweed (*Polygonum erectum*) together is more productive than growing either one alone, Mueller discovered. Planted in tandem, along with the other known lost crops, they could have fed thousands.

Archaeologists found the first evidence of the lost crops in rock shelters in Kentucky and Arkansas in the 1930s. Seed caches and dried leaves were their only clues. Over the past 25 years, pioneering research by Gayle Fritz, professor emerita of archaeology at Washington University, helped to establish the fact that a previously unknown crop complex had supported local societies for millennia before maize -- a.k.a. corn -- was adopted as a staple crop.

But how, exactly, to grow them?

The lost crops include a small but diverse group of native grasses, seed plants, squashes and sunflowers -- of which only the squashes and sunflowers are still cultivated. For the rest, there is plenty of evidence that the lost crops were purposefully tended -- not just harvested from free-living stands in the wild -- but there are no instructions left.

"There are many Native American practitioners of ethnobotanical knowledge: farmers and people who know about medicinal plants, and people who know about wild foods. Their knowledge is really important," Mueller said. "But as far as we know, there aren't any people who hold knowledge about the lost crops and how they were grown.

"It's possible that there are communities or individuals who have knowledge about these plants, and it just isn't published or known by the academic community," she said. "But the way that I look at it, we can't talk to the people who grew these crops.

"So our group of people who are working with the living plants is trying to participate in the same kind of ecosystem that they participated in -- and trying to reconstruct their experience that way."

That means no greenhouse, no pesticides and no special fertilizers.

"You have not just the plants but also everything else that comes along with them, like the bugs that are pollinating them and the pests that are eating them. The diseases that affect them. The animals that they attract, and the seed dispersers," Mueller said. "There are all of these different kinds of ecological elements to the system, and we can interact with all of them."

Her new paper reported on two experiments designed to investigate germination requirements and yields for the lost crops.

Mueller discovered that a polyculture of goosefoot and erect knotweed is more productive than either grown separately as a monoculture. Grown together, the two plants have higher yields than global averages for closely related domesticated crops (think: quinoa and buckwheat), and they are within the range of those for traditionally grown maize.

"The main reason that I'm really interested in yield is because there's a debate within archeology about why these plants were abandoned," Mueller said. "We haven't had a lot of evidence about it one way or the other. But a lot of people have just kind of assumed that maize would be a lot more productive because we grow maize now, and it's known to be one of the most productive crops in the world per unit area."

Mueller wanted to quantify yield in this experiment so that she could directly compare yield for these plants to maize for the first time.

But it didn't work out perfectly. She was only able to obtain yield estimates for two of the five lost crops that she tried to grow -- but not for the plants known as maygrass, little barley and sumpweed.

Reporting on the partial batch was still important to her.

"My colleagues and I, we're motivated from the standpoint of wanting to see more diverse agricultural systems, wanting to see the knowledge and management of indigenous people recognized and curiosity about what the ecosystems of North America were like before we had this industrial agricultural system," Mueller said.

http://bit.ly/2Zrulf9

Powder, not gas: A safer, more effective way to create a star on Earth

Sprinkling boron powder into the plasma could aid in harnessing the ultra-hot gas within a tokamak facility

A major issue with operating ring-shaped fusion facilities known as tokamaks is keeping the plasma that fuels fusion reactions free of impurities that could reduce the efficiency of the reactions. Now, scientists at the U.S. Department of Energy's (DOE) Princeton Plasma Physics Laboratory (PPPL) have found that sprinkling a type of powder into the plasma could aid in harnessing the ultra-hot gas within a tokamak facility to produce heat to create electricity without producing greenhouse gases or long-term radioactive waste.

Fusion, the power that drives the sun and stars, combines light elements in the form of plasma -- the hot, charged state of matter composed of free electrons and atomic nuclei -- that generates massive amounts of energy. Scientists are seeking to replicate fusion on Earth for a virtually inexhaustible supply of power to generate electricity.

"The main goal of the experiment was to see if we could lay down a layer of boron using a powder injector," said PPPL physicist Robert Lunsford, lead author of the paper reporting the results in Nuclear Fusion. "So far, the experiment appears to have been successful."

¬The boron prevents an element known as tungsten from leaching out of the tokamak walls into the plasma, where it can cool the plasma particles and make fusion reactions less efficient. A layer of boron is applied to plasma-facing surfaces in a process known as "boronization." Scientists want to keep the plasma as hot as possible -- at least ten times hotter than the surface of the sun -- to maximize the fusion reactions and therefore the heat to create electricity.

Using powder to provide boronization is also far safer than using a boron gas called diborane, the method used today. "Diborane gas is explosive, so everybody has to leave the building housing the tokamak during the process," Lunsford said. "On the other hand, if you could just drop some boron powder into the plasma, that would be a lot easier to manage. While diborane gas is explosive and toxic, boron powder is inert," he added. "This new technique would be less intrusive and definitely less dangerous."

Another advantage is that while physicists must halt tokamak operations during the boron gas process, boron powder can be added to the plasma while the machine is running. This feature is important because to provide a constant source of electricity, future fusion facilities will have to run for long, uninterrupted periods of time. "This is one way to get to a steady-state fusion machine," Lunsford said. "You can add more boron without having to completely shut down the machine."

There are other reasons to use a powder dropper to coat the inner surfaces of a tokamak. For example, the researchers discovered that injecting boron powder has the same benefit as puffing nitrogen gas into the plasma -- both techniques increase the heat at the plasma

edge, which increases how well the plasma stays confined within the magnetic fields.

The powder dropper technique also gives scientists an easy way to create low-density fusion plasmas, important because low density allows plasma instabilities to be suppressed by magnetic pulses, a relatively simple way to improve fusion reactions. Scientists could use powder to create low-density plasmas at any time, rather than waiting for a gaseous boronization. Being able to create a wide range of plasma conditions easily in this way would enable physicists to explore the behavior of plasma more thoroughly.

In the future, Lunsford and the other scientists in the group hope to conduct experiments to determine where, exactly, the material goes after it has been injected into the plasma. Physicists currently hypothesize that the powder flows to the top and bottom of the tokamak chamber, the same way the plasma flows, "but it would be useful to have that hypothesis backed up by modeling so we know the exact locations within the tokamak that are getting the boron layers," Lunsford said.

This research was supported by the DOE Office of Science (FES) and the Euratom research and training programme. The research group included collaborators from Germany's Max Planck Institute for Plasma Physics.

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Study reveals which countries' researchers work through their holidays

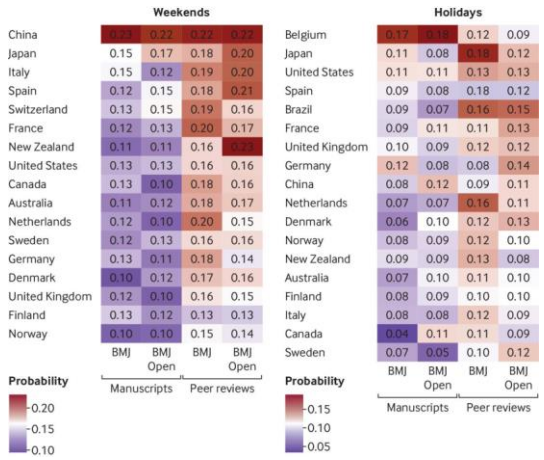
Academics are renowned for working long hours but exactly how often they work on holidays and at weekends has now been revealed.

By Jamie Durrani

The study examined when manuscripts and peer reviews were submitted to two medical journals to uncover how likely scientists are to work outside of office hours – and which countries' researchers struggle most with work–balance.

Long working hours and time spent preparing manuscripts for publication are common complaints in academic circles. Heavy workloads were at the heart of strikes that affected 60 UK universities earlier this month.

Now, researchers in Australia and the UK have attempted to quantify how often academics around the world carry on working late into the night, and even into weekends and holidays. They analysed the time when almost 50,000 scientific articles and 76,000 peer reviews were submitted to the *The BMJ* and *BMJ Open* over the last eight years.



An image showing each country's probability of submission on weekends and holidays **Source:** ***© 2019, British Medical Journal Publishing Group***

Out of hours work was strongly correlated with country, which the researchers behind the study say means that 'a "culture of overwork" is a literal thing, not just a figure of speech'. The study found that scientists in Belgium were the most likely to give up their holidays to finish off that important paper, while researchers in Canada were the most likely to switch off over national breaks.

Researchers in China were the most likely to work on manuscripts through the night and over the weekend, whereas Danish scientists were the most likely to submit their work during the middle of the day.

The researchers who carried out the analysis noted that submitting a paper is the last step of a long process – this means that while a paper might be submitted on the weekend, the majority of the work that went into it could have been done during office hours. They

also point out that different working cultures in other fields might reveal different paper-writing habits.

While they expected to see an increase in the proportion of papers submitted in non-working hours, reflecting increasing pressures on academics' time, no such change was observed over the period.

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http://bit.ly/2ESoOos

Poor antibiotic stewardship blamed as India found to be superbug's birthplace

New research shows another highly drug resistant pathogen that has gone global most likely originated on the Indian subcontinent

By Dinsa Sachan

Over a decade ago, the scientific community raised the alarm over New Delhi metallo-β-lactamase-1 (NDM-1), an enzyme that confers resistance to most antibiotics on bacteria such as Klebsiella pneumoniae and Escherichia coli. The gene for this enzyme, which subsequently spread around the world, was traced back to an infection in a Swedish patient treated at a New Delhi medical facility. Now, new research shows another highly drug resistant pathogen that has gone global most likely originated on the Indian subcontinent too.

Sequencing of 340 samples of the multi-drug resistant Staphylococcus aureus strain, known as the Bengal Bay clone, has traced its origins to the Indian subcontinent in the 1960s.[1] The samples were collected over 10–15 years from 14 countries, including India and Bangladesh.

Methicillin-resistant *Staphylococcus aureus* (MRSA) is principally a threat to hospital patients and the immunocompromised and can often lead to deadly conditions such as sepsis. MRSA claimed nearly 20,000 lives in the US in 2017 alone.

Steven Tong, associate professor at the Peter Doherty Institute for Infection and Immunity in Australia, and his team attempted to work out when the Bengal Bay clone formed by measuring the mutation rates of the samples. 'Based on that, we could estimate backwards back to when we think it all started – 1960,' says Tong.`

Joakim Larsson, who is the director at the centre for antibiotic resistance research at University of Gothenburg in Sweden, says studies like this one that trace the origin of resistant pathogens are valuable to manage antibiotic resistance. 'I think we can expect to see more and more problematic pathogens coming from regions with poor antibiotic stewardship and insufficient transmission control,' he says.

India's growing resistance problem

Antibiotic resistance isn't a problem for just India though. According to the UN, 700,000 people die every year as a result of antimicrobial resistance. By 2050, this number could hit 10 million.

But the problem in India is particularly acute. A recent review found that 70% of *Klebsiella spp*, 54% *of E. coli* and 78% of *Acinetobacter* isolates obtained from babies with neonatal sepsis in hospitals were multi-drug resistant.[2] Another study found that 70% of 207 individuals in India had antibiotic resistant bacteria in their stools.[3]

The US Center for Disease Dynamics, Economics and Policy has developed a tool called the Drug Resistance Index (DRI), which maps out the efficacy of antibiotics for particular pathogens in a specific location. In a 2019 study, India was found to have the lowest DRI among 41 countries, indicating that the country has high levels of resistance to most commonly consumed antibiotics in the country. Other countries with extremely low DRI scores include Ecuador, Thailand and Venezuela. Wealthy countries such as Sweden, Canada and Denmark were found to be the best stewards of antibiotics.

As meat production continues to grow in developing countries, antibiotic resistance is also rapidly spreading through animals as

farmers rely heavily on antibiotics to keep livestock healthy. The epicentres of antibiotic resistance in animals lie in India and China. Kamini Walia, a scientist at the division of epidemiology and communicable diseases at the Indian Council of Medical Research, says two things drive resistance in people in India: irrational use of antibiotics and poor sanitation.

It is little surprise that India struggles with resistance problems when it is one of the largest consumers of antibiotics in the world. The nation's drug laws restrict the sale of antibiotics without a prescription, but pharmacists often ignore this. Problems with unnecessary antibiotics prescriptions persist too.

India also suffers from a severe shortage of doctors and pharmacists, particularly in rural areas. 'How can you think of having a good antibiotics stewardship programme in the absence of the human resources you require to run it?' says Walia. To top it all, medical consultation and diagnostic tests are more expensive than antibiotics, she notes, forcing people to self-medicate.

A superbug birthplace?

There have been reports of other superbugs arising in India. Last year, scientists at a hospital in Vellore reported a highly virulent form of *K. pneumoniae*. It was resistant to carbapenem antibiotics, which are reserved for fighting multidrug resistant bacteria. More than half of the patients who reported this strain succumbed to the infection – an unusually high mortality rate.

While NDM-1 and Bengal Bay Clone have been traced to the subcontinent, it's not clear how many superbugs originate from the Indian subcontinent. The quality of resistance surveillance varies from country to country. 'If a country has more surveillance or better surveillance, they can find a superbug first but that superbug may not have emerged in that country,' says Coilin Nunan, scientific adviser for the charity Alliance to Save our Antibiotics. 'And so, sometimes where something is first found can get blamed for the emergence, but that's not necessarily the case.'

He notes that antibiotic resistance genes can jump from one bacterium to another, making it hard to track their spread. Sometimes resistance emerges in one country, but is only scaled up in another, Nunan adds.

Ramanan Laxminarayan, founder and director of the CDDEP, says it's unfair to call India a 'birthplace of superbugs' based on the NDM-1 and Bengal Bay Clone findings. 'These [superbugs] are being selected for everywhere, all the time,' says Laxminarayan, citing the example of the US300 MRSA strain that was first reported in the US and is now found in many countries. 'The likelihood in India is potentially greater because of the background of burden of bacterial infections, large population, easy transmission of pathogens and large use of antibiotics.'

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https://nyti.ms/39a4CfN

The Ganges Brims With Dangerous Bacteria

This sacred river offers clues to the spread of one of the world's most daunting health problems: germs impervious to common medicines.

By Donald G. McNeil Jr.

GANGOTRI, India — High in the Himalayas, it's easy to see why the Ganges River is considered sacred.

According to Hindu legend, the Milky Way became this earthly body of water to wash away humanity's sins. As it drains out of a glacier here, rock silt dyes the ice-cold torrent an opaque gray, but biologically, the river is pristine — free of bacteria.

Then, long before it flows past any big cities, hospitals, factories or farms, its purity degrades. It becomes filled with a virulent type of bacteria, resistant to common antibiotics.

The Ganges is living proof that antibiotic-resistant bacteria are almost everywhere. The river offers powerful insight into the prevalence and spread of drug-resistant infections, one of the world's most pressing public health problems. Its waters provide clues to how these pathogens find their way into our ecosystem.

Winding over 1,500 miles to the Bay of Bengal, Ma Ganga — "Mother Ganges"— eventually becomes one of the planet's most polluted rivers, a mélange of urban sewage, animal waste, pesticides, fertilizers, industrial metals and rivulets of ashes from cremated bodies.

But annual tests by scientists at the Indian Institute of Technology show that antibiotic-resistant bacteria appear while the river is still flowing through the narrow gorges of the Himalayan foothills, hundreds of miles before it encounters any of the usual suspects that would pollute its waters with resistant germs.

The bacterial levels are "astronomically high," said Dr. Shaikh Ziauddin Ahammad, a professor of biochemical engineering at the Indian Institute of Technology. The only possible source is humans, specifically the throngs of ritual bathers who come to wash away their sins and immerse themselves in the waters.

India's resistance problem

Beyond the Ganges, India has some of the highest antibiotic-resistance rates in the world, according to a 2017 report from the government's Ministry of Science and Technology.

Tests showed that about 70 percent of four bacteria species commonly found in hospital patients were resistant to typical first-line antibiotics. Between 12 percent and 71 percent — depending on the species tested — were also resistant to carbapenems, a class of antibiotics once considered the last line of defense.

Other studies confirm the danger. An article in Lancet Infectious Diseases found that about 57 percent of infections in India with Klebsiella pneumoniae, a common bacterium, were carbapenem-resistant.

But where exactly do these armies of drug-resistant germs come from? Are they already everywhere — in the soil beneath our feet, for example? Do they emerge in hospitals, where antibiotics are heavily used?

Are they bred in the intestines of livestock on factory farms? Do they arise in the fish, plants or plankton living in lakes downstream from pharmaceutical factories?

Or are the germs just sitting inside the patients themselves, waiting for their hosts to weaken enough for them to take over?

Research now being done in India and elsewhere suggests an answer to these questions: Yes, all of the above.

But how drug-resistant bacteria jump from one human to another outside of a hospital setting is the least-understood part of the process, and that is why the findings from the Ganges are so valuable.

Origins of drug-resistant germs

Antibiotic-resistance genes are not new. They are nearly as old as life itself.

On a planet that is about 4.5 billion years old, bacteria appeared about 3.8 billion years ago. As they fed on one other — and later on molds, fungi, plants and animals — their victims evolved genes to make bacteria-killing proteins or toxins, nature's antibiotics. (Penicillin, for example, was discovered growing in mold.)

The bacteria, in turn, evolved defenses to negate those antibiotics. What modern medicine has done, scientists say, is put constant Darwinian pressure on bacteria.

Outside the body, they face sunlight, soap, heat, bleach, alcohol and iodine. Inside, they face multiple rounds of antibiotics. Only the

ones that can evolve drug-resistance genes — or grab them from a nearby species, which some bacteria can do — will survive.

The result is a global bout of sudden-death elimination at a microscopic level. Bacteria once susceptible to all families of antibiotics have become resistant to penicillins, then tetracyclines, then cephalosporins, then fluoroquinolones — and so on, until nearly nothing works against them.

"When bacteria are stressed, they turn on their S.O.S. system," said David W. Graham, a professor of ecosystems engineering at Newcastle University in Britain and a pioneer in antibiotic-resistance testing. "It accelerates the rate at which they rearrange their genes and pick up new ones."

Eight years ago, Dr. Ahammad, a former student of Dr. Graham, suggested testing Indian waters.

"Until then," Dr. Graham said, "I had avoided India because I thought it was one huge polluted mess." With antibiotic-resistant bacteria so ubiquitous, it would be hard to design a good experiment — one with a "control," someplace relatively bacteria-free. "We needed to find some place with clear differences between polluted and unpolluted areas," Dr. Graham said.

That turned out to be the Ganges.

Healthy pilgrims, dangerous germs

Although it is officially sacred, the Ganges is also a vital, working river. Its numerous watersheds in the mountains, across the Deccan Plateau and its vast delta serve 400 million people — a third of India's population — as a source of drinking water for humans and animals, essential for crop irrigation, travel and fishing.

Twice a year, two of Dr. Ahammad's doctoral students, Deepak K. Prasad and Rishabh Shukla, take samples along the whole river, from Gangotri to the sea, and test them for organisms with drug-resistance genes.

The high levels discovered in the river's lower stretches were no surprise. But the researchers found bacteria with resistance genes even in the river's first 100 miles, after it leaves Gangotri and flows past the next cities downstream: Uttarkashi, Rishikesh and Haridwar.

More important, the researchers found that the levels were consistently low in winter and then surged during the pilgrimage season, May and June.

Tiny Gangotri is so high in the mountains that it closes in winter, made impassable by the snow. But in summer, the area's population swells with hundreds of thousands of pilgrims.

Because the district is sacred, no alcohol or meat may be sold there. Devout Hindus are often vegetarian and abstemious.

The riverside cities have wide flights of steps, called ghats, leading into the water, often with netting or guardrails. They help pilgrims safely immerse themselves and drink — a ritual that is supposed to wash away sins and hasten entry into paradise.

Souvenir stands sell plastic jugs so pilgrims can take Ganges water home to share.

The most famous of the Upper Ganges pilgrimage cities is Rishikesh. Its streets are lined with hotels with names like Holy River and Aloha on the Ganges. Besides pilgrims, Westerners pour in for the town's annual yoga festival or to study in its many ashrams and ayurvedic medicine institutes.

In 1968, the Beatles studied Transcendental Meditation there with the Maharishi Mahesh Yogi. In his pre-Apple days, Steve Jobs pursued enlightenment there. Prince Charles and Camilla Parker-Bowles have visited.

Adventure tourists also travel there. Rishikesh offers river-rafting, mountain trekking, zip lines and paintball tournaments.

The population is about 100,000 in winter, but in the pilgrimage-vacation season it can swell to 500,000. The city's sewage

treatment plant can handle the waste of only 78,000 people, Dr. Ahammad said. The government deploys many portable toilets, but the slightest rainstorm can send sewage cascading into the river.

In 2014, Dr. Graham and Dr. Ahammad found the clean-versus-dirty line in the Ganges to be at its starkest at Rishikesh.

Upstream, the water was fairly clean both summer and winter, but downstream in summer, the levels of bacteria with drug-resistance genes were astounding. The levels of NDM-1 — a drug-resistance gene that was first discovered in India and whose first two initials stand for New Delhi — were 20 times higher.

That finding has led the researchers to several conclusions. The resistant bacteria in the water had to have come from people — specifically, from their intestines. Perhaps more intriguing, those people were fairly healthy — most were hale and hearty enough to be pilgrims, yoga students or river-rafters.

Presumably, Dr. Ahammad and Dr. Graham explained, the healthy travelers "bad" gut flora were held in check by their "good" flora.

At least 1,000 bacterial species have been found colonizing human intestines. A healthy individual has at least 150 species, all competing with one another for space and food.

People can shed the bacteria they carry into the Ganges, Dr. Ahammad's and Dr. Graham's research shows. Then, if someone else picks them up, then falls ill and is given antibiotics, the person's good bacteria can be killed and the bad ones have an opportunity to take over.

Pilgrimage areas, Dr. Ahammad and Dr. Graham wrote, are "potential hot spots for antibiotic-resistance transmission at large scales." "We are not telling people to stop rituals they've done for thousands of years," Dr. Ahammad said. "But the government should do more to control the pollution and protect them."

What will be required, he said, is an Indian equivalent of the Clean Water Act, which provided billions of federal dollars to build hundreds of sewage treatment plants across the United States.

And even that, he explained, would not be enough. While tertiary sewage treatment can kill or remove resistant bacteria, it doesn't destroy free-floating DNA. "That technology hasn't been invented yet," said Mr. Shukla, who is working to invent it.

A continuing risk

In the meantime, pilgrims will continue to be at risk, trusting in the gods to protect them.

"Ganga is our mother — drinking her water is our fate," said Jairam Bhai, a large, jovial 65-year-old food vendor who held two small jugs as he waited to descend into the water in Gangotri. "If you have faith, you are safe."

"We don't follow bacteria, we don't think about it," added Jagdish Vaishnav, a 30-year-old English teacher who said he swam and drank the water in Rishikesh, Haridwar and even in Varanasi, where torrents of raw sewage can be seen flowing into the river.

Devout Hindus go there to die so that they can be cremated on the ghats or on floating rafts and have their ashes can be strewn on the water to free them from the cycle of death and rebirth.

Up high in Gangotri, the priests on the banks say they are well aware of the dangers downstream.

"Below Haridwar, I believe there are chances of disease," said Basudev Semwal, 50. "That's why we publicize that people should come here — because it's cleaner."

His companion, Suraj Semwal, 44, said the government should do more. If all Hindu religious figures could get together, they might be able to demand a cleanup, he said. But the many Hindu religious orders are not hierarchical like those of Roman Catholicism, which has a Pope.

"Everyone has their own voice, so they can't speak together," he said.

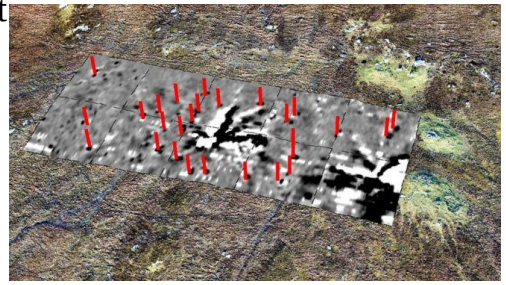
In Canada, he said he had heard, "There is a river where you can get fined if you even touch it — and it's just a river, not holy at all. Here we have a holy river, and it's very dirty and nothing is being done."

https://bbc.in/2tQ5l5G

Lewis stone circle has star-shaped lightning strike

Evidence of a "massive" lightning strike has been found at the centre of a stone circle in the Western Isles.

A single large strike, or many smaller ones on the same spot, left a star-shaped magnetic anomaly at the 4,000-year-old site in Lewis. Scientists made the discovery at Site XI or Airigh na Beinne Bige, a hillside stone circle now consisting of a single standing stone. The site is at the famous Calanais Standing Stones.



Evidence of the strike at the centre of the stone circle was found during a geophysics survey **University of St Andrews**

Scientists said the lightning strike, which was indentified in a geophysics survey, could show a potential link between the construction of ancient stone circles and the forces of nature.

They said the lightning struck some time before peat enveloped the stone circle at Site XI 3,000 years ago. The discovery is detailed in new research published online.

Dr Richard Bates, of the University of St Andrews, said: "Such clear evidence for lightning strikes is extremely rare in the UK and the association with this stone circle is unlikely to be coincidental.

"Whether the lightning at Site XI focused on a tree or rock which is no longer there, or the monument itself attracted strikes, is uncertain. "However, this remarkable evidence suggests that the forces of nature could have been intimately linked with everyday life and beliefs of the early farming communities on the island."

The discovery was made by the Calanais Virtual Reconstruction Project, a joint venture led by the University of St Andrews with standing stones trust Urras nan Tursachan and the University of Bradford and supported by funding from Highlands and Islands Enterprise.

The same project has also produced a 3D virtual model recreating another of the area's "lost" stone circle, Na Dromannan. Its stones are today either lying flat or buried under peat.

The new discovery was made at the famous Calanais Standing Stones **Getty Images**

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http://bit.ly/2ZxltF7

Chimpanzees more likely to share tools, teach skills when task is complex

Teach a chimpanzee to fish for insects to eat, and you feed her for a lifetime. Teach her a better way to use tools in gathering prey, and you may change the course of evolution.

For most wild chimpanzees, tool use is an important part of life—but learning these skills is no simple feat. Wild chimpanzees transfer tools to each other, and this behavior has previously been shown to serve as a form of teaching.

A new study led by researchers at Washington University in St. Louis, the University of Miami and Franklin & Marshall College finds that chimpanzees that use a multi-step process and complex tools to gather termites are more likely to share tools with novices.

The research was conducted in partnership with the Wildlife Conservation Society, Lincoln Park Zoo and the Jane Goodall Institute. The study helps illuminate chimpanzees' capacity for prosocial—or helping—behavior, a quality that has been recognized for its potential role in the evolution of human cultural abilities.

"Non-human primates are often thought to learn tool skills by watching others and practicing on their own, with little direct help from mothers or other expert tool users," said Stephanie Musgrave, assistant professor of anthropology at the University of Miami, and first author of the study published the week of Dec. 23 in the *Proceedings of the National Academy of Sciences*.

"In contrast, the results from this research indicate that social learning may vary in relation to how challenging the task is: during tasks that are more difficult, mothers can in fact play a more active role, including behaviors that function to teach."

Beginning with Jane Goodall in the 1960s, researchers have been studying chimpanzee tool use for decades at the Gombe Stream Research Center in Tanzania. The Gombe chimpanzee study is one of the longest running studies of animal behavior in the wild. This year marks the 20-year anniversary of the study of chimpanzees in the Goualougo Triangle, Republic of Congo, where researchers have documented some of the most complex tool behaviors of chimpanzees.

The study is distinctive because it applies standardized methods to directly compare how processes of cultural transmission may differ between two populations of wild chimpanzees. In both populations, the chimpanzees use tools to target the same resource—but the task varies in complexity.

The findings of the current study are important on a number of levels, Musgrave said. "First, chimpanzee populations may vary not only in the complexity of their tool behaviors but in the social mechanisms that support these behaviors," she said. "Second, the capacity for helping in chimpanzees may be both more robust and more flexible than previously appreciated."

Maintaining chimpanzee cultures

Among animals, chimpanzees are exceptional tool users. Different groups of chimpanzees use different types of tools—and likewise, researchers have suggested that the teaching process might be customized to facilitate these local skills.

In this study, researchers examined the transfer of tools between chimpanzees during termite gathering, and compared the population in the Goualougo Triangle, Republic of Congo, with the population in Gombe, Tanzania.

Termites and other insects are a valuable source of fat and protein in the diet of wild chimpanzees and also contribute important vitamins and minerals. Termites build complex nest structures that encompass a network of below-ground chambers, sometimes topped with a towering, freestanding mound reaching several meters high.

Chimpanzees in both locations use fishing-probe style tools to harvest termites, but Goualougo chimpanzees use multiple, different types of tools sequentially. They also make tools from specific plant species and customize fishing probes to improve their efficiency.

The researchers found differences in the rate, probability and types of tool transfer during termite gathering between these two populations.

At Goualougo, where the fishing tasks were more complex, the rate of tool transfer was three times higher than at Gombe, and Goualougo mothers were more likely to transfer a tool in response to a request. Further, mothers at Goualougo most often responded to tool requests by actively giving a tool to offspring. Such active transfers were never observed at Gombe, where mothers most often

responded by refusing to transfer tools. Given that offspring in both populations made comparable requests for tools, these differences suggest that mothers at Goualougo were in fact more willing to provide tools.

"We have previously documented that tool transfers at Goualougo function as a form of teaching," said Crickette Sanz, associate professor of biological anthropology in Arts & Sciences at Washington University. "The population differences we observed in the present study suggest that teaching may be related specifically to the demands of learning to manufacture tools at Goualougo, where chimpanzees use multiple tool types, make tools from select plant species, and perform modifications that increase tool efficiency."

"An increased role for this type of social learning may thus be an important component of the transmission of complex tool traditions over generations," she said. "While Gombe and Goualougo chimpanzees both fish for termites, we suspected that there might be differences in how this skill is acquired," said Elizabeth Lonsdorf, associate professor of psychology at Franklin & Marshall College. "But only after many years of accumulating these data were we able to rigorously quantify these differences."

"To date, prosocial helping in chimpanzees has been principally examined in captivity or using differing methods in the wild," said Stephen Ross, director of the Lester E. Fisher Center for the Study and Conservation of Apes at Lincoln Park Zoo. "This study provides novel evidence for helping behavior in wild chimpanzees and demonstrates that chimpanzees can help flexibly depending on context."

A shared capacity

Understanding how chimpanzee tool traditions are passed on over generations can provide insights into the evolutionary origins of complex cultural abilities in humans.

"Human evolution is characterized by the emergence and elaboration of complex technologies, which is often attributed to our species' aptitude for passing skills onto one another through mechanisms such as teaching and imitation. However, the evolutionary origins of these capacities remain unclear," Musgrave said.

"Our research shows that the human propensity to assist others in acquiring complex skills may build at least in part upon capacities that we share with our closest living relatives."

Conservation efforts are fundamental to this research and future studies. "Chimpanzees and their cultures are endangered," said Emma Stokes, director of the Central Africa Program at the Wildlife Conservation Society.

"Recent research shows that human activity imperils the survival of chimpanzee cultures. Studying our closest living relatives offers a unique opportunity to gain insights into the evolutionary origins of cultural behavior—but this privilege depends on long-term efforts to conserve these apes and their habitats."

More information: *Stephanie Musgrave el al., "Teaching varies with task complexity in wild chimpanzees," PNAS (2019). www.pnas.org/cgi/doi/10.1073/pnas.1907476116*

http://bit.ly/2slAv4l

New Study Identifies Key Characteristics of Expert Liars

Good liars lean towards telling inconsequential lies, mostly to colleagues and friends

According to a **new study** published in the journal ***PLoS ONE***, good liars lean towards telling inconsequential lies, mostly to colleagues and friends, and generally via face-to-face interactions; they may attempt to strategically manipulate their verbal behavior to stay close to the truth and to tell a plausible, simple, and clear story.

Verigin *et al* found that self-reported good liars (i) may be responsible for a disproportionate amount of lies in daily life, (ii) tend to tell inconsequential lies, mostly to colleagues and friends, and generally via face-to-face interactions, and (iii) highly rely on verbal strategies of deception, most commonly reporting to embed their lies into truthful information, and to keep the statement clear, simple and plausible. Image credit: Ryan McGuire.

"We found a significant link between expertise at lying and gender. Men were more than twice as likely to consider themselves expert liars who got away with it," said Dr. Brianna Verigin, a researcher at the University of Portsmouth and the University of Maastricht.

The study involved 194 participants (97 females, 95 males, 2 preferred not to say), with an average age of 39.

They were asked a series of questions including how good they were at deceiving others, how many lies they'd told in the past 24 hours, the type of lies they'd told, who to, and whether they'd done so face-to-face or via other means.

"Time after time, studies have shown we are not as good at detecting lies as we think we are. At best, most of us have a 50:50 chance of getting it right when someone is pulling the wool over our eyes," Dr. Verigin said.

"We wanted to focus on those who are good at lying and try to understand how they do it and to whom."

The scientists found one of the key strategies of liars is to tell plausible lies that stay close to the truth, and to not give away much information. And the better someone thinks they are at lying, the more lies they'll tell.

The most commonly used strategy among all those who admitted to lying, whether experts or poor liars, was to leave out certain information.

But expert liars added to that an ability to weave a believable story embellished with truth, making the lies harder to spot.

In contrast, those who thought they weren't good at lying resorted, when they did lie, to being vague.

Overall, of the 194 participants, the most common types of deception, in descending order, were 'white lies,' exaggerations, hiding information, burying lies in a torrent of truth and making up things.

Most people chose to lie face-to-face, then via text message, a phone call, email, and last, via social media.

Most expert liars lie most often to family, friends or colleagues. Employers and authority figures were least likely to be lied to.

The study showed no link between level of education and lying ability.

"More research needs to be done, particularly on better understanding good liars' expertise at embedding lies within truthful information, and at using facts that were impossible to check," Dr. Verigin said.

B.L. Verigin et al. *2019. Lie prevalence, lie characteristics and strategies of self-reported good liars.* PLoS ONE *14 (12): e0225566; doi: 10.1371/journal.pone.0225566*

https://nyti.ms/34QtLbT

Asian Giant Hornet Invasion Threatens Honey Bees in Pacific Northwest

An expert said of the hornets: "They are sworn enemies of honey bees. I would say a bee's worst nightmare."

By Neil Vigdor

As if honey bees didn't have enough to contend with, from pesticides to bacterial pathogens, another nemesis has emerged in the Pacific Northwest, one capable of freaking out humans, too.

It's called the Asian giant hornet — and is also known as the yak-killer hornet, the commander wasp in Korea and the tiger head bee in Taiwan, according to experts.

As the names indicate, the hornets are indigenous to Asia, but some appeared for the first time this month in Washington State, where

agricultural officials have issued a pest alert and warned that the hornets pose a threat to honeybees.

They showed up in British Columbia in August, prompting a similar advisory from the Canadian province's agriculture ministry.

The reputation of the mammoth hornets — which are distinguished by their yellow heads and can be nearly two inches long with a wingspan of up to three inches — precedes them.

May Berenbaum, the head of the entomology department at the University of Illinois at Urbana-Champaign, said on Monday that the hornets can wipe out an entire beehive.

They're generally not aggressive toward humans but their stingers are about six millimeters long and can inflict substantial pain and possibly even death in someone who is allergic, she said.

"You want to talk about beepocalypse," Professor Berenbaum said. "They are sworn enemies of honey bees. I would say a bee's worst nightmare. Probably the worst nightmare of a lot of people, too."

The Asian giant hornet has appeared for the first time in Washington State. **Credit...Nobuo Matsumura/Alamy**

A resident of Blaine, Wash., which is on the Canadian border and about 30 miles south of Vancouver, found a dead hornet on Dec. 8 that was then collected by state entomologists, the Washington State Department of Agriculture said.

The agency said it confirmed that the specimen was an Asian giant hornet. The resident reported that a second hornet had been flying near a hummingbird feeder before it disappeared into a nearby forest, officials said.

"Though they are typically not interested in humans, pets or large animals, they can inflict a nasty sting if threatened or their nest is disturbed," the state agency said in the pest alert, on Dec. 19.

In British Columbia, officials advised residents to report any sightings of the hornets to the Ministry of Agriculture and take photographs if possible.

"Asian Hornets are not interested in humans, pets and large animals," the ministry said. "They hunt insects for food. The only time hornets will attack is when their nest is disturbed. Asian Hornets will feed on honeybees and are capable of destroying hives in a short time period."

Insect experts said that the pests, which are among the largest hornets, are usually dormant at this time of year. They make their nests in the ground.

Professor Berenbaum said there was a distinct possibility that the hornets were "stowaways" on a ship that crossed the Pacific and could be attracted to any kind of sugary fermenting cargo. They could have also nested in any soil used as ballast material in ships, she said. "I can't imagine why anyone would deliberately bring this over," she said. "There are so many ways insects can be accidentally transported."

Unlike honey bees in North America, honey bees in Asia have developed their own defenses against the Asian giant hornet as they have evolved, Professor Berenbaum said. "When a hornet gets into the nest, they mob the hornet and generate enough body heat to kill it," she said.

In 2014, she wrote an essay titled "Spirits of the Hive" for the American Entomologist, the journal of the Entomological Society of America, about how Asian giant hornets are steeped in liquor by distillers in Asia. A Taiwanese graduate student once presented her with a bottle of Asian hornet wine.

The professor also keeps a specimen of the Asian giant hornet.

"I have a Lucite paperweight with one in there," she said. "It kind of showcases how enormous they are."

http://bit.ly/2MsVLvS

Why isn't there a vaccine for staph?

New approach points to untapped immune cells, early immunization

Staph bacteria, the leading cause of potentially dangerous skin infections, are most feared for the drug-resistant strains that have become a serious threat to public health. Attempts to develop a vaccine against methicillin-resistant *Staphylococcus aureus* (MRSA) have failed to outsmart the superbug's ubiquity and adaptability to antibiotics.

Now, a study from Washington University School of Medicine in St. Louis may help explain why previous attempts to develop a staph vaccine have failed, while also suggesting a new approach to vaccine design. This approach focuses on activating an untapped set of immune cells, as well as immunizing against staph in utero or within the first few days after birth.

The research, in mice, found that T cells -- one of the body's major types of highly specific immune cells -- play a critical role in protecting against staph bacteria. Most vaccines rely solely on stimulating the other main type of immune cells, the B cells, which produce antibodies to attack disease-causing microorganisms such as bacteria. The findings are published online Dec. 24 in the *Journal of Clinical Investigation*.

"Across the globe, staph infections have become a pervasive health threat because of increasing antibiotic resistance," said senior author Juliane Bubeck Wardenburg, MD, PhD, director of the university's Division of Pediatric Critical Care. "Despite the medical community's best efforts, the superbug has shown a consistent ability to elude treatment. Our findings indicate that a robust T cell response is absolutely essential for protection against staph infections."

Highly contagious, staph survives and thrives on human skin and can be spread through skin-to-skin contact or exposure via contaminated surfaces. Generally, the bacteria live harmlessly and invisibly in about one-third of the population. From their residence on the skin, the bacteria can cause red, pus-filled sores. Ever persistent, the superbug will deliver recurrent infections in about half of its victims.

Staph strains can enter the bloodstream, bones or organs and lead to pneumonia, severe organ damage and other serious complications in hundreds of thousands of people each year. More than 10,000 people die in the U.S. from drug-resistant staph infections annually.

"The focus in the vaccine field for *Staphylococcus aureus* during the past 20 years has been on generating antibody responses, not on specific T cell responses," Bubeck Wardenburg said. "This new approach shows promise."

For nearly 15 years, Bubeck Wardenburg has studied a single toxin -- called alpha-toxin -- made by staph. This toxin plays a role in tissue damage in multiple forms of infection. "An important thing about the alpha-toxin is that it is found in all staph strains, meaning those that are and are not antibiotic-resistant," she said. "Understanding this allowed us to devise studies in mice that examined the effect of alpha-toxin on the immune response in minor skin infections as well as in more serious infections that spread in the bloodstream."

The researchers found that the immune cells did not protect mice that had minor staph infections on their skin. However, mice that were exposed to life-threatening staph infections in the bloodstream did develop protection. "We discovered a robust T cell response targeting staph in the bloodstream," Bubeck Wardenburg said. "By contrast, T cells were diminished in skin infections as a result of the toxin. Because skin infection is very common, we think that staph

uses alpha-toxin to prevent the body from activating a T cell response that affords protection against the bacteria."

In terms of the big picture, Bubeck Wardenburg said blocking the toxin in skin infections may yield a healthy T cell response.

Further, protecting the T cell response from the time of birth may reprogram the bacteria's overall effect on the immune system. "This bug is deliberate and acts in a sinister way early on," she said. "The bug appears to be using the toxin to shape the T cell response in a way that's favorable for the bug but not for humans."

Previous vaccine development efforts have focused on adults. However, Bubeck Wardenburg said, a vaccine may be more likely to succeed if administered before infants first encounter staph. Therefore, immunization should happen before initial exposure to staph, to block the toxin and generate a vigorous T cell response.

"We envision two strategies," Bubeck Wardenburg said. "One is immunizing pregnant women so they can transfer antibodies that protect infants against the toxin at birth. The second involves immunizing infants within a day or two after birth. Neither of these strategies has been considered for staph vaccines to date."

http://bit.ly/2tKuXAK

Many younger patients with stomach cancer have a distinct disease, Mayo research discovers

New, early onset form often grows and spreads more quickly, has a worse prognosis, and is more resistant to traditional chemotherapy treatments

ROCHESTER, Minn. — Many people under 60 who develop stomach cancer have a "genetically and clinically distinct" disease, new Mayo Clinic research has discovered. Compared to stomach cancer in older adults, this new, early onset form often grows and spreads more quickly, has a worse prognosis, and is more resistant to traditional chemotherapy treatments, the study finds. The research was published recently in the journal Surgery.

While rates of stomach cancer in older patients have been declining for decades, this early onset cancer is increasing and now makes up more than 30% of stomach cancer diagnoses.

"I think this is an alarming trend, as stomach cancer is a devastating disease," says senior author Travis Grotz, M.D., a Mayo Clinic surgical oncologist. "There is little awareness in the U.S. of the signs and symptoms of stomach cancer, and many younger patients may be diagnosed late — when treatment is less effective."

The research team studied 75,225 cases using several cancer databases to review stomach cancer statistics from 1973 to 2015. Today, the average age of someone diagnosed with stomach cancer is 68, but people in their 30s, 40s and 50s are more at risk than they used to be.

Although there's no clear cutoff age for the definition of early onset and late-onset stomach cancer, the researchers found the distinctions held true whether they used an age cutoff of 60, 50 or 40 years. The researchers found that the incidence of late-onset stomach cancer decreased by 1.8% annually during the study period, while the early onset disease decreased by 1.9% annually from 1973 to 1995 and then increased by 1.5% through 2013. The proportion of early onset gastric cancer has doubled from 18% of all cases in 1995 to now more than 30% of all gastric cancer cases.

"Typically, we see stomach cancer being diagnosed in patients in their 70s, but increasingly we are seeing 30- to 50-year-old patients being diagnosed," Dr. Grotz says.

The increased rate of the early onset disease is not from earlier detection or screening, Dr. Grotz adds. "There is no universal screening for stomach cancer, and the younger patients actually presented with later-stage disease than the older patients," he says.

In addition to being more deadly, early onset stomach cancer is also genetically and molecularly distinct, researchers found. Furthermore, traditional risk factors for developing stomach cancer

among older Americans, such as smoking tobacco, did not appear to correlate with its early onset counterpart.

"Hopefully, studies like this will raise awareness and increase physician suspicion of stomach cancer, particularly in younger patients," Dr. Grotz says. Younger patients who feel full before finishing a meal, or have reflux, abdominal pain, unintentional weight loss and difficulty eating should see their health care provider, he adds.

Stomach cancer is the 16th most common cancer in the U.S., according to the American Cancer Society. It has a five-year survival rate of 31.5%, and there will be an estimated 27,510 new cases in 2019, according to the National Cancer Institute.

Next the research team hopes to better identify risk factors for early onset stomach cancer using the Rochester Epidemiology Project and potentially other large databases.

The study's lead author is John Bergquist, M.D., now with Stanford University. At the time of the study, Dr. Bergquist was a surgical outcomes fellow in the Mayo Clinic Robert D. and Patricia E. Kern Center for the Science of Health Care Delivery. Study co-authors are Jennifer Leiting, M.D.; Elizabeth Habermann, Ph.D.; Sean Cleary, M.D.; Michael Kendrick, M.D.; Rory Smoot, M.D.; David Nagorney, M.D.; and Mark Truty, M.D. — all of Mayo Clinic.

The research was supported in part by the Mayo Clinic Robert D. and Patricia E. Kern Center for the Science of Health Care Delivery.

The researchers report no conflicts of interest.

https://wb.md/39ePvla

Flu Season Worsens Early, More Deaths Reported

Influenza has spread across the entire United States during week 50, worsening several weeks earlier than last year

Troy Brown, RN

Influenza has spread across the entire United States during the week ending December 14 (week 50), worsening several weeks earlier than last year, according to a report from the Centers for Disease Control and Prevention (CDC).

This season, at least 3.7 million influenza cases, 32,000 hospitalizations, and 1800 deaths have occurred from influenza.

Pediatric deaths are also up from last year: The CDC received reports during week 50 of nine pediatric deaths that occurred during the weeks ending November 2 and December 14 of this year; that brings the total to 19 this season. Last flu season, one child died during week 50 for a total of seven deaths by the end of that week.

Another significant difference from last year is the national emergence of influenza B/Victoria as the predominant virus this early; last flu season at this point, all viruses cocirculated but B/Victoria did not predominate until much later.

"A(H1N1) viruses are the next most common and are increasing in proportion relative to other influenza viruses in some regions," the CDC explains in its report.

Two child deaths were linked to influenza A(H1N1)pdm09 virus infection and seven were associated with influenza B viruses. Lineage determination for two of the influenza B viruses found that both were B/Victoria viruses.

The proportion of outpatient visits for influenza-like illness was 3.9%, and has now been above the baseline of 2.4% for 6 weeks.

High levels of influenza-like illness have been reported in Puerto Rico, New York City, and 19 states (Alabama, Arizona, Arkansas, Colorado, Florida, Georgia, Kansas, Kentucky, Maryland, Mississippi, Nebraska, New Mexico, Oklahoma, Oregon, South Carolina, Tennessee, Texas, Virginia, and Washington).

Activity has been moderate in the District of Columbia and six states (Connecticut, Illinois, Minnesota, New Jersey, North Carolina, and North Dakota), and low in 10 states (California, Hawaii, Indiana, Massachusetts, Nevada, New York, Pennsylvania, Utah, Wisconsin, and Wyoming).

Geographically, influenza-like illness was widespread in Puerto Rico and 30 states (Alabama, Alaska, Arizona, California,

Connecticut, Delaware, Florida, Georgia, Idaho, Indiana, Kentucky, Louisiana, Maryland, Massachusetts, Minnesota, Mississippi, Montana, Nebraska, Nevada, New Mexico, New York, North Carolina, Ohio, Oregon, Pennsylvania, South Carolina, Tennessee, Texas, Virginia, and Washington).

Activity was regional in 17 states (Arkansas, Colorado, Illinois, Iowa, Kansas, Maine, Michigan, Missouri, New Hampshire, New Jersey, North Dakota, Oklahoma, Rhode Island, South Dakota, Utah, Wisconsin, and Wyoming).

Virtually all (> 99%) viruses that have undergone testing have shown susceptibility to the four influenza antiviral drugs that the US Food and Drug Administration recommends for this season.

The CDC says there is still time to get vaccinated and urges everyone to do so.

https://wb.md/378LYTF

Updated Guidance for Hepatitis C Virus Treatment in Primary Care

We lack enough providers willing to diagnose, evaluate, treat, and monitor most of the infected patients in the primary care setting.

David E. Bernstein, MD

Imagine a chronic disease spreading through the population, shortening lives and causing untold misery. What if a few months' worth of pills could cure it? Wouldn't we do whatever we could to banish this disease from our communities?

We do have such a disease—hepatitis C virus (HCV) infection—and we do have a cure: direct-acting antiviral (DAA) therapy. What we lack is enough providers willing to diagnose, evaluate, treat, and monitor most of the infected patients in the primary care setting. Without the participation of our primary care providers (PCPs), thousands of people will face the looming specter of a liver transplant.

Against this backdrop, the New York State Department of Health AIDS Institute (NYSDOH AI) updated evidence-based HCV screening and clinical management guidelines specifically for PCPs. *Treatment of Chronic HCV with Direct-Acting Antivirals* is a tool to help PCPs integrate HCV evaluation and management into their practices. New information addresses DAA agents that are available and used in the United States, treating patients with "undetectable" or "indeterminate" HCV genotype results, managing HCV infection in pregnancy (including HCV screening in women who are pregnant or planning to become pregnant), and HCV testing in transgender women and individuals who are taking pre-exposure prophylaxis to prevent HIV.

At the same time, the guideline sets specific parameters for referral to a liver disease specialist. Specialist care is indicated for patients with compensated or decompensated cirrhosis, concurrent hepatobiliary conditions, extrahepatic manifestations of HCV infection (including renal, dermatologic, and rheumatologic manifestations), a glomerular filtration rate of < 30 mL/min, chronic hepatitis B virus (HBV) infection, or DAA retreatment for patients for whom first-line treatment failed. The guideline is available online and updated whenever new information becomes available.

Curing Chronic HCV Infection

Chronic HCV infection, one of the leading indications for liver transplantation and the most common chronic bloodborne infectious disease in the United States, is now curable in more than 95% of individuals treated with DAA agents. This cure rate applies to all HCV genotypes, including 1 and 3, which were difficult to treat before the advent of DAA agents. Cure has also been achieved in people who could not be cured by older HCV treatment regimens and in those with compensated or decompensated cirrhosis, advanced kidney disease (including patients receiving dialysis), or

HCV/HIV coinfection. People for whom first-line HCV treatment failed are now being cured with second-line DAA treatment.

Achieving cure is easier now than in the past because DAA agents are highly effective, much easier to tolerate than older HCV treatments, taken for a short period of time, and have a low pill burden. Most DAA regimens can be administered as either a single tablet or three tablets taken once daily for 8, 12, or 16 weeks. Side effects are minimal, with approximately 10% of patients experiencing headache, nausea, or fatigue. Most people receiving DAA treatment report no side effects or that they feel better than before starting treatment.

Curing HCV infection reduces morbidity by slowing or halting the progression of liver diseases, including cirrhosis or liver cancer. With DAA treatment, liver health improves to the degree that many patients experience a reversal of cirrhosis. Perhaps most exciting is that curing chronic HCV infection has been associated with an overall increase in survival among patients with non–liver-related diseases, such as stroke and heart disease.

Striving for Eradication

On the heels of the discovery of a cure for HCV infection, the World Health Organization (WHO) set a goal of eliminating HCV infection globally by 2030. However, the United States will not meet that goal because the incidence of HCV infection is increasing among people younger than 30 years and because access to healthcare remains a significant challenge in this country.

Rising US incidence of HCV infection in people younger than 30 years. HCV infection is not distributed equally across the United States. More than 50% of people infected with HCV live in just 9 states: California, Texas, Florida, New York, Pennsylvania, Ohio, Michigan, Tennessee, and North Carolina. Many of these states are experiencing an opioid epidemic crisis. Increased opioid use among people younger than 30 years is associated with increased incidence of HCV infection in this population, creating a large population of young people in their early teens to mid-20s who are infected with HCV. Although baby boomers (individuals born between 1945 and 1965) are being diagnosed with, treated for, and cured of chronic HCV infection, new HCV infections are accumulating in younger people who use injection drugs.

Limited access to affordable care. Another significant challenge to HCV infection eradication is that many individuals who would benefit from DAA therapy cannot afford it or cannot access treatment. These drugs often have high medication copays, and insurance companies may deny coverage based on disease severity. These barriers place people who have a curable disease at risk of developing cirrhosis, liver cancer, or liver failure.

Shortage of DAA treatment providers. Access to care for HCV infection is also limited by a shortage of clinicians with specialized knowledge of HCV treatment. Treatment with DAA agents can be complicated. The DAA agents include different classes of medications that are combined for optimal effect. The mechanism of action is not the same across all drug classes, nor is the safety profile of drugs within each class. As a result, not all patients can take all DAA agents. For example, people with compensated liver disease should not take DAA protease inhibitors. To ensure effective treatment for each individual, comprehensive pretreatment assessment is essential to identifying the best DAA regimen.

HCV treatment can also have unexpected and unintended consequences. Reports of herpes simplex virus and HBV flares have prompted new recommendations for evaluation and monitoring when clinicians treat patients with HCV/HBV coinfection. These viral flares are manageable with careful observation of patients during HCV treatment and follow-up of patients whose disease is cured.

Ongoing Challenges

Prevention, diagnosis, and treatment of HCV infection remain challenges in the United States, and HCV infection is increasing in some populations. Despite the simplified treatment and cure offered by DAA therapy, the rising incidence of HCV infection secondary to the opioid epidemic and issues of affordable and accessible treatment are barriers to cure in the United States and globally. Considerable understanding of HCV infection and its treatment is still required to provide care to all people infected with HCV. The NYSDOH AI guideline focuses on increasing the number of PCPs able to treat chronic HCV infection and is an important component of the state's efforts to eradicate the disease. If successful in this endeavor, New York will help move the United States closer to achieving the WHO goal of global eradication of HCV infection by 2030.

David E. Bernstein, MD, is a hepatologist with decades of experience in treating liver disease.

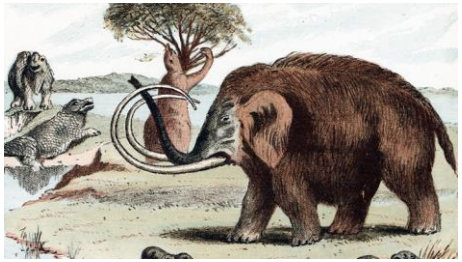
http://bit.ly/2ZqwY12

What Happens to Meat When You Freeze It for 35,000 Years

A gastronomic investigation of mammoth feasts

Sarah Zhang

Up in the Arctic cold, frozen woolly-mammoth carcasses can be so well preserved that they still have blood in their veins. Their flesh is still pink—which means that, of course, yes, someone has thought about eating it. Tales of dining on woolly mammoths frozen since the Ice Age range from the fantastical to the truer and grosser. Let us start—why not?—with the fantastical stories.



Universal History Archive / Getty Images

In 1901, an expedition to the Beresovca River in Siberia found a male mammoth so exquisitely preserved that it still had grass in its mouth. The mammoth's bones and skin were put on display in St. Petersburg, and its flesh was, supposedly, served at a "mammoth banquet." The meal was a hit, according to one glowing account, "particularly the course of mammoth steak, which all the learned guests declared was agreeable to the taste, and not much tougher than some of the sirloin furnished by butchers of today."

Half a century later, the Explorers Club put on its own exotic feast in New York. This time, the prehistoric flesh reportedly came from a carcass found in the Aleutian Islands, by a Jesuit-turned-geologist known as the Glacier Priest. Each diner got mere slivers of meat, but those slivers made quite the impression. Guests went home bragging of their Ice Age dinner. But they later disagreed over whether the meat was really supposed to be mammoth or mastodon or an extinct giant sloth called megatherium.

In any case, DNA analysis of meat from the 1951 dinner eventually proved it was none of the above. It wasn't even prehistoric at all. Its DNA matched green sea turtle, a modern and living species. As for the 1901 banquet, well, that couldn't have been mammoth either. "All stories published in newspapers of this country of a dinner in St. Petersburg where the meat of the Beresovca mammoth was served, are a hundred per cent invention," the paleontologist I. P. Tolmachoff wrote in the *Transactions of the American Philosophical Society* back in 1929. As Tolmachoff also wrote, woolly-mammoth meat frozen for tens of thousands of years is "absolutely unpalatable" with "an intolerable putrid smell." It is not something that belongs on a dinner table. It is certainly not something that belongs in a human mouth.

Which brings us to the true stories of eating—or attempting to eat—frozen mammoth.

In the 18th and 19th century, explorers to Siberia wrote that the region's indigenous people, the Evenki, occasionally fed their dogs mammoth meat. But humans have generally been less enthusiastic about eating it. Over tens of thousands of years, the things that make meat tasty turn quite foul.

Fat is one problem. It turns to soap—specifically, a substance called adipocere, also known as "corpse wax" or "grave wax" when it's found in human bodies left in cool, wet conditions. Paleontologists have noticed it in the fat of woolly mammoths too, even though extremely cold conditions are thought to inhibit the microbes that turn fat into adipocere. The substance could have formed in Siberia, says Shari Forbes, a forensics expert at Université du Québec à Trois-Rivières, if temperatures ever fluctuated over tens of thousands of years. Adipocere, she adds, can have the texture of cottage cheese. The smell is rancid. "I know why people would not want to eat it!," she wrote to me in an email.

The muscle of the frozen mammoths changes as well, like meat left in the freezer for too long. (In this case, many, many millennia too long.) The formation of ice crystals would pierce the muscle fibers of the meat, says Matt Hartings, a food chemist at American University. Frozen, the meat might still be reasonably solid and, well, meat-like. But once defrosted, he says, "it'll be turned into a goo."

In fact, Dmitry V. Arzyutov, a historian at the KTH Royal Institute of Technology, wrote earlier this year that Russian paleontologists he interviewed about woolly mammoths "had tried to fry mammoth meat, but it had turned into a smelly liquid." Not that this has stopped certain mammoth hunters. In the recent woolly-mammoth documentary *Genesis 2.0*, one expeditioner even chews raw Ice Age meat on camera.

"It looks for me like a common practice among them," Arzyutov added to me in an email. Male bravado, he suggested, may have something to do with it.

https://bbc.in/37aeHaC

New engine tech that could get us to Mars faster

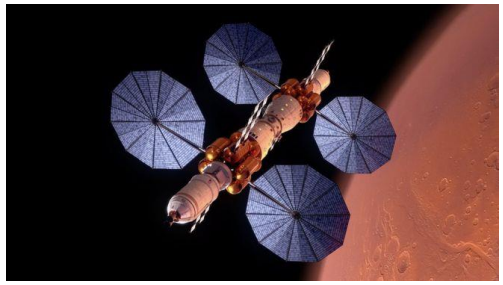
If we're ever to make regular journeys from Earth to Mars and other far-off destinations, we might need new kinds of engines.

By Mary-Ann Russon Science writer

Engineers are exploring revolutionary new technologies that could help us traverse the Solar System in much less time. Because of the orbital paths Mars and Earth take around the Sun, the distance between them varies between 54.6 million km and 401 million km.

Missions to Mars are launched when the two planets make a close approach. During one of these approaches, it takes nine months to get to Mars using chemical rockets - the form of propulsion in widespread use.

That's a long time for anyone to spend travelling. But engineers, including those at the US space agency (Nasa), are working with industrial partners to develop faster methods of getting us there. So what are some of the most promising technologies?



Mars Base Camp: one concept of an orbiting outpost at the Red Planet by Lockheed Martin **Lockheed Martin**

Solar electric propulsion

Solar electric propulsion could be used to send cargo to Mars ahead of a human mission. That would ensure equipment and supplies were ready and waiting for astronauts when they arrived using chemical rockets, according to Dr Jeff Sheehy, chief engineer in Nasa's Space Technology Mission Directorate.

With solar electric propulsion, large solar arrays unfurl to capture solar energy, which is then converted to electricity. This powers something called a Hall thruster.

There are pros and cons. On the upside, you need far less fuel, so the spacecraft becomes lighter. But it also takes your vehicle longer to get there. "In order to carry the payload we'd need to, it would probably take between two to 2.5 years to get us there," Dr Sheehy tells the BBC. "For the kinds of outposts we'd need to build on Mars for crews to be able to survive for months, and the vehicles, you'd need a lot of cargo."

Aerojet Rocketdyne is working on a Hall thruster for the Gateway, a proposed space station in lunar orbit.

"Solar is the best because we know we can scale it up," Joe Cassidy, executive director of Aerojet Rocketdyne's space division, explains. "We've already got these flying today on communications satellites. The power level we fly at today is 10-15kW (kilowatts), and what we're looking to do with the Gateway is to scale it up to something greater than 50kW."

Mr Cassidy said Aerojet Rocketdyne's Hall thruster will be much more fuel efficient than a liquid hydrogen and oxygen rocket engine. But a good way to make access to space cheaper would be to have fewer launches, he explains.

"I think that solar electric propulsion is very good technology, using xenon as the propellant. But the two major drawbacks are the amount of time it takes to get there, and the size of the solar arrays," says Tim Cichan, a human spaceflight architect at aerospace giant Lockheed Martin.

Dale Thomas, a professor and eminent scholar in systems engineering at the University of Alabama in Huntsville (UAH) concurs.

"Solar electric works well for smaller payloads, but we're still having trouble getting it to scale," he tells the BBC.

He thinks it could become an important alternative technology if the technical challenges can be solved. But for now, he says, there are other better options, such as nuclear thermal electric propulsion.

Nuclear thermal electric propulsion

Another idea is to use chemical rockets to lift off from Earth and to land on Mars. But for the middle part of the journey, some engineers propose using something called nuclear thermal electric propulsion.

Astronauts could be sent to the Gateway in Nasa's Orion capsule. The Orion crew capsule would then dock with a transfer vehicle.

Once Orion has been connected to the transfer vehicle, a nuclear electric rocket would be used to get the crew capsule and the transport module to Mars, where they link up with a Mars orbiter and lander, which are waiting in Mars' orbit.

In a nuclear thermal electric rocket, a small nuclear reactor heats up liquid hydrogen. The gaseous form of the element expands and shoots out of the thruster.

"If we can cut transit time [to Mars] down by 30-60 days, it will improve the exposure to radiation facing the crew," says Mr Cassidy. "We're looking at nuclear thermal as a key technology because it can enable faster transit times."

Dale Thomas, together with UAH, has a study contract with Nasa to design a space rocket featuring a nuclear thermal engine. He thinks nuclear thermal electric is the closest new engine technology to being ready for use.

"Some of the trajectories we run in my lab, we can get the transit time down to three months, which is still a very long journey, but it's about a third of the time that chemical propulsion requires to get us there," he says.

Boeing is not so keen on nuclear thermal propulsion, because it worries about the effects a nuclear reactor might have on astronauts.

Mr Thomas disagrees: "This is a common misperception. The hydrogen propellant is a great radiation shield.

"The crew will be at one end of the vehicle, and the engine at the other end. As such, preliminary estimates show that the crew will get more radiation dosage from cosmic rays than from the nuclear thermal engine." However, he admits one downside of the technology is the inability to easily test it on Earth.

But Nasa is designing a ground test apparatus that scrubs the exhaust to remove radioactive particles - making ground tests possible.

Electric ion propulsion

Another idea is electric ion propulsion. These generate thrust by accelerating ions - charged atoms or molecules - using electricity.

Ion propulsion is already being used to power satellites in space. But they produce only a low thrust - more like the power of a hairdryer - and therefore have a low acceleration. But given time, they can reach high speeds.

Ad Astra says it is working on a type of thruster called the Vasimr that uses radio waves to ionise and heat a propellant and then a magnetic field to accelerate the resulting soup of particles - the plasma. The Vasimr is designed to produce much more thrust than a standard ion engine.

The electricity needed can be generated in different ways. But for sending humans to Mars, the team wants to use a nuclear reactor. The Vasimr would use solar electric for smaller payloads.

Ad Astra's president and chief executive Franklin Chang Diaz, who is a former Nasa astronaut, says crewed missions need to get to Mars in less than nine months, ideally.

Going to the Red Planet is much harder than going to the Moon, he says.

"The solution is to go fast," Mr Chang Diaz tells the BBC. "For a spacecraft that would weigh 400-600 metric tonnes, with a power level of 200 MW (megawatts), you can get to Mars in 39 days."

Dale Thomas believes scaling up the Vasimr will be difficult, like going from the power of a lawnmower to a space rocket. But the technology does show promise.

"If, or perhaps I should say, when Ad Astra can solve the technical challenges of Vasimr, it does appear to be the best choice for electric propulsion at the human-ferrying spacecraft scale," Mr Thomas says.

"The physics says that it should work. However, I must point out that Vasimr is still under development in the laboratory; it's a long way from being flight-ready at any scale."

Mr Chang Diaz doesn't see a problem with scaling up, it's just that there's currently no market for a 10MW engine, so Ad Astra is sticking with 200kW. "We have a market for the 200kW engine, there's a lot of activity in low-Earth orbit and near the Moon to move cis-Earth satellites," says Mr Chang Diaz.

Lockheed Martin also thinks the Vasimr is promising technology, but it is focusing on solar electric propulsion.

The case for chemical rockets

Although the new technologies are interesting, veteran space players Lockheed Martin and Boeing both think liquid chemical rockets need to be the bedrock of any human mission to Mars.

Lockheed Martin says we already have the technology we need to get to Mars, and chemical rockets are a proven technology that worked in all the Apollo missions.

"We already have the technology to get us to Mars today," says Mr Cichan, the former system architect for Orion.

"There are some technical challenges, but it's really about taking the technology we have, building the systems and gaining experience in

flying in deep space that is the work ahead of us, as well as developing technology that will be groundbreaking in the future."

Hydrogen upper stage launchers have been used since the 1960s, and they have a high success rate, he stresses.

"Nasa's Space Launch System (SLS) has four liquid hydrogen and oxygen RS-25 rocket engines," Rob Broeren, a Boeing rocket propulsion specialist tells the BBC.

"These are shuttle heritage engines, and the advantage of the RS-25's is that they're well proven, high-reliability engines.

"The nice thing about going with highly proven technologies is that you have full confidence that they definitely work. With new technologies, they sound good on paper, but when it comes to implementing them, you will run into issues that will delay you."

When will we get to Mars?

A recent study by the Science and Technology Policy Institute (STPI) found that it was unlikely for human missions to Mars to follow Nasa's timetable and begin in 2033.

Given the constraints on Nasa's budgets, STPI thinks it is much more likely that we will leave for Mars in 2039, though the White House wants the US space agency to explore the Moon first by 2024, under its Artemis programme.

Dr Paul Dimotakis, John K Northrop professor of aeronautics and professor of applied physics at the California Institute of Technology (Caltech) is sceptical of the new technologies, and even chemical propulsion.

"I personally have not seen answers to technical questions of how to have enough chemical propulsion to last the long trip. It's not known for a hydrogen-oxygen rocket to last longer than six months," he says.

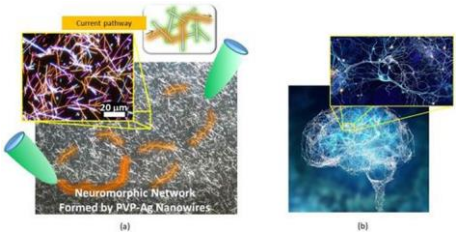
"We do not have a technical solution that addresses all the issues. Plus, someone has to demonstrate this before we send humans to Mars, and all of these things do not correspond to Nasa's timetable."

http://bit.ly/2Q0rIhv

Brain-like functions emerging in a metallic nanowire network

Emerging fluctuation-based functionalities are expected to open a way to novel memory device technology

An international joint research team led by NIMS succeeded in fabricating a neuromorphic network composed of numerous metallic nanowires. Using this network, the team was able to generate electrical characteristics similar to those associated with higher order brain functions unique to humans, such as memorization, learning, forgetting, becoming alert and returning to calm. The team then clarified the mechanisms that induced these electrical characteristics.



(a) Micrograph of the neuromorphic network fabricated by this research team. The network contains of numerous junctions between nanowires, which operate as synaptic elements. When voltage is applied to the network (between the green probes), current pathways (orange) are formed in the network. (b) A Human brain and one of its neuronal networks. The brain is known to have a complex network structure and to operate by means of electrical signal propagation across the network. **NIMS**

The development of artificial intelligence (AI) techniques has been rapidly advancing in recent years and has begun impacting our lives in various ways. Although AI processes information in a manner similar to the human brain, the mechanisms by which human brains operate are still largely unknown. Fundamental brain components, such as neurons and the junctions between them (synapses), have been studied in detail. However, many questions concerning the brain as a collective whole need to be answered. For example, we still do not fully understand how the brain performs such functions as memorization, learning and forgetting, and how the brain

becomes alert and returns to calm. In addition, live brains are difficult to manipulate in experimental research. For these reasons, the brain remains a "mysterious organ." A different approach to brain research in which materials and systems capable of performing brain-like functions are created and their mechanisms are investigated may be effective in identifying new applications of brain-like information processing and advancing brain science.

The joint research team recently built a complex brain-like network by integrating numerous silver (Ag) nanowires coated with a polymer (PVP) insulating layer approximately 1 nanometer in thickness. A junction between two nanowires forms a variable resistive element (i.e., a synaptic element) that behaves like a neuronal synapse. This nanowire network, which contains a large number of intricately interacting synaptic elements, forms a "neuromorphic network". When a voltage was applied to the neuromorphic network, it appeared to "struggle" to find optimal current pathways (i.e., the most electrically efficient pathways).

The research team measured the processes of current pathway formation, retention and deactivation while electric current was flowing through the network and found that these processes always fluctuate as they progress, similar to the human brain's memorization, learning, and forgetting processes. The observed temporal fluctuations also resemble the processes by which the brain becomes alert or returns to calm. Brain-like functions simulated by the neuromorphic network were found to occur as the huge number of synaptic elements in the network collectively work to optimize current transport, in the other words, as a result of self-organized and emerging dynamic processes..

The research team is currently developing a brain-like memory device using the neuromorphic network material. The team intends to design the memory device to operate using fundamentally different principles than those used in current computers. For example, while computers are currently designed to spend as much time and electricity as necessary in pursuit of absolutely optimum solutions, the new memory device is intended to make a quick decision within particular limits even though the solution generated may not be absolutely optimum. The team also hopes that this research will facilitate understanding of the brain's information processing mechanisms.

This project was carried out by an international joint research team led by Tomonobu Nakayama (Deputy Director, International Center for Materials Nanoarchitectonics (WPI-MANA), NIMS), Adrian Diaz Alvarez (Postdoctoral Researcher, WPI-MANA, NIMS), Zdenka Kuncic (Professor, School of Physics, University of Sydney, Australia) and James K. Gimzewski (Professor, California NanoSystems Institute, University of California Los Angeles, USA).

This research was published in Scientific Reports, an open access journal, on October 17, 2019.

http://bit.ly/2Sz7L2Q

Report links recommended physical activity levels to lower risk of seven cancers

More activity linked to lower risk for several cancer types

A pooled analysis of nine prospective studies involving more than 750,000 adults finds that recommended amounts of leisure-time physical activity were linked to a lower risk for seven cancers, with several cancer types having a 'dose/response' relationship. The study was led by investigators at the National Cancer Institute, the American Cancer Society, and the Harvard T.H. Chan School of Public Health and appears in the *Journal of Clinical Oncology*.

While it's long been known that physical activity is associated with a lower risk of several cancers, less clear has been the shape of the relationship and whether recommended amounts of physical activity are associated with lower risk. Updated guidelines for activity now state that people should aim for 2.5 to 5 hours/week of moderate-intensity activity or 1.25 to 2.5 hours/week of vigorous activity. Moderate-intensity activities are those that get you moving fast enough or strenuously enough to burn off three to six times as

much energy per minute as sitting quietly (3 to 6 METs). Vigorous-intensity activities burn more than 6 METs.

For the current analysis, investigators pooled data from nine prospective cohorts with self-reported leisure-time physical activity and follow-up for cancer incidence, looking at the relationship between physical activity with incidence of 15 types of cancer.

They found engaging in recommended amounts of activity (7.5 to 15 MET hours/week) was associated with a statistically significant lower risk of seven of the 15 cancer types studied, with the reduction increasing with more MET hours. Physical activity was associated with a lower risk of colon cancer in men (8% for 7.5 MET hours/week; 14% for 15 MET hours/week), female breast cancer (6%-10%), endometrial cancer (10%-18%), kidney cancer (11%-17%), myeloma (14%-19%), liver cancer (18%-27%), and non-Hodgkin lymphoma (11%-18% in women). The dose response was linear in shape for half of the associations and nonlinear for the others.

The analysis had some limitations: Even with 750,000 participants, patient numbers were limited for some cancers; participants were primarily white; there was a limited number of cohorts with detailed physical activity measures; and the authors relied on self-reported physical activity.

The authors conclude: "These findings provide direct quantitative support for the levels of activity recommended for cancer prevention and provide actionable evidence for ongoing and future cancer prevention efforts."

"Physical activity guidelines have largely been based on their impact on chronic diseases like cardiovascular disease and diabetes," said Alpa Patel, Ph.D., senior scientific director of epidemiology research at the American Cancer Society. "These data provide strong support that these recommended levels are important to cancer prevention, as well."

Article: Amount and Intensity of Leisure-Time Physical Activity and Lower Cancer Risk, Matthews et al. J Clin Oncol 2019; doi 10.1200/JCO.19.02407

http://bit.ly/350TyhD

Women with single dose of HPV vaccine gain similar protection as multiple doses

One dose of the HPV vaccine may prevent infection from the potential cancer-causing virus

A new study revealed that one dose of the HPV vaccine may prevent infection from the potential cancer-causing virus, according to research published in JAMA Network Open from The University of Texas Health Science Center at Houston (UTHealth).

According to the Centers for Disease Control (CDC), 34,800 new cancer diagnoses are linked to human papillomavirus (HPV) annually. The virus is thought to account for more than 90% of all cervical and anal cancers, more than 60% of all penile cancers, and approximately 70% of all oral cancers.

While results of the paper showed that a single dose may be as effective as the currently recommended two- or three-dose series, it's too early for people to rely on a single dose of the vaccine for protection, according to senior author Ashish A. Deshmukh, PhD, MPH, an assistant professor at UTHealth School of Public Health.

"HPV vaccine coverage is less than 10% globally because of poor vaccine uptake rates in many resource-limited countries. Ensuring boys and girls receive their first dose is a big challenge in several countries and a majority of adolescents are not able to complete the recommended series due to a lack of intensive infrastructure needed to administer two or three doses," Deshmukh said. "If ongoing clinical trials provide evidence regarding sustained benefits of a one-dose regimen, then implications of single-dose strategy could be substantial for reducing the burden of these cancers globally."

Although the study participants included only women, the CDC recommends a two-dose regimen for all children starting the series

before age 15 or a three-dose regimen if the series is started between ages 16 to 26. The latest generation of HPV vaccine can protect against nearly 90% of cancer-causing HPV infections. Yet, current vaccinations rates are less than ideal - half of people in the U.S. are not vaccinated against this common sexually transmitted infection.

"The current HPV vaccine dosing regimen can be cumbersome for people to understand. If one dose is proven effective in trials, the vaccine regimen will be simplified. This will help improve the coverage rate among adolescents that are currently below the Healthy People 2020 goal and possibly will also increase the momentum of uptake in the newly approved age group," said lead author Kalyani Sonawane, PhD, who is an assistant professor at UTHealth School of Public Health.

Michael D. Swartz, PhD, of UTHealth co-authored the study, along with Alan G. Nyitray, PhD, of the Medical College of Wisconsin; and Gizem S. Nemutlu, PhD, and Jagpreet Chhatwal, PhD, from Harvard Medical School.

Research was supported by the National Cancer Institute of the National Institutes of Health (R01CA232888). The content is solely the responsibility of the authors and does not necessarily represent the official views of the NIH.

http://bit.ly/2Qp8vVA

Forces from Earth's spin may spark earthquakes and volcanic eruptions at Mount Etna

New research suggests forces pulling on Earth's surface as the planet spins may trigger earthquakes and eruptions at volcanoes.

by Erin I. Garcia De Jesus, American Geophysical Union

Seismic activity and bursts of magma near Italy's Mount Etna increased when Earth's rotational axis was furthest from its geographic axis, according to a new study comparing changes in Earth's rotation to activity at the well-known Italian volcano.

Earth's spin doesn't always line up perfectly with its north and south poles. Instead, the geographic poles often twirl like a top around Earth's rotational axis when viewed from space. Every 6.4 years, the axes line up and the wobble fades for a short time—until the geographic poles move away from the spin axis and begin to spiral once again.

This phenomenon, called polar motion, is driven by changes in climate due to things like changing seasons, melting ice sheets or movement from tectonic plates. As polar motion fluctuates, forces pulling the planet away from the sun tug at Earth's crust, much like tides due to the gravitational pull from the sun and moon. The tide from polar motion causes the crust to deform over the span of seasons or years. This distortion is strongest at 45 degrees latitude, where the crust moves by about 1 centimeter (0.4 inches) per year.

Now, a new study published in AGU's journal *Geophysical Research Letters* suggests that polar motion and subsequent shifts in Earth's crust may increase volcanic activity.

"I find it quite exciting to know that while climate drives Earth's spin, its rotation can also drive volcanoes and seismicity," said Sébastien Lambert, a geophysicist at Paris Observatory in France and lead author of the study.

The new findings, however, don't allow scientists to forecast volcanic activity. Although the study suggests earthquakes might be more common or volcanic eruptions may eject more lava when the distance between Earth's geographic and rotational axes is at its peak, the timescale is too large for meaningful short-term forecasts, according to the authors.

But the results point to an interesting concept. "It's the first time we've found this relationship in this direction from Earth's rotation to volcanoes," Lambert said. "It's a small excitation process, but if you accumulate a small excitation over a long time it can lead to measurable consequences."

Shaking Earth

Previous work has shown the length of a day on Earth, which changes based on the speed of Earth's spin, also deforms the crust

and could affect volcanic behavior. In the new study, Lambert and his colleague, Gianluca Sottili, a volcanologist from Sapienza University of Rome in Italy, wanted to study the relationship between polar motion and volcanic activity.

They focused on Mount Etna because the volcano is well-studied, meaning there's plenty of data, and it sits just south of 45 degrees latitude. There also weren't any volcanic crises out of the ordinary at Mount Etna during the study period, which might otherwise mask the signal from polar motion.

Lambert and Sottili used seismic records from 11,263 earthquakes that happened within 43 kilometers (26.7 miles) of Mount Etna's summit between 1999 and 2019. The team also used records of how much magma erupted from the volcano since 1900. They included 62 eruptions in the analysis, based on the time span between events.

The pair then compared the distance between the geographic and rotational poles at the time each event occurred to determine whether volcanic activity was connected to Earth's rotation.

Lambert and Sottili discovered there were more earthquakes when Earth's rotational pole was furthest from the geographic axis—at the point in Earth's top-like spin when it looks like it is about to fall over. Between 1999 and 2019, those peaks were in 2002 and 2009. An expected peak in 2015 never materialized because one of the oscillations contributing to polar motion has been slowing down.

The team also uncovered a link between the amount of magma ejected during an eruption. Polar motion appears to drive the largest eruptions from Mount Etna, although to a lesser extent than its seismic activity, according to the researchers.

Examining volcanoes in the Ring of Fire to see if Earth's spin impacts their activity would surely be interesting, Sottili said, who was senior author of the study. Even expanding to other planets might open scientists' view of how external forces impact volcanoes on the surface, he added.

More information: *S. Lambert et al. Is there an influence of the pole tide on volcanism? Insights from Mount Etna recent activity, Geophysical Research Letters (2019). DOI: 10.1029/2019GL085525*

http://bit.ly/2sOqe0X

Measles may have emerged when large cities rose, 1500 years earlier than thought

Virus may have entered the human population as early as the fourth century B.C.E., rather than in medieval times

By Kai Kupferschmidt

BERLIN - On 3 June 1912, a 2-year-old girl at the Charité University Hospital here died of pneumonia following a measles infection. The next day, doctors took out her lungs, fixed them in formalin, and added them to a collection of anatomical specimens started by Rudolf Virchow, the "father of pathology."

There they languished for more than 100 years—until Sebastien Calvignac-Spencer, an evolutionary biologist at the Robert Koch Institute, came across them in the basement of Berlin's Museum of Medical History.

Scientists assembled a measles virus genome from the preserved lungs of a girl who died in 1912. **Kai Kupferschmidt/*Science***

Calvignac-Spencer and his team took a sample from the lungs, isolated RNA from it, and subsequently pieced together what is the oldest known genome of the measles virus. Its sequence helped them shed light on a much earlier period in measles' history. In a study posted to the preprint server bioRxiv today, the team concludes that the virus may have entered the human population as early as the fourth century B.C.E., rather than in medieval times, as previous research had suggested.

The work is technically brilliant, says evolutionary biologist Mike Worobey of the University of Arizona: "Just being able to get the

measles virus out of these old, wet specimens. That sets the stage for all sorts of exciting work." Monica Green, a historian of infectious diseases at Arizona State University, Tempe, calls the sequencing "very impressive" as well but says the study lacks enough data points to "provide decisive answers" about measles' emergence. The authors agree. They hope sequences from antiquity, preserved in naturally mummified or frozen bodies, may one day do so.

Measles, which killed an estimated 142,000 people in 2017, is one of the most infectious human diseases. But when, where, and how it became a human pathogen is still debated. The closest relative of the measles virus is one that causes rinderpest, a disease that affected cattle, deer, buffalo, and other even-toed ungulate species before it was eradicated in 2011. Most researchers believe both viruses had a common ancestor that infected cattle. "The challenge is that … measles has left so few clear traces in historical disease descriptions," Green says.

Because measles spreads so fast and infection confers lifelong immunity, scientists estimate it needs populations of 250,000 to a half-million people to avoid burning itself out. Historians believe that the largest cities reached that size around the fourth century B.C.E. But when researchers in Japan used available genomes of the measles and rinderpest viruses to build a phylogenetic tree, enabling them to date the branches, they concluded in 2010 that measles didn't emerge until the 11th or 12th century C.E.

The uncertainty stems in part from a surprising lack of historic sequences. Only three genomes from measles viruses occurring before 1990 are known; the oldest is one isolated in 1954 that was turned into the first measles vaccine. So Calvignac-Spencer turned to the Berlin museum, whose shelves are filled with thousands of tissues and organs floating in formalin-filled glass cases, like aquariums of human anatomy.

Formalin fixes tissue by cross-linking proteins and other large molecules, including RNA, which the measles genome is made of. To extract RNA from such samples, scientists use techniques pioneered about 10 years ago by cancer researchers interested in formalin-fixed biopsies. "We put them at 98° for 15 minutes and that breaks the cross-links," Calvignac-Spencer says. This also breaks up RNA, but modern methods allow scientists to sequence the fragments and piece them back together.

Calvignac-Spencer's team drew up a new phylogenetic tree using the 1912 genome as well as a new one from 1960, pieced together from a sample in another collection, and other available genomes. The resulting tree suggests the disease could have jumped to humans as early as 345 B.C.—right around the time human populations reached the critical size.

The earlier date for measles' emergence also reflects the models that the team used to analyze the viral sequences. When drawing up a family tree using differences in genomes, researchers must estimate the speed at which viral genomes diverge. In the past, their estimates were often too high, because some deleterious mutations tend to disappear over time. The new model accounts for this effect, called purifying selection. It pushes back the divergence of measles and rinderpest even without including the 1912 genome. But the genome strengthens the new timeline, Calvignac-Spencer says.

The researchers can't rule out that the measles virus first circulated in humans and then jumped to cattle, but that seems unlikely, says Albert Osterhaus of the University of Veterinary Medicine in Hanover, Germany. For one, ungulate herds probably reached the critical population size long before humans did. And the closest relative of the two viruses, which is even older, causes peste des petits ruminants, a sheep and goat disease that probably crossed to cattle more easily than to humans.

Similar studies have suggested that HIV and other pathogens also took off in the wake of major changes in the human population structure, Worobey says. "It seems like changes in human ecology really did coincide with the successful emergence of these viruses."

The ability to fish viral RNA out of very old samples has renewed interest in the Virchow collection, says Thomas Schnalke, head of the museum. "It came as a kind of revolution for us that researchers are coming and saying: 'Your samples are interesting for us again.'" Calvignac-Spencer has already labeled additional specimens he'd like to study with orange stickers. "It's a treasure trove," he says. "A window to the past that we can open now."

https://wb.md/35iPpWJ

'Alarming Trend': Gastric Cancer Increase in Younger Adults

Incidence of gastric cancer among younger adults in the U.S. increased steadily since the 1990s and now makes up at least 30% of all new gastric cancer diagnoses

Pam Harrison

The incidence of gastric cancer among younger adults (20–59 years of age) in the United States has been increasing steadily since the 1990s. Such cases now make up at least 30% of all new gastric cancer diagnoses, a new analysis reveals.

"I think this is an alarming trend, as stomach cancer is a devastating disease, so hopefully studies like this will raise awareness and increase physicians' suspicion of stomach cancer, particularly in younger patients," senior author Travis Grotz, MD, Mayo Clinic, Rochester, Minnesota, commented in a statement.

"Typically, we see stomach cancer being diagnosed in patients in their 70s, but increasingly, we are seeing 30- to 50-year-old patients being diagnosed [with the disease]," he added.

Early-onset gastric cancer (EOGC) is genetically and clinically distinct from what has traditionally been seen in older adults (>60 years), which is referred to as later-onset gastric cancer (LOGC).

It also has multiple features that are associated with a worse prognosis, the same analysis shows.

The study was published in October 2019 in the journal *Surgery*.

"We know from prior studies that traditional gastric cancer has declined dramatically in incidence in the United States during the past several decades, owing in large part to risk-factor reduction, including smoking cessation, improvements in medical management of acid reflux, and increased treatment of *H pylori*," the authors observe.

"However, our data demonstrate that EOGC is not associated with traditional risk factors and has been steadily increasing as a proportion of all [gastric cancer] cases for nearly 3 decades," they add. "Additional investigation is necessary to identify risk factors for EOGC to inform public health policy on risk reduction strategies," they suggest.

Symptoms of EOGC include feeling full before finishing a meal or having difficulty eating; acid reflux or abdominal pain; and unintentional weight loss, they add. The authors suggest that novel treatment approaches are needed for patients with EOGC, because current strategies are not very effective for these patients.

Details of the Findings

For this analysis, the research team evaluated incident cases of gastric cancer reported to the Surveillance, Epidemiology and End Results (SEER) registry from 1973 to 2015. The researchers compared reports for patients aged 20 – 59 years and those aged ≥60 years.

A total of 75,225 cases of gastric cancer were identified across the study, including 18,608 diagnoses of EOGC and 56,617 diagnoses of LOGC.

Analysis showed that the incidence of EOGC declined by 1.9% per year from 1973 to 1995, then increased by 1.5% a year from 1995 to 2013 ($P < .05$). In contrast, the incidence of LOGC steadily declined by 1.8% per year ($P < .05$) during the entire study period (1973 – 2015), the researchers note.

"As a percentage of all gastric cancer cases, the proportion of EOGC cases has increased rapidly from a nadir of 18.4% in 1990 to >30.0% in every year since 2012 ($P < .05$)," the investigators report. This trend was seen in all ethnic groups, they note.

Results from a sensitivity analysis showed that, when using age 40 years to define EOGC, the incidence increased from a low of 1.7% in 1973 to 3.5% in 2015 — effectively doubling the incidence of gastric cancer during the study interval.

The same results were seen when the investigators used the age of 50 as a cutoff definition for EOGC. In that analysis, the incidence initially decreased until 1982, then effectively doubled from its nadir by 2015. "EOGC patients were more often male, nonwhite, with proximally located tumors," the researchers observe.

Different Type of Tumors

The team emphasizes that the gastric tumors seen in younger patients are different from those seen in older patients.

Patients with EOGC were more likely to have certain tumor characteristics, including tumors with poorly differentiated histologic grade, signet-ring cells, Lauren-diffuse histologic type, and regional or distant metastasis at presentation.

The team investigated potential underlying genetic differences between EOGC and LOGC using the Cancer Genome Atlas (TCGA), a publicly available dataset that catalogs genome alternations in many types of tumors.

Among those patients for whom both clinical and genomic data were available from TGCA, the researchers found that EOGC cases were more likely to be an Epstein-Barr virus or a genomically stable subtype. In contrast, LOGC cases were more likely to be a microsatellite instability subtype (all $P < .01$).

Table. Differences Between EOGC Tumors and LOGC Tumors

	Poorly Differentiated Histologic Grade	Signet-Ring Cells	Lauren-Diffuse Histologic Type	Regional/Distant Metastasis at Presentation
EOGC	55.2%	19%	25.7%	49.5%
LOGC	46.9%	10.4%	15%	40.9%

Behavioral Gastric Cancer Risk Factors

The research team also evaluated data from the Behavioral and Risk Factor Surveillance Survey (BRFSS) to identify common risk factors for EOGC and LOGC.

Self-reported risk factors from the BRFSS indicated that smoking and binge drinking correlated with the risk for gastric cancer in the LOGC cohort but not the EOGC cohort.

That said, strong risk factors for gastric cancer, such as *H pylori* infection and the consumption of nitrites and smoked foods, were not included in the BRFSS risk assessment survey, so these factors could not be assessed in the cohort overall, the team notes.

The authors have disclosed no relevant financial relationships.

Surgery. 2019;166:547-555. Abstract

http://bit.ly/2QNvV7r

Injecting the flu vaccine into a tumor gets the immune system to attack it

Activating the immune system at the site of a tumor can re-engage the immune system.

John Timmer

A number of years back, there was a great deal of excitement about using viruses to target cancer. A number of viruses explode the cells that they've infected in order to spread to new ones. Engineering those viruses so that they could only grow in cancer cells would seem to provide a way of selectively killing these cells.

And some preliminary tests were promising, showing massive tumors nearly disappearing.

But the results were inconsistent, and there were complications. The immune system would respond to the virus, limiting our ability to use it more than once. And some of the tumor killing seemed to be the result of the immune system, rather than the virus.

Now, some researchers have focused on the immune response, inducing it at the site of the tumor. And they do so by a remarkably simple method: injecting the tumor with the flu vaccine. As a bonus, the mice it was tested on were successfully immunized, too.

Revving up the immune system

This is one of those ideas that seems nuts but had so many earlier results pointing toward it working that it was really just a matter of time before someone tried it. To understand it, you have to overcome the idea that the immune system is always diffuse, composed of cells that wander the blood stream. Instead, immune cells organize at the sites of infections (or tumors), where they communicate with each other to both organize an attack and limit that attack so that healthy tissue isn't also targeted.

From this perspective, the immune system's inability to eliminate tumor cells isn't only the product of their similarities to healthy cells. It's also the product of the signaling networks that help restrain the immune system to prevent it from attacking normal cells. A number of recently developed drugs help release this self-imposed limit, winning their developers Nobel Prizes in the process. These drugs convert a "cold" immune response, dominated by signaling that shuts things down, into a "hot" one that is able to attack a tumor.

But not everyone has a response to these drugs, raising the question of whether there are other ways to activate the immune system at the site of a tumor.

One potential option is simply the things that normally rev up the immune system: infectious agents. The immune response to cancer-targeting viruses mentioned above would provide an indication that this does occur. Others have targeted a variety of pathogens to the sites of tumors and found that this increases the immune response to the tumor as well.

To check whether something similar might be happening in humans, the researchers identified over 30,000 people being treated for lung cancer and found those who also received an influenza diagnosis. You might expect that the combination of the flu and cancer would be very difficult for those patients, but instead, they had *lower* mortality than the patients who didn't get the flu.

Moving to mice

For more detailed tests, the researchers moved to mice, using melanoma cells that can form tumors when transplanted into the lungs of the mice. These model systems often respond to treatments that don't end up working in humans, so the results have to be treated with appropriate caution. Still, they can be a valuable way of understanding the biology of the immune response here.

The use of melanoma cells is informative, as these cells cannot be infected by the influenza virus. So this system also provides a test of whether the tumor cells themselves have to be infected in order to increase the immune response to them.

Apparently they do not. Having an active influenza virus infection reduced the ability of the melanoma cells to establish themselves in the lung. The effect isn't limited to the location of the infection, though, as tumors in the lung that wasn't infected were also inhibited. The effects were similar when breast cancer cells were placed into the lung, as well.

All of this is consistent with the immune stimulation provided by a pathogen. The stimulation causes a general activation of the immune system that releases it from limits on its activity that

prevent it from attacking tumor cells. But does it require an actual infection?

To find out, the researchers used a flu virus that had been inactivated by heat treatment. Normally, heat treating a virus is used to create a control for an effect that needs an active virus. But here, it turned out to be another experiment, as the heat-treated virus was also able to work just as effectively as the live virus.

This isn't entirely surprising, given that inactive viruses are often used as vaccines and thus clearly can stimulate the immune system. But that, in turn, suggested another experiment: would vaccines actually work? To find out, the researchers obtained this year's flu vaccine and injected it into the sites of tumors. Not only was tumor growth slowed, but the mice ended up immune to the flu virus.

Oddly, this wasn't true for every flu vaccine. Some vaccines contain chemicals that enhance the immune system's memory, promoting the formation of a long-term response to pathogens (called adjuvants). When a vaccine containing one of these chemicals was used, the immune system wasn't stimulated to limit the tumors' growth.

This suggests that it's less a matter of stimulating the immune system and more an issue of triggering it to attack immediately. But this is one of the things that will need to be sorted out with further study.

The location of the stimulation will also need to be sorted out, too. Here, stimulation in one lung increases activity in both. But injection into muscles didn't work at all, and earlier work by some of the same team had indicated a heavy infection outside the lungs enhanced tumor growth by diverting immune cells elsewhere.

But the story does fit in well with the general consensus that the immune system can be a powerful tool against cancer, provided it can be mobilized properly. And, in at least some cases, a flu vaccine just might do the trick.

PNAS, *2019. DOI: 10.1073/pnas.1904022116 (About DOIs).*

http://bit.ly/2rWVxWY

Heart attack discovery could give hope to people not able to be treated

New treatment for heart attack scar

Heart disease remains the largest killer in Australia and around the world. A new study has shown that a protein therapy- recombinant human platelet-derived growth factor-AB (rhPDGF-AB) - could improve outcomes following heart attack.

After a heart attack, scar tissue forms and this negatively affects heart function. Now, researchers from The Westmead Institute for Medical Research (WIMR) and the University of Sydney found that, infusing rhPDGF into subjects that have had heart attacks improves the quality of the scar, leads to the formation of new blood vessels in the heart, and reduced rates of dangerous heart arrhythmia (irregularities of heart rhythm that can cause sudden death).

This study was in a pre-clinical large animal model.

The discovery publishes today in the leading journal *Science Translational Medicine.*

Corresponding author who led the research team, Associate Professor James Chong, said: "This is an entirely new approach with no current treatments able to change scar in this way.

"By improving cardiac function and scar formation following heart attack, treatment with rhPDGF-AB led to an overall increase in survival rate in our study. "While the treatment did not affect overall scar size, importantly we found that rhPDGF-AB led to increased scar collagen fibre alignment and strength. This improved heart function after the heart attack.

"Our collaborator Professor Richard Harvey, from the Victor Chang Cardiac Research Institute, had previously shown that the protein can improve heart function in mouse models following heart attack. "This project has been developed over more than 10 years and we

now have compelling data in two species for the effectiveness of this treatment.

Following heart attack, the heart muscle is damaged, causing thick scar tissue to form. This can limit the heart's ability to function efficiently, and can increase the risk of heart failure, and sudden cardiac death. Current treatments aim to restore blood and the oxygen supply to the heart as quickly as possible to reduce scarring. While this improves clinical outcomes, up to a quarter of patients experiencing their first heart attack will develop heart failure within one year.

Associate Professor Chong said: "While we have treatment protocols in place, it's clear that there is an urgent, unmet need for additional treatments to improve patient outcomes particularly after large heart attacks. "Heart disease is the leading cause of death in Australia. It is thought that more than 400,000 Australians have had a heart attack at some stage in their lives and that there is roughly one heart attack every 10 minutes. Through our research, we have the opportunity to change the negative impact of these statistics.

"Some further animal studies are required to clarify safety and dosing. Then we can start looking towards clinical trials in humans very soon. rhPDGF-AB is clearly a promising therapeutic option, and could potentially be used alongside existing treatments to improve heart attack patient outcomes and survival rates.

"We now hope to further investigate the treatment, including whether it could be used in other organ systems impacted by scar tissue, such as the kidneys."

Associate Professor James Chong is Co-Director of WIMR's Centre for Heart Research and Leader of WIMR's Cardiac Regeneration Group; a Cardiologist at Westmead Hospital; Associate Professor at the University to Sydney; Principle Investigator and Westmead Applied Research Centre (WARC).

This research was conducted in collaboration with University of Sydney, The Victor Chang Cardiac Research Institute, Westmead Hospital, Kolling Institute of Medical Research and QIMR Berghofer. It was made possible by funding from NSW Office of Health and Medical Research, Heart Foundation, NSW Cardiovascular Research Network and Stem Cells Australia.

http://bit.ly/2FqHaje

Delivering TB vaccine intravenously dramatically improves potency, study shows

Simply changing the way the vaccine is administered could dramatically boost its protective power

Pittsburgh - Worldwide, more people die from tuberculosis (TB) than any other infectious disease, even though the vast majority were vaccinated. The vaccine just isn't that reliable. But a new Nature study finds that simply changing the way the vaccine is administered could dramatically boost its protective power.

Researchers at the University of Pittsburgh School of Medicine and the National Institute of Allergy and Infectious Diseases (NIAID) discovered that intravenous TB vaccination is highly protective against the infection in monkeys, compared to the standard injection directly into the skin, which offers minimal protection.

"The effects are amazing," said senior author JoAnne Flynn, Ph.D., professor of microbiology and molecular genetics at the Pitt Center for Vaccine Research. "When we compared the lungs of animals given the vaccine intravenously versus the standard route, we saw a 100,000-fold reduction in bacterial burden. Nine out of 10 animals showed no inflammation in their lungs."

Flynn's team tested several routes and doses of the only commercially available human TB vaccine, Bacille Calmette-Guérin (BCG), which is made of a live, weakened form of TB bacteria found in cattle. The BCG vaccine has been around for 100 years and is among the most widely used vaccines in the world, but its efficacy varies widely.

The idea for an intravenous TB vaccination came from earlier experiments by the other senior author on the study, Robert Seder, M.D., at the NIAID's Vaccine Research Center. Seder showed in

both animals and humans that the malaria vaccine is more effective when delivered intravenously.

To test whether the method of administration matters for TB, Flynn and colleagues separated their colony of monkeys into six groups: unvaccinated, standard human injection, stronger dose but same injection route, mist, injection plus mist, and finally, the stronger dose of BCG delivered as a single shot directly into the vein.

Six months later, the researchers exposed the animals to TB and monitored them for signs of infection.

Monkeys are extremely susceptible to TB. All of the animals who received the standard human dose had persistent lung inflammation, and the average amount of TB bacteria in their lungs was only slightly less than in the monkeys who received no vaccine at all. The other injected and inhaled vaccines offered similarly modest TB protection.

The intravenous vaccine, on the other hand, offered nearly full protection. There was virtually no TB bacteria in the lungs of these animals, and only one monkey in this group developed lung inflammation. "The reason the intravenous route is so effective," Flynn explained, "is that the vaccine travels quickly through the bloodstream to the lungs, the lymph nodes and the spleen, and it primes the T cells before it gets killed."

Flynn's team found BCG and activated T cells in the lungs of all the intravenously vaccinated animals. Among the other groups, BCG was undetectable in the lung tissue and T cell responses were relatively meagre. Next, the researchers plan to test whether lower doses of intravenous BCG could offer the same level of protection without the side effects, which mostly consist of temporary inflammation in the lungs. But before this method can be translated to humans, researchers need to know that it's not only safe, but also practical. An intravenous vaccine requires more skill to administer and carries a higher risk of infection.

"We're a long way from realizing the translational potential of this work," Flynn said. "But eventually we do hope to test in humans."

Additional authors on the study include Patricia Darrah, Ph.D., Joshua Hackney, Supriya Pokkali, Ph.D., Phillip Swanson, M.D., Megha Kamath, and Mario Roederer, Ph.D., of NIAID; Joseph Zeppa, Ph.D., Pauline Maiello, Nicole Grant, Mark Rodgers, M.S., Chelsea Causgrove, Edwin Klein, D.V.M., Alexander White, and Charles Scanga, Ph.D., of Pitt; Marc Wadsworth, Travis Hughes, M.P.H., and Alex Shalek, Ph.D., of the Massachusetts Institute of Technology and Harvard University; Dominick Laddy, Ph.D., and Danilo Casimiro, Ph.D., of Aeras; Aurelio Bonavia, Ph.D., of Vir Biotechnology; and Philana Ling Lin, M.D., of UPMC Children's Hospital of Pittsburgh.

This research was supported by the Bill and Melinda Gates Foundation, the National Institutes of Health (grants 5U24AI118672 and 2RM1HG006193) and the NIAID Intramural Research Program. PARI Pharma GbmH provided the aerosol vaccine delivery device.

https://nyti.ms/2trRwdp

Stolen Research: Chinese Scientist Is Accused of Smuggling Lab Samples

Zaosong Zheng, a promising cancer researcher, confessed that he had planned to take the stolen samples to Sun Yat-sen Memorial Hospital, and publish the results under his own name.

By Ellen Barry

BOSTON — Zaosong Zheng was preparing to board Hainan Airlines Flight 482, nonstop from Boston to Beijing, when customs officers pulled him aside.

Inside his checked luggage, wrapped in a plastic bag and then inserted into a sock, the officers found what they were looking for: 21 vials of brown liquid — cancer cells — that the authorities say Mr. Zheng, 29, a cancer researcher, took from a laboratory at Beth Israel Deaconess Medical Center.

Under questioning, court documents say, Mr. Zheng acknowledged that he had stolen eight of the samples and had replicated 11 more based on a colleague’s research. When he returned to China, he said, he would take the samples to Sun Yat-sen Memorial Hospital and turbocharge his career by publishing the results in China, under his own name.

Mr. Zheng's arrest on Dec. 10 signified an escalation in the F.B.I.'s efforts to root out scientists who, the authorities say, are stealing research from American laboratories. Federal prosecutors warn that he may be charged with transporting stolen goods or with the theft of trade secrets, a felony that brings a prison term of up to 10 years.

At a hearing on Monday, Magistrate Judge David Hennessy granted prosecutors' wish to hold Mr. Zheng without bail, noting that the theft appeared to have the support of the Chinese government. Two other Chinese scientists who worked in the same lab as Mr. Zheng had successfully smuggled stolen biological material out of the country, prosecutors say.

Mr. Zheng's case is the first to unfold in the laboratories clustered around Harvard University, but it is not likely to be the last. Federal officials are investigating hundreds of cases involving the potential theft of intellectual property by visiting scientists, nearly all of them Chinese nationals.

Christopher Wray, director of the F.B.I., described the researchers as "nontraditional collectors" of intelligence acting at the behest of the Chinese government, part of a collective effort to "steal their way up the economic ladder at our expense."

Dr. Ross McKinney Jr., chief scientific officer of the Association of American Medical Colleges, said the actions Mr. Zheng was accused of were especially bold.

"This is one of the few cases where there's been stealing of physical material as well as the stealing of ideas," he said. "It's an escalation over most of what we've been seeing."

Researchers of Chinese descent make up nearly half of the work force in American research laboratories, in part because American-born scientists are drawn to the private sector and less interested in academic careers, Dr. McKinney said. Among the 6,000 Chinese scientists who have received grants from the National Institutes of Health, around 180 are under investigation for possible violation of intellectual property law, he said.

Harvard University had sponsored Mr. Zheng's visa starting on Sept. 4, 2018, according to Jason A. Newton, a spokesman for the university. The visa support ended when Mr. Zheng lost his job at Beth Israel Deaconess Medical Center, he said.

The hospital said in a statement that it was cooperating with the investigation. "Any efforts to compromise research undermine the hard work of our faculty and staff to advance patient care," said Jennifer Kritz, the hospital's director of communication. A message left for Brendan O. Kelley, Mr. Zheng's lawyer, was not returned.

Court records sketch out a cat-and-mouse game between Mr. Zheng and Kara Spice, the F.B.I. special agent assigned to the case. Customs and Border Protection agents had been warned that he was "a high risk for possibly exporting biological undeclared biological material," and inspected his luggage in the airline's bag room.

At first, Mr. Zheng deflected their interest in the 21 vials, telling the agents that they "were not important and had nothing to do with his research." Then he offered another explanation, saying that they had been given to him by a friend and that he had no plans to do anything with them.

"Zheng could not explain why he was attempting to leave the United States with the vials concealed in a sock in his checked bag," Ms. Spice's statement says. Shortly thereafter, he confessed to stealing the material.

Mr. Zheng booked another flight to China the following day, but was detained by F.B.I. agents before he could board it, court documents say. Through a Mandarin interpreter, he waived his Miranda rights and told the agents he intended to use the samples for cancer research. At that point, he was arrested.

Agents learned more when they visited Mr. Zheng's apartment, according to court documents. His former roommate, a fellow

medical researcher named Jialin Li, told them that Mr. Zheng had packed all his possessions in preparation for his Dec. 9 flight, suggesting that he did not intend to return to the United States.

Mr. Li also told them that two other Chinese researchers, Lei Liu and Leina Mo, who had worked in the same laboratory at Beth Israel Deaconess Medical Center, had managed to smuggle biological material into China without getting caught, according to court documents.

Mr. Zheng's theft "was not an isolated incident," prosecutors stated in the motion to hold him without bail. "Rather, it appears to have been a coordinated crime, with likely involvement by the Chinese government, as two other Chinese nationals working in the same lab have also stolen biological materials and smuggled them out of the United States."

http://bit.ly/2ZM8rnc

Earliest evidence for rhizomes roasting in Africa 170 thousand years ago

Earliest direct evidence for the collecting and cooking of carbohydrate-rich rhizomes

日本のニュース

The 170,000-year-old charred remains of starchy plant parts from Border Cave, South Africa provides the earliest direct evidence for the collecting and cooking of carbohydrate-rich rhizomes, a new study reports.

The findings suggest that palatable rhizomes from Hypoxis sp.- a genus of small flowering plants - ay have been a reliable and transportable staple food for Middle Stone Age humans at the site and perhaps a familiar source of food for early human populations traveling throughout Africa and beyond.

Hunting strategies and animal-based diets of early humans are well recognized and widely studied as the bones and stone tools left behind from these activities are often preserved far better in archaeological sites than the perishable evidence of plant diets.

However, plants rich in carbohydrates were almost certainly eaten throughout the long history of our earliest ancestors and likely contributed substantially to ancient nutrition.

Some plants called geophytes - onions, potatoes and ginger, for example - store carbohydrates by growing starchy roots beneath the ground. In more modern times, many of these plants have become an important source of food, but because of their ephemeral nature in the archaeological record, it remains unclear when humans first began eating them.

Sifting through the ashes from ancient cooking fires from Border Cave in South Africa, Lyn Wadley and colleagues discovered the charred remains of ancient rhizomes roasted up to 170 thousand years ago.

According to Wadley et al., the rhizome specimens - likely only preserved because they were burnt - are suggestive of Hypoxis genus plants, which are commonly known as the star lily or the African Potato and found growing throughout southern Africa.

Hypoxis rhizomes are highly nutritious carbohydrate-rich and, while edible raw, are far less tough once cooked, the authors say.

http://bit.ly/2QOfY0O

Climate signals detected in global weather

The climate signal can actually be discerned in daily weather data, provided that global spatial patterns are taken into account

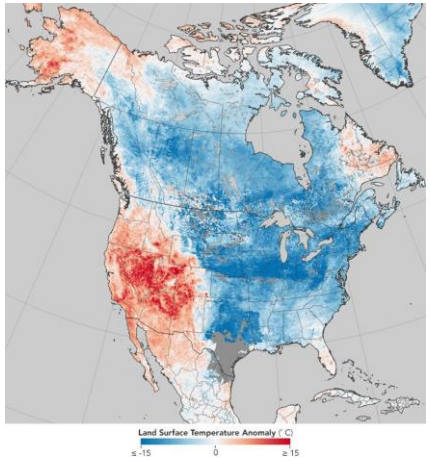
In October this year, weather researchers in Utah measured the lowest temperature ever recorded in the month of October in the US (excluding Alaska): -37.1°C. The previous low-temperature record for October was -35°C, and people wondered what had happened to climate change.

Until now, climate researchers have responded that climate is not the same thing as weather. Climate is what we expect in the long

term, whereas weather is what we get in the short term - and since local weather conditions are highly variable, it can be very cold in one location for a short time despite long-term global warming. In short, the variability of local weather masks long-term trends in global climate.

A paradigm shift

Now, however, a group led by ETH professor Reto Knutti has conducted a new analysis of temperature measurements and models. The scientists concluded that the weather-is-not-climate paradigm is no longer applicable in that form. According to the researchers, the climate signal - that is, the long-term warming trend - can actually be discerned in daily weather data, such as surface air temperature and humidity, provided that global spatial patterns are taken into account.



North American surface temperatures for Dec. 26, 2017-Jan. 2, 2018: even if it is extremely cold in a region, this does not mean that climate change has stopped. **Credit: Source: NASA Earth Observatory**

In plain English, this means that - despite global warming - there may well be a record low temperature in October in the US. If it is simultaneously warmer than average in other regions, however, this deviation is almost completely eliminated. "Uncovering the climate change signal in daily weather conditions calls for a global perspective, not a regional one," says Sebastian Sippel, a postdoc working in Knutti's research group and lead author of a study recently published in *Nature Climate Change*.

Statistical learning techniques extract climate change signature

In order to detect the climate signal in daily weather records, Sippel and his colleagues used statistical learning techniques to combine simulations with climate models and data from measuring stations. Statistical learning techniques can extract a "fingerprint" of climate change from the combination of temperatures of various regions and the ratio of expected warming and variability. By systematically evaluating the model simulations, they can identify the climate fingerprint in the global measurement data on any single day since spring 2012.

A comparison of the variability of local and global daily mean temperatures shows why the global perspective is important. Whereas locally measured daily mean temperatures can fluctuate widely (even after the seasonal cycle is removed), global daily mean values show a very narrow range.

If the distribution of global daily mean values from 1951 to 1980 are then compared with those from 2009 to 2018, the two distributions (bell curves) barely overlap. The climate signal is thus prominent in the global values but obscured in the local values, since the distribution of daily mean values overlaps quite considerably in the two periods.

Application to the hydrological cycle

The findings could have broad implications for climate science. "Weather at the global level carries important information about climate," says Knutti. "This information could, for example, be used for further studies that quantify changes in the probability of extreme weather events, such as regional cold spells. These studies are based on model calculations, and our approach could then provide a global context of the climate change fingerprint in observations made during regional cold spells of this kind. This gives rise to new opportunities for the communication of regional weather events against the backdrop of global warming."

The study stems from a collaboration between ETH researchers and the Swiss Data Science Center (SDSC), which ETH Zurich operates jointly with its sister university EPFL. "The current study underlines how useful data science methods are in clarifying environmental questions, and the SDSC is of great use in this," says Knutti. Data science methods not only allow researchers to demonstrate the strength of the human "fingerprint", they also show where in the world climate change is particularly clear and recognisable at an early stage. This is very important in the hydrological cycle, where there are very large natural fluctuations from day to day and year to year. "In future, we should therefore be able to pick out human-induced patterns and trends in other more complex measurement parameters, such as precipitation, that are hard to detect using traditional statistics," says the ETH professor.

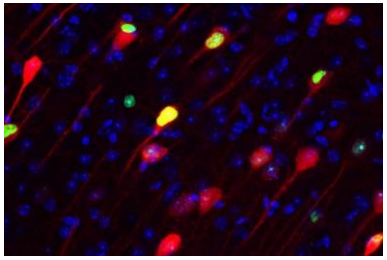
Reference *Sippel S, Meinshausen N, Fischer EM, Székely E, Knutti R: Climate change now detectable from any single day of weather at global scale. Nature Climate Change 2019, 2 January, DOI: 10.1038/s41558-019-0666-7*

http://bit.ly/2ZNX7H6

Engrams emerging as the basic unit of memory

Rapid progress made over the last dozen years in identifying, characterizing and even manipulating engrams

Though scientist Richard Semon introduced the concept of the "engram" 115 years ago to posit a neural basis for memory, direct evidence for engrams has only begun to accumulate recently as sophisticated technologies and methods have become available.



Above: Memory engram cells labeled green and red in the prefrontal cortex of a mouse. **Credit: Takashi Kitamura/MIT Picower Institute**

In a new review in Science, Professors Susumu Tonegawa of The Picower Institute for Learning and Memory at MIT and Sheena Josselyn of the Hospital for Sick Children (SickKids) and the University of Toronto describe the rapid progress they and colleagues have been making over the last dozen years in identifying, characterizing and even manipulating engrams, as well as the major outstanding questions of the field.

Experiments in rodents have revealed that engrams exist as multiscale networks of neurons. An experience becomes stored as a potentially retrievable memory in the brain when excited neurons in a brain region such as the hippocampus or amygdala become recruited into a local ensemble. These ensembles combine with others in other regions, such as the cortex, into an "engram complex." Crucial to this process of linking engram cells is the ability of neurons to forge new circuit connections, via processes known as "synaptic plasticity" and "dendritic spine formation." Importantly, experiments show that the memory initially stored across an engram complex can be retrieved by its reactivation but may also persist "silently" even when memories cannot be naturally recalled, for instance in mouse models used to study memory disorders such as early stage Alzheimer's disease.

"More than 100 years ago Semon put forth a law of engraphy," wrote Josselyn, Senior Scientist at SickKids, Professor of Psychology and Physiology at the University of Toronto and Senior Fellow in the Brain, Mind & Consciousness Program at the Canadian Institute for Advanced Research, (CIFAR) and Tonegawa, Picower Professor of Biology and Neuroscience at the RIKEN-MIT Laboratory for Neural Circuit Genetics at MIT and Investigator of the Howard Hughes Medical Institute. "Combining these theoretical ideas with the new tools that allow researchers to image and manipulate engrams at the level of cell ensembles facilitated many important insights into memory function."

"For instance, evidence indicates that both increased intrinsic excitability and synaptic plasticity work hand in hand to form

engrams and that these processes may also be important in memory linking, memory retrieval, and memory consolidation."

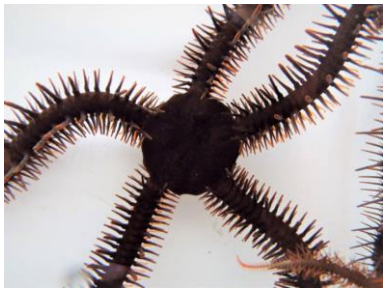
For as much as the field has learned, Josselyn and Tonegawa wrote, there are still important unanswered questions and untapped potential applications: How do engrams change over time? How can engrams and memories be studied more directly in humans? And can applying knowledge about biological engrams inspire advances in artificial intelligence, which in turn could feedback new insights into the workings of engrams?

The paper appears in Science*'s Jan. 3 edition.*

http://bit.ly/2sBVu3j

No eyes, no problem: Marine creature expands boundaries of vision

Ophiocoma wendtii, is only the second creature known to be able to see without having eyes



WASHINGTON – A cousin of the starfish that resides in the coral reefs of the Caribbean and Gulf of Mexico lacks eyes, but can still see, according to scientists who studied this creature that expands the boundaries of the sense of sight in the animal kingdom.

***A red brittle star, Ophiocoma wendtii, is seen in this image released on Thursday.* | Lauren Sumner-Rooney / Handout / Via Reuters**

Researchers said on Thursday that the red brittle star, called Ophiocoma wendtii, is only the second creature known to be able to see without having eyes — known as extraocular vision — joining a single species of sea urchin.

It possesses this exotic capability thanks to light-sensing cells, called photoreceptors, covering its body and pigment cells, called chromatophores, that move during the day to facilitate the animal's dramatic color change from a deep reddish-brown in daytime to a stripy beige at nighttime.

Brittle stars, with five radiating arms extending from a central disk, are related to starfish (also called sea stars), sea cucumbers, sea urchins and others in a group of marine invertebrates called echinoderms. They have a nervous system but no brain.

The red brittle star — up to about 14 inches (35 cm) from arm tip to arm tip — lives in bright and complex habitats, with high predation threats from reef fish. It stays hidden during daytime — making the ability to spot a safe place to hide critical — and comes out at night to feed on detritus.

Its photoreceptors are surrounded during daytime by chromatophores that narrow the field of the light being detected, making each photoreceptor like the pixel of a computer image that, when combined with other pixels, makes a whole image. The visual system does not work at night, when the chromatophores contract.

"If our conclusions about the chromatophores are correct, this is a beautiful example of innovation in evolution," said Lauren Sumner-Rooney, a research fellow at Oxford University Museum of Natural History who led the study published in the journal Current Biology.

Laboratory experiments indicated the brittle stars have rudimentary vision. Placed in a circular arena, they moved toward walls that were white with a black bar, suggestive of a daytime hiding place.

Another scenario showed they were not simply detecting brightness versus darkness. When they were presented with gray walls making it so no part of the arena was lighter or darker overall, they still moved toward the black stripe, which was centered on a white stripe so as to reflect the same amount of light as the gray.

"It's such an alien concept for us, as very visually driven animals, to conceive of how an animal might see its habitat without eyes, but now we know of two examples," Sumner-Rooney added.

http://bit.ly/2QmLbcl

Demon with Forked Tongue Found on Clay Tablet in Library of Assyrian Exorcists

An ancient drawing of a demon blamed for epileptic seizures has been discovered on a 2,700-year-old Assyrian clay tablet.

By Tom Metcalfe - Live Science Contributor

University of Copenhagen Assyriologist Troels Pank Arbøll was examining a tablet of ancient writing at the Vorderasiatisches Museum in Berlin when he noticed the drawing of the demon — portrayed with horns, a tail and a snake-like forked tongue.

The drawing was overlooked for decades on the tablet from the library of a family of exorcists who lived in the Assyrian city of Assur. The depiction is shown here in red. **© Staatliche Museen zu Berlin - Vorderasiatisches Museum/Photograph by Olaf M. Tessmer**

The tablet came from the library of a family of exorcists who lived in about 650 B.C. in the city of Assur, now in northern Iraq, Arbøll said. But it's likely it was copied from a much older text.

The tablet is written in cuneiform — a very early system of letters formed by pressing a triangular stylus into softened clay.

The inscription describes cures for convulsions, twitches and other involuntary muscle movements — an affliction called "Bennu" by the Assyrians and now interpreted as symptoms of epilepsy.

Ancient Assyrians, however, thought Bennu was caused by demonic possession. "I was the first one to notice the drawing, despite the text having been known to researchers for decades," Arbøll told Live Science in an email, "so it is not easily seen today unless one knows it is there due to the damage on the manuscript."

In new research published last month in Le Journal des Médecines Cunéiformes, Arbøll describes the demon as having "curvy horns, a serpent's tongue and possibly a reptile-like eye. … The creature has a long tail placed alongside the left leg…."

Epilepsy demon

Arbøll determined the outlines of the damaged drawing over the months that followed his discovery; the text, he suggests, shows the demon that causes Bennu on behalf of the Mesopotamian moon god Sîn.

The ancient Assyrians believed epilepsy was related to madness, and that both were caused by the moon god, he said. This ancient idea is reflected in an English word for madness — lunacy — which implies a connection with the moon, called "luna" in Latin.

Drawings on cuneiform tablets are rare, and portraits of demons are even rarer: "This specific drawing is a depiction of the actual demon, instead of other comparable drawings, which generally depict a figurine made during a ritual to remove the illness," Arbøll said.

The Assyrians did not distinguish between magic and medicine, and magical remedies like rituals and incantations were used alongside remedies that would be seen as medical today, like ingested potions, external ointments and bandages.

The 2,700-year-old drawing of the demon thought by the Assyrians to cause the convulsive seizures of Bennu, or epilepsy, was spotted on an ancient clay tablet. **Troels Pank Arbøll**

"Doctors" of the time would have treated Bennu-epilepsy by placing a leather amulet around the infected person's neck, heating various ingredients on hot coals and directing the resulting smoke toward the patient, Arbøll said. "Less often, we find mixtures to be ingested or salves applied to the patient."

http://bit.ly/2sL69sj

How the extinction of ice age mammals may have forced us to invent civilization

Disappearance of the animals we depended on for food may have forced our culture to evolve

Nick Longrich *

Why did we take so long to invent civilisation? Modern *Homo sapiens* first evolved roughly 250,000 to 350,000 years ago. But initial steps towards civilisation – harvesting, then domestication of crop plants – began only around 10,000 years ago, with the first civilisations appearing 6,400 years ago.

For 95% of our species' history, we didn't farm, create large settlements or complex political hierarchies. We lived in small, nomadic bands, hunting and gathering. Then, something changed.

We transitioned from hunter-gatherer life to plant harvesting, then cultivation and, finally, cities. Strikingly, this transition happened only after the ice age megafauna – mammoths, giant ground sloths, giant deer and horses – disappeared. The reasons humans began farming still remain unclear, but the disappearance of the animals we depended on for food may have forced our culture to evolve.

Early humans were smart enough to farm. All groups of modern humans have similar levels of intelligence, suggesting our cognitive capabilities evolved before these populations separated around 300,000 years ago, then changed little afterwards. If our ancestors didn't grow plants, it's not that they weren't clever enough. Something in the environment prevented them – or they simply didn't need to.

Global warming at the end of the last glacial period, 11,700 years ago, probably made farming easier. Warmer temperatures, longer growing seasons, higher rainfall and long-term climate stability made more areas suitable for cultivation. But it's unlikely farming had been impossible everywhere. And Earth saw many such warming events – 11,700, 125,000, 200,000 and 325,000 years ago – but earlier warming events didn't spur experiments in farming. Climate change can't have been the only driver.

Human migration probably contributed as well. When our species expanded from southern Africa throughout the African continent, into Asia, Europe and then the Americas, we found new environments and new food plants. But people occupied these parts of the world long before farming began. Plant domestication lagged human migration by tens of millennia. If opportunities to invent farming already existed, then the delayed invention of agriculture suggests our ancestors didn't need, or want, to farm.

Agriculture has significant disadvantages compared to foraging. Farming takes more effort and offers less leisure time and an inferior diet. If hunters are hungry in the morning, they can have food on the fire at night. Farming requires hard work today to produce food months later – or not at all. It requires storage and management of temporary food surpluses to feed people year round. A hunter having a bad day can hunt again tomorrow or seek richer hunting grounds elsewhere, but farmers, tied to the land, are at the mercy of nature's unpredictability. Rains arriving too soon or too late, droughts, frosts, blights or locusts can cause crop failure – and famine.

Agriculture has military disadvantages as well. Hunter-gatherers are mobile and can travel long distances to attack or retreat. Constant practice with spears and bows made them deadly fighters. Farmers are rooted to their fields, their schedules dictated by the seasons. They are predictable, stationary targets, whose food stockpiles tempt hungry outsiders.

And having evolved to the lifestyle, humans may simply have loved being nomadic hunters. The Comanche Indians fought to the death to preserve their hunting lifestyle. The Kalahari Bushmen of southern Africa continue to resist being turned into farmers and

herders. Strikingly, when Polynesian farmers encountered New Zealand's abundant flightless birds, they largely abandoned agriculture, creating the Maori moa-hunter culture.

Hunting abandoned

Yet something changed. From 10,000 years ago onward, humans repeatedly abandoned the hunter-gatherer lifestyle for farming. It may be that after the extinction of mammoths and other megafauna from the Pleistocene epoch, and the overhunting of surviving game, the hunter-gatherer lifestyle became less viable, pushing people to harvest and then cultivate plants. Perhaps civilisation wasn't born out of a drive to progress, but disaster, as ecological catastrophe forced people to abandon their traditional lifestyles.

As humans left Africa to colonise new lands, large animals disappeared everywhere we set foot. In Europe and Asia, megafauna like wooly rhinos, mammoths, and Irish Elk vanished around 40,000 to 10,000 years ago. In Australia, giant kangaroos and wombats disappeared 46,000 years ago. In North America, horses, camels, giant armadillos, mammoths and ground sloths declined and disappeared from 15,000 to 11,500 years ago, followed by extinctions in South America 14,000 to 8,000 years ago. After people spread to the Caribbean Islands, Madagascar, New Zealand and Oceania, their megafauna vanished as well. Megafaunal extinctions inevitably followed humans.

Harvesting big game like horses, camels and elephants produces a better return than hunting small game like rabbits. But large animals like elephants reproduce slowly, and have few offspring compared to small animals like rabbits, making them vulnerable to overharvesting. And so everywhere we went, our human ingenuity – hunting with spear-throwers, herding animals with fire, stampeding them over cliffs – meant we harvested large animals faster than they could replenish their numbers. It was arguably the first sustainability crisis.

With the old way of life no longer viable, humans would have been forced to innovate, increasingly focusing on gathering, then cultivating plants to survive. This let human populations expand. Eating plants rather than meat is a more efficient use of land, so farming can support more people in the same area than hunting. People could settle permanently, build settlements, then civilisations.

The archaeological and fossil records tell us our ancestors could have pursued farming, but did only so after they had little alternative. We probably would have continued hunting horses and mammoths forever, but we were just too good at it, and likely wiped out our own food supply.

Agriculture and civilisation may have been invented not because they were an improvement over our ancestral lifestyle, but because we were left no choice. Agriculture was desperate attempt to fix things when we took more than the ecosystem could sustain. If so, we abandoned the life of ice age hunters to create the modern world, not with foresight and intent, but by accident, because of an ecological catastrophe we created thousands of years ago.

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Disclosure statement

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https://bbc.in/2MWRq4p

China pneumonia outbreak: Mystery virus probed in Wuhan

Chinese authorities have launched an investigation into a mysterious viral pneumonia which has infected dozens of people in the central city of Wuhan.

A total of 44 cases have been confirmed so far, 11 of which are considered "severe", officials said on Friday. The outbreak has

prompted Singapore and Hong Kong to bring in screening processes for travellers from the city.

It comes amid online fears the virus could be linked to Sars, or severe acute respiratory syndrome.

The potentially deadly, flu-like Sars virus killed more than 700 people around the world in 2002-03, after originating in China.

There has been speculation on social media about a possible connection to the highly contagious disease.

Wuhan police said eight people had been punished for "publishing or forwarding false information on the internet without verification".

The Wuhan health commission said on Friday it was investigating the cause of the outbreak.

In a statement on its website, it said it had already ruled out a number of infection sources - including influenza, avian influenza and common respiratory diseases - but did not mention Sars.

There has also been no human-to-human transmission, the statement added. However, a number of those infected worked at a seafood market in the city, leading authorities to clean the area.

A spokesman for the World Health Organization (WHO) said it was aware of the outbreak and was in contact with the Chinese government.

"There are many potential causes of viral pneumonia, many of which are more common than severe acute respiratory syndrome coronovirus," the spokesman added. "WHO is closely monitoring this event and will share more details as we have them. "

Fears sparked by an older epidemic

Analysis by BBC Health's Philippa Roxby

This latest outbreak appears to have sparked memories for those who dealt with a Sars epidemic 18 years ago.

At the time, the WHO criticised China for under-reporting the number of cases of Sars in a southern Chinese province.

In the 2002-03 epidemic, the virus affected more than 8,000 people in 26 countries, killing 349 people in mainland China and 299 in Hong Kong.

Travellers flying to other countries are thought to have been behind the large number of cases in that outbreak because Sars spreads quickly without swift treatment in hospital. China sacked its health minister at the time for the poor handling of the crisis.

The country has been free of Sars since May 2004.

http://bit.ly/2udQ2Up

New Study Looks at Why Neptune-Sized and Larger Exoplanets are Rare

Atmospheres of sub-Neptunes readily dissolve into magma oceans on their surface once the planets reach about 3 times the size of Earth

Sub-Neptunes - extrasolar planets with radii between 2.7 and 3 times that of Earth — are much more numerous than Neptune-sized and larger planets. A new study proposes that this drop-off is so abrupt because atmospheres of sub-Neptunes readily dissolve into magma oceans on their surface once the planets reach about 3 times the size of Earth.

“This is a cliff edge in the data, and it’s quite dramatic. What we have been puzzling over is why planets would tend to stop growing beyond about 3 times Earth’s size,” said Dr. Edwin Kite, a planetary scientist at the University of Chicago.

Sub-Neptunes are thought to have oceans of magma on their surfaces, which are kept hot by a thick blanket of hydrogen-rich atmosphere. “So far, almost all models we have ignore this magma, treating it as chemically inert, but liquid rock is almost as runny as water and very reactive,” Dr. Kite said.

The question Dr. Kite and his colleagues considered was whether, as the planets acquired more hydrogen, the ocean might begin to dissolve the atmosphere.

In this scenario, as a sub-Neptune acquires more gas, it piles up in the atmosphere, and the pressure at the bottom where the atmosphere meets the magma starts to build. At first, the magma takes up the added gas at a steady rate, but as the pressure rises, the hydrogen starts to dissolve much more readily into the magma.

"Not only that, but the little bit of the added gas that stays in the atmosphere raises the atmospheric pressure, and thus an even greater fraction of later-arriving gas will dissolve into the magma," Dr. Kite explained. Thus the planet's growth stalls out before it reaches the size of Neptune.

The study authors call this the 'fugacity crisis,' after the term that measures how much more readily a gas dissolves into a mixture than what would be expected based on pressure.

"The theory fits well with existing observations," Dr. Kite noted. "There are also several markers that astronomers could look for in future." "For example, if the theory is correct, planets with magma oceans that are cold enough to have crystallized on the surface should display different profiles, since this would prevent the ocean from absorbing so much hydrogen."

The study was published in the *Astrophysical Journal Letters*.

Edwin S. Kite et al. *2019. Superabundance of Exoplanet Sub-Neptunes Explained by Fugacity Crisis.* ApJL *887, L33; doi: 10.3847/2041-8213/ab59d9*

http://bit.ly/35mh9d4

Man with 5.5-inch horn growing on his back slipped "through the net," docs say

The man lived in a developed country with access to free healthcare.

Beth Mole - 1/4/2020, 4:28 AM

Smartphones won't make you grow horns—but neglecting a worsening skin cancer lesion for years could do the trick.

Recently, doctors in the UK surgically removed a 14cm-long "dragon horn" from a man's lower back. The 50-year-old patient reported that it had been growing for at least three years. The doctors determined that the "gigantic" skin growth was a cutaneous squamous cell carcinoma (cSCC)—a type of skin cancer that causes growing, scaly bumps on the top layer of skin.

The "dragon horn"—do not click through this gallery if you'd prefer not to see other angles. **Plonczak et al. BMJ**

While SCC is a very common type of skin cancer, the man's case is rare, the doctors report in the journal BMJ Case Reports this week. Such lesions are typically caught much earlier. But in this case, doctors found "an extremely large well-differentiated SCC that was neglected by a patient," even though he was "living in a developed country with access to free healthcare."

"This highlights that despite current public skin cancer awareness and rigorous healthcare measures, cases like this can still arise and slip through the net," they conclude.

Cases of SCC are typically seen in those with light skin, who have a lot of sun exposure, are older, have a weakened immune system, or have had certain chemical exposures, such as arsenic.

In this case, the man was a light-skinned manual laborer, but he reported no other clear risk factors. He had no significant sun exposure, no personal or family history of skin cancers, and was not immunosuppressed. Also unusual, his lymph nodes weren't swollen—a common, nonspecific sign that the body is fighting off an infection or disease, such as skin cancer.

There was only "an enormous cutaneous horn on the lower back measuring 140×60×55mm," the doctors report.

To treat the woefully neglected cancer, doctors surgically removed the horn, taking out several millimeters of peripheral tissue to

ensure no cancer was left behind. Tests indicated that they caught it all, and the doctors patched the resulting gaping wound on the man's back with skin from his thigh.

While the surgery seems to have been a success, the doctors report that SCC should be diagnosed and treated earlier, "before becoming 'dragon horns.'"

BMJ Case Reports, *2020. DOI: 10.1136/bcr-2019-233305 (About DOIs).*

http://bit.ly/2ZS8Nsl

Australia's Worst Wildfires in Decades Are About to Get Even Worse

The worst wildfires to ravage Australia in decades—already blamed for the deaths of at least 17 people—are expected to cause more damage over the weekend, as the country faces soaring temperatures and no rain in sight.

Molly Olmstead

The fires have prompted authorities to announce a state of emergency in New South Wales, where the fires are concentrated, to cope with the dangers expected Saturday. On Thursday, the state's premier, Gladys Berejiklian, warned in a news conference that many more people would likely have to flee their homes in the next few days. A large "tourist leave zone" has been declared in New South Wales, and according to the BBC, the resulting exodus has been called "the largest relocation out of the region ever." Thousands already have evacuated from New South Wales and the neighboring state of Victoria this week.

Around 4,000 people in the popular tourist town of Mallacoota, Victoria, sought refuge at the beach on Monday after the fire overtook the town, and the Australian navy began evacuating them on Thursday. Some 800 were being rescued on a naval ship.

Citizens have started to express their frustration with what they see as the government's inaction. Australian Prime Minister Scott Morrison has faced criticism for suggesting that the fires were a result of "many other factors" besides climate change and insisting that Australia could not have taken any steps to mitigate climate change in a way that would have prevented the current situation. And as conditions in Australia worsened last month, he took his family on a vacation to Hawaii. As Morrison toured one fire-scarred town in New South Wales on Thursday, residents shouted insults at him and demanded better funding for rural fire crews.

The fires, sparked and fed by abnormally hot and arid conditions, began in October and now number more than 200. More than 1,200 homes have been destroyed, and more than 10 million acres have burned. At least 17 people are still missing.

According to Australia's Bureau of Meteorology, this season has been the second driest period on record since 1902, and for the past few years, New South Wales has had below-average rainfall. The heat, too, has been severe: Australia experienced its hottest day on record in mid-December, with an average of 107.4 degrees across the continent. Temperatures are expected to exceed 112 degrees in parts of the country on Friday, according to the bureau. Experts warn that the country may see little relief for weeks or even months, as temperatures usually hit their highs in January and February, when Australia's peak fire season typically begins.

Meanwhile, 39 American firefighters arrived in Melbourne on Thursday to assist with the efforts. Some 70 additional American and Canadian firefighters are set to arrive next week.