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Mount Sinai discovers placental stem cells that can regenerate heart after heart attack

stem cells derived from the placenta known as Cdx2 cells can regenerate healthy heart cells after heart attacks in animal models

Researchers at the Icahn School of Medicine at Mount Sinai have demonstrated that stem cells derived from the placenta known as Cdx2 cells can regenerate healthy heart cells after heart attacks in animal models. The findings, published in the May 20 issue of Proceedings of the National Academy of Sciences (PNAS), may represent a novel treatment for regenerating the heart and other organs.

"Cdx2 cells have historically been thought to only generate the placenta in early embryonic development, but never before were shown to have the ability to regenerate other organs, which is why this is so exciting. These findings may also pave the way to regenerative therapy of other organs besides the heart," said principal investigator Hina Chaudhry, MD, Director of Cardiovascular Regenerative Medicine at the Icahn School of Medicine at Mount Sinai.

"They almost seem like a super-charged population of stem cells, in that they can target the site of an injury and travel directly to the injury through the circulatory system and are able to avoid rejection by the host immune system."

This team of Mount Sinai researchers had previously discovered that a mixed population of mouse placental stem cells can help the hearts of pregnant female mice recover after an injury that could otherwise lead to heart failure.

In that study, they showed that the placental stem cells migrated to the mother's heart and directly to the site of the heart injury. The stem cells then programmed themselves as beating heart cells to help the repair process.

The new study was aimed at determining what type of stem cells made the heart cells regenerate. The investigators started by looking at Cdx2 cells, the most prevalent stem cell type in the previously identified mixed population, and found them to comprise the highest percentage (40 percent) of those assisting the heart from the placenta.

To test the Cdx2 cells' regenerative properties, the researchers induced heart attacks in three groups of male mice. One group received Cdx2 stem cell treatments derived from end-gestation mouse placentas, one group received placenta cells that did not express Cdx2, and the third group received a saline control.

The team used magnetic resonance imaging to analyze all mice immediately after the heart attacks, and three months after induction with cells or saline. They found that every mouse in the group with Cdx2 stem cell treatments had significant improvement and regeneration of healthy tissue in the heart.

By three months, the stem cells had migrated directly to the heart injury and formed new blood vessels and new cardiomyocytes (beating heart muscle cells). The mice injected with saline and the non-Cdx2 placenta cells went into heart failure and their hearts had no evidence of regeneration.

Researchers noted two other properties of the Cdx2 cells: they have all the proteins of embryonic stem cells, which are known to generate all organs of the body, but also additional proteins, giving them the ability to travel directly to the injury site, which is something embryonic stem cells cannot do, and they appear to avoid the host immune response.

The immune system did not reject these cells when administered from the placenta to another animal.

"These properties are critical to the development of a human stem cell treatment strategy, which we have embarked on, as this could be a promising therapy in humans. We have been able to isolate Cdx2 cells from term human placentas also; therefore, we are now hopeful that we can design a better human stem cell treatment for the heart than we have seen in the past," explained Dr. Chaudhry. "Past strategies tested in humans were not based on stem cell types that were actually shown to form heart cells, and use of embryonic stem cells for this goal is associated with ethics and feasibility concerns. Placentas are routinely discarded around the world and thus almost a limitless source."

"These results were very surprising to us, as no other cell type tested in clinical trials of human heart disease were ever shown to become beating heart cells in petri dishes, but these did and they knew exactly where to go when we injected them into the circulation," said first author Sangeetha Vadakke-Madathil, PhD, postdoctoral fellow in Medicine (Cardiology) at the Icahn School of Medicine at Mount Sinai.

http://bit.ly/2HOIevD

Farmers have less leisure time than hunter-gatherers, study suggests

Hunter-gatherers who adopt farming work ten hours a week longer than their forager neighbours

Hunter-gatherers in the Philippines who adopt farming work around ten hours a week longer than their forager neighbours, a new study suggests, complicating the idea that agriculture represents progress. The research also shows that a shift to agriculture impacts most on the lives of women.

For two years, a team including University of Cambridge anthropologist Dr Mark Dyble, lived with the Agta, a population of small scale hunter-gatherers from the northern Philippines who are increasingly engaging in agriculture.

Every day, at regular intervals between 6am and 6pm, the researchers recorded what their hosts were doing and by repeating this in ten different communities, they calculated how 359 people divided their time between leisure, childcare, domestic chores and out-of-camp work.

While some Agta communities engage exclusively in hunting and gathering, others divide their time between foraging and rice farming.

The study, published today in Nature Human Behaviour, reveals that increased engagement in farming and other non-foraging work resulted in the Agta working harder and losing leisure time. On average, the team estimate that Agta engaged primarily in farming work around 30 hours per week while foragers only do so for 20 hours.

They found that this dramatic difference was largely due to women being drawn away from domestic activities to working in the fields. The study found that women living in the communities most involved in farming had half as much leisure time as those in communities which only foraged.

Dr Dyble, first author of the study, says: "For a long time, the transition from foraging to farming was assumed to represent progress, allowing people to escape an arduous and precarious way of life.

"But as soon as anthropologists started working with hunter-gatherers they began questioning this narrative, finding that foragers actually enjoy quite a lot of leisure time. Our data provides some of the clearest support for this idea yet."

The study found that on average, Agta adults spent around 24 hours each week engaged in out-of-camp work, around 20 hours each week doing domestic chores and around 30 hours of daylight leisure time. But the researchers found that time allocation differed significantly between adults.

For both men and women leisure time was lowest at around 30 years of age, steadily increasing in later life. There was also a sexual division of labour with women spending less time working out-of-camp, and more time engaged in domestic chores and childcare than men, even though men and women had a similar amount of leisure time. However, the study found that the adoption of farming had a disproportionate impact on women's lives.

Dr Dyble says "This might be because agricultural work is more easily shared between the sexes than hunting or fishing. Or there may be other reasons why men aren't prepared or able to spend more time working out-of-camp. This needs further examination."

Agriculture emerged independently in multiple locations world-wide around 12,500 years ago, and had replaced hunting and gathering as the dominant mode of human subsistence around 5,000 years ago.

Co-author, Dr Abigail Page, an anthropologist at the London School of Hygiene and Tropical Medicine, adds: "We have to be really cautious when extrapolating from contemporary hunter-gatherers to different societies in pre-history. But if the first farmers really did work harder than foragers then this begs an important question - why did humans adopt agriculture?"

Previous studies, including one on the Agta, have variously linked the adoption of farming to increases in fertility, population growth and productivity, as well as the emergence of increasingly hierarchical political structures.

But Page says: "The amount of leisure time that Agta enjoy is testament to the effectiveness of the hunter-gatherer way of life. This leisure time also helps to explain how these communities manage to share so many skills and so much knowledge within lifetimes and across generations."

Reference: Dyble, M., Thorley, J., Page, A.E., Smith, D. & Migliano, A.B. 'Engagement in agricultural work is associated with reduced leisure time among Agta hunter-gatherers.' Nature Human Behaviour (2019). DOI: 10.1038/s41562-019-0614-6

http://bit.ly/2EuyN3A

Bonobo moms play an active role in helping their sons find a mate

And in so doing, they increase their sons' chance of fatherhood three-fold

Many social animals share child-rearing duties, but research publishing May 20 in the journal *Current Biology* finds that bonobo moms go the extra step and actually take action to ensure their sons will become fathers. From physically preventing other males from mating to bringing their sons in close proximity to ovulating females, bonobo moms bring new meaning to the notion of being overbearing - but in so doing, they increase their sons' chance of fatherhood three-fold.

"This is the first time that we can show the impact of the mother's presence on a very important male fitness trait, which is their fertility," says Martin Surbeck, a primatologist at the Max Planck Institute for Evolutionary Anthropology. "We were surprised to see that the mothers have such a strong, direct influence on the number of grandchildren they get."

A young juvenile male bonobo is groomed by his mom in the Kokolopori Bonobo Reserve. **Martin Surbeck**

Surbeck and his colleagues observed wild populations of bonobos in the Democratic Republic of Congo, as well as wild populations of chimpanzees in Côte d'Ivoire, Tanzania, and Uganda. They found that while both bonobo and chimpanzee mothers would advocate for their sons in male-on-male conflicts, bonobo moms went the extra mile to aid their sons' copulation efforts. This involved protecting their sons' mating attempts from other males,

intervening in other male's mating attempts, and intentionally bringing their sons around fertile females.

The bonobo mothers were also able to use their rank in the bonobo's matriarchal society to give their sons access to popular spots within social groups in the community and help them achieve higher status--and therefore, better mating opportunities. The authors note that these interactions were rare in chimpanzee societies likely because males hold dominant positions over females, making the actions of chimp mothers less influential than those of bonobo mothers.

Interestingly, bonobo moms did not extend similar help to their daughters, nor were there any observations of daughters receiving assistance in rearing their offspring. "In bonobo social systems, the daughters disperse from the native community and the sons stay," Surbeck says. "And for the few daughters that stay in the community, which we don't have many examples of, we don't see them receiving any help from their mothers."

Moving forward, Surbeck and his team would like to better understand the benefits these behaviors confer on bonobo mothers. Currently, they think that it allows for an indirect continuation of their genes. "These females have found a way to increase their reproductive success without having more offspring themselves," he says, noting that the prolongation of the post-reproductive human female lifespan, as well as the early age at which human women can no longer bear children, may have evolved from this indirect method of continuing their genetic line.

Surbeck acknowledges that gathering data on post-reproductive lifespans of females in chimp and bonobo communities will require a long-term, collaborative study, similar to this one. "Without the help and participation from all of the field sites where data were collected, these important interactions could have been overlooked," he says. "Now as the director of a bonobo field site, I'm looking forward to further exploring this topic."

The authors acknowledge support from the Max Planck Society, the National Geographic Society, and the Wenner-Gren Foundation. They also acknowledge partial support by SNF. Current Biology, Surbeck, M.: "Males with a mother living in their group have higher paternity success in bonobos but not in chimpanzees" http://www.cell.com/current-biology/fulltext/S0960-9822(19)30338-0

https://bbc.in/2wqLz19

Artificial intelligence diagnoses lung cancer

Artificial intelligence is better than specialist doctors at diagnosing lung cancer, a US study suggests.

By James Gallagher Health and science correspondent, BBC News

The researchers at Northwestern University in Illinois and Google hope the technology could boost the effectiveness of cancer screening.

Finding tumours at an earlier stage should make them easier to treat. The team said AI would have a "huge" role in the future of medicine, but the current software is not yet ready for clinical use.

The study focused on lung cancer, which kills more people - 1.8 million a year - than any other type of cancer. It is why the US recommends screening for people at high risk because of years of heavy smoking. However, screening can result in invasive biopsies for people who turn out not to have cancer, and also misses some tumours.

The study used artificial intelligence to see if the analysis of scans could be improved. The first step was to train the computer software with 42,290 CT lung scans from nearly 15,000 patients. The researchers did not tell the AI what to look for, just which patients went on to get cancer and which did not. The AI was then tested against a team of six radiologists who made a career out of analysing CT scans.

It was more effective than the radiologists when examining a single CT scan and was equally effective when doctors had multiple scans

to go on. The results, in Nature Medicine, showed the AI could boost cancer detection by 5% while also cutting false-positives (people falsely diagnosed with cancer) by 11%.

Dr Mozziyar Etemadi, from Northwestern University, told the BBC: "The next step is to use it on patients in the form of a clinical trial." He says what the AI is using to identify a cancer is a "little bit of a black box".

He added: "Sometimes it highlights a lung nodule (a growth) that for all intents and purposes looks benign but the model thinks it isn't. "It's usually correct and one area of scientific inquiry is figuring out why." Dr Etemadi says that AI and doctors working side by side would be even more effective and that AI had a "huge" role to play in medicine.

Rebecca Campbell, from Cancer Research UK, said: "It's encouraging to see new technological innovations that could one day help us to detect lung cancer early. Similarly to how we learn from experience, deep learning algorithms perform a task repeatedly, each time tweaking it a little to improve accuracy.

"Detecting cancer early, when treatment is more likely to be successful, is one of the most powerful ways of improving survival, and developing inexpensive technology which isn't invasive could play an important role.

"The next steps will be to test this technology further to see whether it can be applied accurately to large numbers of people."

http://bit.ly/2X62waq

Head injury effects halted by xenon gas, finds first ever life-long study in mice

Xenon, given shortly after a TBI, prevents early death and long-term cognitive impairment and protects brain tissue itself in mice

TBI is the leading cause of death and disability in people under 45 in developed countries. The primary injury, caused by the initial force from a fall or car accident for example, is followed by a secondary injury which develops in the minutes, hours and days afterwards.

This secondary injury is largely responsible for the mental and physical disabilities associated with TBI - but there are currently no specific drug treatments that can be given after the trauma to stop it from developing.

TBI patients who survive the injury have a reduced life expectancy and an increased risk of developing Alzheimer's disease or other dementias later in life.

Now, researchers from Imperial College London and Johannes Gutenberg University Mainz have found that the anaesthetic drug xenon, given shortly after a TBI, prevents early death and long-term cognitive impairment and protects brain tissue itself in mice. The xenon-treated mice had a similar life expectancy, cognitive function, and brain tissue integrity, to mice that had never sustained a TBI.

Previously, the same team led by Dr Robert Dickinson and colleagues at Imperial's Department of Surgery & Cancer, showed xenon limited early brain damage and improved long-term motor function in mice with TBI. However, they had yet to look at xenon's effect on life expectancy, long-term cognitive function and brain tissue degeneration after TBI.

This new study, published in the *British Journal of Anaesthesia*, looked at the effects of xenon over the whole lifespan of mice for the first time.

Animals were randomly allocated to one of three groups: TBI xenon, TBI control, and healthy control. Under general anaesthesia, and with long-acting pain relief, a controlled mechanical force was applied to the brains of the TBI control and TBI xenon groups. The healthy control group was given anaesthesia, but did not receive a TBI. The researchers gave xenon gas to one of these groups (TBI xenon group), while the other two received control gas for the same amount of time.

All three groups then underwent learning and memory tests at two weeks and 20 months after injury. The researchers also recorded their time of death and examined their brain tissues.

They found that:

- ***The TBI xenon group had the same life expectancy as the healthy control group which had not suffered a TBI.***
- ***The TBI control group developed late-onset cognitive damage. Xenon treatment shortly after TBI appeared to prevent this.***
- ***Key brain areas involved in cognitive functioning were damaged in control TBI group. Xenon-treatment prevented or significantly reduced this damage.***
- ***Xenon prevented the loss of brain cells in the hippocampus (an area of the brain associated with learning and memory), and prevented degeneration of nerve fibres in the corpus callosum (which connects the two brain hemispheres) that may explain the improvement in cognitive function (see images in Notes to Eds.) Xenon was also shown to reduce long-term brain inflammation that is believed to be involved in cognitive impairment in Alzheimer's Disease and other dementias.***

According to the group, the findings are important as they could offer insight into new treatments for patients with TBI. Patients with TBI early in life are eight times more likely to die early than people without and are more likely to develop Alzheimer's Disease and other types of dementia later on. There is currently no specific drug treatment available for people who suffer a TBI - instead, the treatment is supportive and rehabilitative.

Lead author of the study, Dr Rita Campos-Pires, from the Department of Surgery & Cancer, said: "There is currently a huge gap in what treatment we can offer to patients who've suffered TBI - an injury which can impact all areas of their lives.

"Although xenon has not yet been tested for TBI in humans, our findings add to the growing body of evidence that suggests it could be used after head injuries to prevent secondary injury developing. "Xenon appears to act in a variety of ways, but one of the most likely mechanisms to explain its protective effects on brain tissue is by inhibiting receptors in the brain known as NMDA receptors, that become over-activated following a brain injury."

Dr Dickinson added: "We have looked at very long-term outcomes, up to 20 months after TBI in mice. This is very rarely done in animal studies and is equivalent to following up human TBI patients until their 80s. The finding that only a short treatment with xenon can have beneficial effects on cognition, survival, and brain damage almost two years later suggests that xenon might in future prevent cognitive decline and improve survival in human TBI patients."

Xenon is already used as a human general anaesthetic, is known to have few side effects and could be easily given via inhalation or to mechanically ventilated TBI patients in the intensive care unit. Given xenon's safety profile - and today's findings - the researchers hope in future to evaluate the effectiveness of xenon in human TBI patients.

This study was funded by the Medical Research Council, the European Society for Anaesthesiology, the National Institute for Academic Anaesthesia, the Association of Anaesthetists of Great Britain & Ireland, and the Gas Safety Trust.

http://bit.ly/2JDR7vc

Doctors can estimate patient adherence by simply asking about medication routine

Patients in the study were asked to describe their daily routine for taking medication

AMES, Iowa - A visit to the doctor's office typically begins with a series of questions, including one about medications. An Iowa State University researcher recommends doctors ask a follow up to that question to make sure patients are taking their medications as prescribed.

Alison Phillips, an associate professor of psychology, says medication adherence is vital to patient health and outcomes. However, research shows 20 to 50 percent of patients forget or do not take their meds for various reasons. While doctors know adherence is a problem, Phillips says they avoid asking about it, because patients struggle to recall missed pills or give an answer they think doctors want to hear rather than admit the truth.

Understanding these challenges, Phillips and co-author Elise A. G. Duwe, former postdoctoral researcher in Phillips' lab and resident physician at Northeast Iowa Family Medicine Education Foundation, tested whether doctors could effectively estimate adherence by reading transcripts of patients' descriptions of their medication routine. The study, published in the Journal of General Internal Medicine, is one of the first to find doctors were as accurate in estimating patients' adherence as patients were in reporting the medications they had taken.

"Most doctors do not discuss adherence with their patients, but they should," Phillips said. "If it's too uncomfortable to ask if they're taking their medications, doctors should ask patients about their habits. It can offer insight on adherence or at the very least be a conversation starter for a topic normally not addressed."

Routines are revealing

Patients in the study were asked to describe their daily routine for taking medication and to recall how many days during the last week they missed a pill. Researchers used a medication monitoring system to track compliance for the following month.

The system attaches to a pill bottle and records the date and time when the bottle is opened. Of the 156 patients, 75 took a pill for hypertension, the other 81 were on medication for type-2 diabetes.

Phillips and Duwe shared examples of how patients described their medication-taking routines. A patient with high adherence: "Get up, take it very first thing because must be time lag between taking it and eating. Then shower and shave then eat." A patient with low adherence: "I take it twice a day with food. I try to take it at lunch and dinner. But sometimes I slip up and end up taking at different times."

Researchers shared this data with doctors and asked them to estimate adherence (for percentage of prescribed doses taken and percentage of doses taken on time) based on patient descriptions and recall.

The estimates were compared to adherence rates calculated by the monitoring system. Phillips says the doctors were just as good at estimating patients' adherence from the patients' routine descriptions as they were when estimating from patients' direct reports of missed pills.

Helping patients develop a routine

If patients do not have a medication routine or habit, developing one will lessen their risk of forgetting, Phillips said. She plans to build upon the research by designing and testing interventions for doctors to share with patients they identify as less likely to adhere.

Phillips says there are several reasons why patients do not take their medications.

For some, cost and access is a barrier. Others do not trust medications and would rather make lifestyle changes than take a pill. Even those who accept they need the medication may think they can take a break or only take half of what is prescribed, she said.

"With many medications, you need at least 80 percent adherence for the drug to work properly and some medications are even higher than that," Phillips said. "Habit-focused interventions would target those who forget to regularly take their pills versus those who consciously decide not to take their pills. Still, if doctors ask about routines it may reveal other barriers they need to consider when prescribing medication."

http://bit.ly/2Ql595v

Formation of the moon brought water to Earth

Planetologists explain how the Earth became a habitable planet; study published in Nature Astronomy

The Earth is unique in our solar system: It is the only terrestrial planet with a large amount of water and a relatively large moon, which stabilizes the Earth's axis. Both were essential for Earth to develop life. Planetologists at the University of Münster (Germany) have now been able to show, for the first time, that water came to Earth with the formation of the Moon some 4.4 billion years ago. The Moon was formed when Earth was hit by a body about the size of Mars, also called Theia. Until now, scientists had assumed that Theia originated in the inner solar system near the Earth. However, researchers from Münster can now show that Theia comes from the outer solar system, and it delivered large quantities of water to Earth. The results are published in the current issue of Nature Astronomy.

From the outer into the inner solar system

The Earth formed in the 'dry' inner solar system, and so it is somewhat surprising that there is water on Earth. To understand why this the case, we have to go back in time when the solar system was formed about 4.5 billion years ago. From earlier studies, we know that the solar system became structured such that the 'dry' materials were separated from the 'wet' materials: the so-called 'carbonaceous' meteorites, which are relatively rich in water, come from the outer solar system, whereas the drier 'non-carbonaceous' meteorites come from the inner solar system.

While previous studies have shown that carbonaceous materials were likely responsible for delivering the water to Earth, it was unknown when and how this carbonaceous material - and thus the water - came to Earth. "We have used molybdenum isotopes to answer this question. The molybdenum isotopes allow us to clearly distinguish carbonaceous and non-carbonaceous material, and as such represent a 'genetic fingerprint' of material from the outer and inner solar system," explains Dr. Gerrit Budde of the Institute of Planetology in Münster and lead author of the study.

The measurements made by the researchers from Münster show that the molybdenum isotopic composition of the Earth lies between those of the carbonaceous and non-carbonaceous meteorites, demonstrating that some of Earth's molybdenum originated in the outer solar system. In this context, the chemical properties of molybdenum play a key role because, as it is an iron-loving element, most of the Earth's molybdenum is located in the core.

"The molybdenum which is accessible today in the Earth's mantle, therefore, originates from the late stages of Earth's formation, while the molybdenum from earlier phases is entirely in the core," explains Dr. Christoph Burkhardt, second author of the study. The scientists' results therefore show, for the first time, that carbonaceous material from the outer solar system arrived on Earth late.

But the scientists are going one step further. They show that most of the molybdenum in Earth's mantle was supplied by the protoplanet Theia, whose collision with Earth 4.4 billion years ago led to the formation of the Moon. However, since a large part of the molybdenum in Earth's mantle originates from the outer solar system, this means that Theia itself also originated from the outer solar system.

According to the scientists, the collision provided sufficient carbonaceous material to account for the entire amount of water on Earth. "Our approach is unique because, for the first time, it allows us to associate the origin of water on Earth with the formation of the Moon. To put it simply, without the Moon there probably would be no life on Earth," says Thorsten Kleine, Professor of Planetology at the University of Münster.

http://bit.ly/30Efa2F

Flamingoes, elephants and sharks: How do blind adults learn about animal appearance?

They've never seen animals like hippos and sharks but adults born blind have rich insight into what they look like, a new Johns Hopkins University study found.

"First-person experience isn't the only way to develop a rich understanding of the world around us," says Judy Kim, a doctoral candidate at Johns Hopkins and corresponding author of the study published May 21 in Proceedings of the National Academy of Sciences.

"Essentially, the question is, how do we know what we know?"

While some previous research has shown that blind people do have knowledge of things like light and color, researchers still have little understanding of what blind people know about appearance and how such information is learned. Some studies suggest that people born blind remember verbal facts, like 'flamingos are pink,' so the research team wanted to investigate further. "People often have the intuition that we can't know what we can't see," says Kim.

The researchers presented 20 blind and 20 sighted adults with animal names and asked participants to: order animals by size (smallest to largest) and height (shortest to tallest); sort animals into groups based on shape, skin texture and color; pick which animal out of a group is unlike the others in shape, and choose from various texture options ("Does a hippo have feathers, fur, skin or scales?").

Overall, blind and sighted participants organized animals in similar ways and agreed on which physical features were most likely to be observed within animal groups. For example, blind and sighted participants judged that dolphins are similar in shape to sharks and sloths are similar in texture to grizzlies. 15 out of 20 blind and 19 out of 20 sighted participants judged elephants to be bigger than rhinos. But the groups also showed some differences.

Contrary to the idea that blind people learn about animal appearance from sighted people's descriptions of what animals look like, blind and sighted participants disagreed most about the dimension that was easiest for sighted people to describe in words: animal color. Sighted participants created groups for white, pink, black, black and white, brown and grey animals, and they easily labeled these groups according to their primary colors. By contrast, sighted people had a hard time verbally describing their shape groupings; they used many words and did not agree with each other. Nevertheless, blind people created similar shape groups to the sighted but did not make consistent color groups.

The researchers found that to deduce what animals looked like, blind people relied on similar biological classifications that scientists use to group species. This strategy works very well for shape and texture: birds, for example, have feathers and a characteristic winged shape. Such inference works less well for color because many very different animals are white (e.g., swans, polar bears and sheep).

The main conclusion is that blind people develop rich and accurate ideas about appearance based on inference.

"It's sometimes assumed that the senses and direct experience are the best way to learn about the world. What the findings show is that linguistic communication can give us rich and accurate knowledge, even knowledge that at first glance seems 'visual.'" says Marina Bedny, Assistant Professor of Psychological and Brain Sciences at Johns Hopkins and another author on the paper.

"Neither sighted nor blind people living in urban environments really need to know about wild animals. But we are fascinated by them. Knowing about lions and elephants is part of our culture and

blind people who are members of the same culture infer animal appearance from linguistic communication."

http://bit.ly/2K7is8q

Why lack of sleep is bad for your heart

Study finds short-sleepers have lower levels of gene-regulating microRNA

In recent years, numerous studies have shown that people who don't get enough sleep are at greater risk of stroke and heart attack.

A new University of Colorado Boulder study, published in the journal Experimental Physiology, helps explain why.

It found that people who sleep fewer than 7 hours per night have lower blood levels of three physiological regulators, or microRNAs, which influence gene expression and play a key role in maintaining vascular health. The findings could potentially lead to new, non-invasive tests for sleep deprived patients concerned about their health, the authors said.

"This study proposes a new potential mechanism through which sleep influences heart health and overall physiology," said senior author Christopher DeSouza, a professor of Integrative Physiology.

Despite recommendations by the American Heart Association that people get 7 to 9 hours of sleep each night, about 40 percent of adults in the United States fall short. Overall, the average American's sleep duration has plummeted from 9 hours nightly to 6.8 hours nightly over the past century.

In another recent study, DeSouza's group found that adult men who sleep 6 hours per night have dysfunctional endothelial cells - the cells that line blood vessels - and their arteries don't dilate and constrict as well as those who get sufficient sleep. But the underlying factors leading to this dysfunction aren't well known.

MicroRNAs are small molecules that suppress gene expression of certain proteins in cells. The exact function of circulating microRNAs in the cardiovascular system, and their impact on cardiovascular health is receiving a lot of scientific attention, and drugs are currently in development for a variety of diseases, including cancer, to correct impaired microRNA signatures.

"They are like cellular brakes, so if beneficial microRNAs are lacking that can have a big impact on the health of the cell," said DeSouza.

For the new study, which is the first to explore the impact of insufficient sleep on circulating microRNA signatures, DeSouza and his team took blood samples from 24 healthy men and women, age 44 to 62, who had filled out questionnaires about their sleep habits. Half slept 7 to 8.5 hours nightly; Half slept 5 to 6.8 hours nightly.

They measured expression of nine microRNAs previously associated with inflammation, immune function or vascular health.

They found that people with insufficient sleep had 40 to 60 percent lower circulating levels of miR-125A, miR-126, and miR-146a, (previously shown to suppress inflammatory proteins) than those who slept enough.

"Why 7 or 8 hours seems to be the magic number is unclear," said DeSouza. "However, it is plausible that people need at least 7 hours of sleep per night to maintain levels of important physiological regulators, such as microRNAs."

Research is now underway in DeSouza's lab to determine whether restoring healthy sleep habits can restore healthy levels of microRNAs.

Ultimately, he said, it's possible that microRNAs in blood could be used as a marker of cardiovascular disease in people with insufficient sleep, enabling doctors to glean important information via a blood test rather than current, more invasive tests.

For now, DeSouza says, the takeaway message for those burning the midnight oil is this:

"Don't underestimate the importance of a good night's sleep."

http://bit.ly/2WvVGy0

Aspirin green light for brain bleed stroke patients, study finds

People who suffer a stroke caused by bleeding in the brain - known as brain haemorrhage - can take common medicines without raising their risk of another stroke, a major clinical trial has found.

Researchers say the findings are reassuring for the thousands of people who take the medicines to reduce their risk of heart attack and another common type of stroke caused by blood clots in the brain.

These everyday treatments - known as antiplatelet medicines - work by slowing or stopping blood from clotting. They are often prescribed to older people because they can lower risk of heart attack and stroke caused by a blood clot.

Doctors had thought the medicines - which include aspirin and clopidogrel - might make people with stroke due to brain haemorrhage more likely to suffer another bleed in the brain.

Researchers led by the University of Edinburgh tracked outcomes from 537 people from across the UK who had suffered a brain haemorrhage while they were taking medicines to stop blood clotting. Patients were randomly assigned to either start taking antiplatelet treatment or avoid it for up to five years.

The team found that people who took antiplatelet medicines experienced fewer recurrences of brain haemorrhage compared with those who did not take these treatments. Some 12 people suffered a brain bleed while taking the medication compared with 23 people who did not. This may suggest the treatments reduce rather than increase risk of further bleeding in the brain, the researchers say, but further studies are needed to confirm this.

Around half of the participants underwent an additional brain scan using MRI at the beginning of the study. These scans are often used by doctors to check for the presence of tiny blood deposits in the brain, known as microbleeds, which can be a warning sign of future strokes. The researchers found treatment with antiplatelet medication was not more hazardous for people who already had microbleeds in their brain.

Experts say this provides further reassurance that brain haemorrhage survivors can safely continue to take antiplatelet medicines to reduce their risk of future heart attacks or strokes.

It also suggests that patients do not need to undergo an MRI scan before starting treatment. This is important because older people are often unable to have an MRI.

The study - called RESTART - is published in The Lancet and The Lancet Neurology. It was funded by the British Heart Foundation. Findings are being presented at the European Stroke Organisation Conference in Milan.

Professor Rustam Salman, of the University of Edinburgh's Centre for Clinical Brain Sciences, said: "The results of the RESTART trial are reassuring for survivors of brain haemorrhage who need to take antiplatelet medicines to prevent heart attacks and strokes. I am keen to investigate the possibility that these medicines might halve the risk of brain haemorrhage happening again."

Professor Metin Avkiran, Associate Medical Director at the British Heart Foundation (BHF), said: "Around a third of people who suffer a brain haemorrhage, also known as haemorrhagic stroke, do so when they are taking an antiplatelet medicine such as aspirin to reduce the risk of a heart attack or an ischaemic stroke. We now have a strong indication they can carry on taking these potentially life-saving medicines after the brain haemorrhage without increasing the risk of another one, which is crucial new information for both patients and doctors.

"Although some developments have been made, the options at our disposal for treating and preventing strokes are still far too limited.

Around 36,000 people die each year in the UK after having a stroke, most commonly an ischaemic stroke. Every advance from important research such as this takes us a step closer to better stroke prevention and management."

http://bit.ly/2JECSWZ

Civil War plant medicines blast drug-resistant bacteria in lab tests

Confederate field hospitals turned to traditional remedies under Union blockade

During the height of the Civil War, the Confederate Surgeon General commissioned a guide to traditional plant remedies of the South, as battlefield physicians faced high rates of infections among the wounded and shortages of conventional medicines. A new study of three of the plants from this guide -- the white oak, the tulip poplar and the devil's walking stick -- finds that they have antiseptic properties.

Scientific Reports is publishing the results of the study led by scientists at Emory University. The results show that extracts from the plants have antimicrobial activity against one or more of a trio of dangerous species of multi-drug-resistant bacteria associated with wound infections: *Acinetobacter baumannii*, *Staphylococcus aureus* and *Klebsiella pneumoniae*.

"Our findings suggest that the use of these topical therapies may have saved some limbs, and maybe even lives, during the Civil War," says Cassandra Quave, senior author of the paper and assistant professor at Emory's Center for the Study of Human Health and the School of Medicine's Department of Dermatology.

Quave is an ethnobotanist, studying how people use plants in traditional healing practices, to uncover promising candidates for new drugs. "Ethnobotany is essentially the science of survival -- how people get by when limited to what's available in their immediate environment," she says. "The Civil War guide to plant remedies is a great example of that."

"Our research might one day benefit modern wound care, if we can identify which compounds are responsible for the antimicrobial activity," adds Micah Dettweiler, the first author of the paper.

If the active ingredients are identified, "it is my hope that we can then [further] test these molecules in our world-renowned models of bacterial infection," says co-author Daniel Zurawski, chief of pathogenesis and virulence for the Wound Infections Department at the Walter Reed Army Institute of Research. "I've always been a Civil War buff," Zurawski adds. "I am also a firm believer in learning everything we can garner from the past so we can benefit now from the knowledge and wisdom of our ancestors."

Additional co-authors on the paper include Ryan Reddinger, from the Walter Reed Army Institute of Research; James Lyles, from the Quave lab; and Kate Nelson, from Emory School of Medicine's Department of Dermatology.

Dettweiler was still an Emory undergraduate when he heard about the Civil War plant guide and decided to research it for his honors thesis. He has since graduated with a degree in biology and now works as a research specialist in the Quave lab.

"I was surprised to learn that far more Civil War soldiers died from disease than in battle," he says. "I was also surprised at how common amputation was as a medical treatment for an infected wound."

About one in 13 surviving Civil War soldiers went home with one or more missing limbs, according to the American Battlefield Trust.

At the time of the Civil War, from 1861 to 1865, germ theory was in its developmental stages and only gradually beginning to gain acceptance. Formal medical training for physicians was also in its infancy. An antiseptic was simply defined as a tonic used to prevent "mortification of the flesh." Iodine and bromine were sometimes

used to treat infections, according to the National Museum of Civil War Medicine, although the reason for their effectiveness was unknown.

Other conventional medicines available at the time included quinine, for treating malaria, and morphine and chloroform, to block pain.

Military field hospitals within the Confederacy, however, did not have reliable access to these medicines due to a blockade -- the Union Navy closely monitored the major ports of the South to prevent the Confederacy from trading.

Seeking alternatives, the Confederacy commissioned Francis Porcher, a botanist and surgeon from South Carolina, to compile a book of medicinal plants of the Southern states, including plant remedies used by Native Americans and enslaved Africans. "Resources of the Southern Fields and Forests," published in 1863, was a major compendium of uses for different plants, including a description of 37 species for treating gangrene and other infections. Samuel Moore, the Confederate Surgeon General, drew from Porcher's work to produce a document called "Standard supply table of the indigenous remedies for field service and the sick in general hospitals."

For the current study, the researchers focused on three plant species Porcher cited for antiseptic use that grow in Lullwater Preserve on the Emory campus. They included two common hardwood trees -- the white oak (Quercus alba) and the tulip poplar (Liriodendron tulipifera) -- as well as a thorny, woody shrub commonly known as the devil's walking stick (Aralia spinosa).

Samples of these three plants were gathered from campus specimens, based on Porcher's specifications. Extracts were taken from white oak bark and galls; tulip poplar leaves, root inner bark and branch bark; and the devil's walking stick leaves. The extracts were then tested on three species of multi-drug-resistant bacteria commonly found in wound infections.

Aceinetobacter baumannii -- better known as "Iraqibacter" due to its association with wounded combat troops returning from the Iraq War -- exhibits extensive resistance to most first-line antibiotics. "It's emerging as a major threat for soldiers recovering from battle wounds and for hospitals in general," Quave says.

Staphylococcus aureus is considered the most dangerous of many common staph bacteria and can spread from skin infections or medical devices through the bloodstream and infect distant organs. *Klebsiella pneumoniae* is another leading cause of hospital infection and can result in life-threatening cases of pneumonia and septic shock.

Laboratory tests showed that extracts from the white oak and tulip poplar inhibited the growth of *S. aureus*, while the white oak extracts also inhibited the growth of *A. baumannii* and *K. pneumoniae*. Extracts from both of these plants also inhibited *S. aureus* from forming biofilms, which can act like a shield against antibiotics.

Extracts from the devil's walking stick inhibited both biofilm formation and quorum sensing in *S. aureus*. Quorum sensing is a signaling system that staph bacteria use to manufacture toxins and ramp up virulence. Blocking this system essentially "disarms" the bacteria.

Traditional plant remedies are often dismissed if they don't actively attack and kill pathogens, Quave notes, adding: "There are many more ways to help cure infections, and we need to focus on them in the era of drug-resistant bacteria."

"Plants have a great wealth of chemical diversity, which is one more reason to protect natural environments," Dettweiler says. He plans to go to graduate school with a focus on researching plants for either medical or agricultural purposes. "I'm interested in plants because, even though they don't move from place to place, they are extremely powerful and important."

The research was supported by a Howard Hughes Medical Institute Science Education Program award to Emory University and grants from the National Institutes of Health, National Center for Complementary and Integrative Health and from the National Institute of Allergy and Infectious Disease.

http://bit.ly/2W3eUv9

'Face Mites' Live in Your Pores, Eat Your Grease and Mate on Your Face While You Sleep

Don't freak out, but you probably have a few dozen arachnids grinding up on the tiny shafts of hair lodged inside your face, quietly gorging themselves on your natural oils.

By Brandon Specktor, Senior Writer

OK, you can freak out if you want. But there's nothing wrong with you. These tick-like arachnids are known as face mites (in the genus *Demodex*) and, according to a skin-tingling new video created by the folks at KQED San Francisco, they live a peaceful life buried in the facial pores of most human adults. (The mites are not found on babies, and they are thought to be transmitted through motherly contact.)

Demodex ***mites burrow face-first inside the pores at the bottom of your hair follicles. Shown here, a scanning electron micrograph of such mites protruding from a dissected human hair follicle.*** **Science Photo Library/Getty Images Plus**

These creepy-crawlies are eight-legged, mostly transparent and microscopic in size, measuring about 0.01 inches (0.3 millimeters) apiece, according to an NPR article accompanying the new video. They live near the roots of facial hair follicles on both men and women, hidden away inside your pores.

What's the draw of these cramped living quarters?

Consider it easy access to an all-you-can-slurp buffet of sebum — the waxy oil your face excretes to keep hydrated.

Sebum is produced by glands tucked inside your pores, near the bottom of your hair follicles; *Demodex* mites seek out this greasy meal ticket by burrowing face-first into those pores, where they sleep by day.

At night, when you're asleep, they crawl onto the surface of your skin to mate.

That's right — there's a nightly mite party on your face, and you're not invited.

Given their dietary preferences, face mites are attracted to the greasiest pores on your body, including those around the cheeks, nose and forehead.

According to a study published in 1992 in the journal Clinical and Experimental Dermatology, infested follicles can hold a half-dozen mites at once, with room for many more.

Each mite can live for about two weeks. These mites pose no known threats to humans, unless they amass in truly huge numbers, sometimes leading to a disease called demodicosis, or demodectic mange.

In humans, demodicosis can cause a red or white sheen to form on the skin, and it is often associated with a decline in immune-system response, Kanade Shinkai, a dermatologist at the University of California, San Francisco, told NPR.

But the condition is rare, Shinkai said, and most people live peacefully with their face mites until old age.

Just think, in your lifetime, your nose could serve as the family home to hundreds of generations of grease-swilling, nocturnal-partying arachnids.

If the thought doesn't fill your pores with pride, consider one last silver lining: You probably won't ever have to clean up after your *Demodex* houseguests. As KQED points out in the video, face mites have no anus, instead storing their poop in their bodies for the full duration of their brief lives. Now that's just good manners.

http://bit.ly/2EwT3lc

Freckled Woman with High Alcohol Tolerance Lived in Japan 3,800 Years Ago

More than two decades after researchers discovered the 3,800-year-old remains of "Jomon woman" in Hokkaido, Japan, they've finally deciphered her genetic secrets.

By Laura Geggel, Associate Editor

And it turns out, from that perspective, she looks very different from modern-day inhabitants of Japan. The woman, who was elderly when she died, had a high tolerance for alcohol, unlike some modern Japanese people, a genetic analysis revealed. She also had moderately dark skin and eyes and an elevated chance of developing freckles.

A facial reconstruction of the Jomon woman, who lived about 3,800 years ago on what is now northern Japan. **Credit: Photo by Nation Museum of Nature and Science, Tokyo**

Surprisingly, the ancient woman shared a gene variant with people who live in the Arctic, one that helps people digest high-fat foods. This variant is found in more than 70% of the Arctic population, but it's absent elsewhere, said study first author Hideaki Kanzawa, a curator of anthropology at the National Museum of Nature and Science in Tokyo. [Photos of Samurai: The Last Century of Japanese Warriors]

This variant provides further evidence that the Jomon people fished and hunted fatty sea and land animals, Kanzawa said.

"Hokkaido Jomon people engaged in [not only] hunting of ... land animals, such as deer and boar, but also marine fishing and hunting of fur seal, Steller's sea lions, sea lions, dolphins, salmon and trout," Kanzawa told Live Science. "In particular, many relics related to hunting of ocean animals have been excavated from the Funadomari site," where the Jomon woman was found.

Who is Jomon woman?

Jomon woman lived during the Joman period, also known as Japan's Neolithic period, which lasted from about 10,500 B.C. to 300 B.C. Though she died more than three millennia ago — between 3,550 and 3,960 years ago, according to recent radiocarbon dating — researchers found her remains only in 1998, at the Funadomari shell mound on Rebun Island, off the northern coast of Hokkaido.

But Jomon woman's genetics have remained a mystery all these years, prompting researchers to study her DNA, which they extracted from one of her molars. Last year, the researchers released their preliminary results, which helped a forensic artist create a facial reconstruction of the woman, showing that she had dark, frizzy hair; brown eyes; and a smattering of freckles.

Her genes also showed that she was at high risk of developing solar lentigo, or darkened patches of skin if she spent too much time in the sun, so the artist included several dark spots on her face.

"These findings provided insights into the history and reconstructions of the ancient human-population structures in east Eurasia," said Kanzawa, who was part of a larger team that included Naruya Saitou, a professor of population genetics at the National Institute of Genetics in Japan.

Now, with their study slated to be published in the next few weeks in The Anthropological Society of Nippon's English-language journal, Kanzawa and his colleagues are sharing more of their results. Jomon woman's DNA shows, for example, that the Jomon people split with Asian populations that lived on the Asian mainland between 38,000 and 18,000 years ago, he said.

It's likely that the Jomon people lived in small hunter-gatherer groups, likely for about 50,000 years, Kanzawa noted. Moreover,

Jomon woman had wet earwax. That's an interesting fact because the gene variant for dry earwax originated in northeastern Asia and today up to 95% of East Asians have dry earwax. (People with the dry earwax variant also lack a chemical that produces smelly armpits.)

Despite her differences from the modern Japanese population, Jomon woman is actually more closely related to today's Japanese, Ulchi (the indigenous culture of eastern Russian), Korean, aboriginal Taiwanese and Philippine people than these populations are to the Han Chinese, Kanzawa said.

http://bit.ly/2JzX2S0

Complex life may only exist because of millions of years of groundwork by ancient fungi

Fossils suggest that fungi may have occupied land well before plants.

by Katie Field, The Conversation

Because of their delicate organic and decomposing nature, fossilized fungi are extremely rare. So rare, in fact, that a new discovery has just pushed back the earliest evidence of fungi by at least 500m years—doubling their age.

Until now, the oldest confirmed fungal fossils dated to around 450m years ago—about the same time that plants migrated from sea to land. One of the most famous fossilized fungi from this period is the *Prototaxites*, which could grow up to eight meters tall—leading to its misidentification for many years as a tree.

But previous examination of the fungal "molecular clock", using DNA-based methods, suggested that fungi may have evolved much earlier, between 760m and 1.06 billion years ago. Extracted from Arctic Canadian shales, the newly discovered billion-year-old fossilised fungal spores and hyphae (long thin tubes) plug the gap in the fossil record and suggest that fungi may have occupied land well before plants.

The fungal fossils were found in rocks that were probably once part a shallow-water estuary. Such environments are typically great for fungi thanks to nutrient-rich waters and the build up of washed-up organic matter to feed on. The high salinity, high mineral and low oxygen content of these ancient coastal habitats also provided great conditions to perfectly preserve the tough chitin molecules embedded within fungal cell walls that otherwise would have decomposed.

While it's not certain whether the newly-discovered ancient fungi actually lived within the estuary or were washed into the sediments from the land, they show many of the distinctive features you'd expect in modern terrestrial fungi. The germinating spores are clearly defined, as are the branching, thread-like tubes that help fungi explore their environment, named *hyphae*. Even the cell walls are distinctively fungal, being made up of two clear layers. In fact, if you didn't know they were so old, you'd be hard-pressed to distinguish them from modern fungi.

Fungal forefathers

As you might imagine from their ancient origins, fungi have played a critical role in shaping Earth's terrestrial biosphere over the last billion years. The first plants to emerge onto land 500m years ago formed intimate partnerships with fungi. Lacking roots, these early plants relied on their fungal partners to grow inside them and spread outwards into the primordial mineral soil. In a process known as biological weathering, fungal hyphae would secrete organic acids to dissolve rocks and extract nutrients held within. In return, the plants would transfer nutrients produced through photosynthesis to the fungi.

This exchange of resources between early plants and fungi powered the growth, evolution and diversification of Earth's flora into ever more complex species, communities and ecosystems, and remains the norm today. Over 90% of land plants associate with a fungal

partner of one type or another, and some are entirely dependent on fungal assistance to survive.

The symbiotic rise of land plants and their fungal partners also had dramatic effects on our atmosphere. Now with abundant access to mineral-based energy building blocks, plants evolved more efficient mechanisms for photosynthesis to capture this energy, for example through better control of the movement of carbon dioxide and water into and out of leaves. Over millions of years, this increased absorption of carbon dioxide produced a massive rise in oxygen concentrations, supporting the emergence of much larger, more complex animal life than the tiny insect-like life forms that previous oxygen levels could support.

From there, the evolutionary story is clear. But in showing that fungi probably arrived on land 500m years before plants, the new fossil evidence raises fundamental questions about the start of this symbiotic journey.

It was previously thought that plants made the transition to terrestrial life simultaneously with aquatic fungal partners, but the new discovery opens up the possibility that Earth's lands may have been already being prepared for successful plant life for hundreds of millions of years. Dissolving mineral-rich rocks and secreting carbon-based organic acids, we know that fungi were extremely important in converting barren lands into the fertile, carbon-rich soils we know today. It could be that the emergence of plant life was only made possible by aeons of groundwork by ancient fungal forefathers.

The outstanding challenge for scientists now is to resolve with certainty whether these ancient fungi were terrestrial in origin, and pinpoint their placement on the evolutionary tree of life. With the focus now on finding further fossil fungi, our understanding of the evolution of the early biosphere will make leaps and bounds.

What is already clear is that without fungi, we would not exist. Playing a vital role in the maintenance of healthy ecosystems across the planet, from the Antarctic deserts to the tropical rainforests, fungi underpin all life on Earth today. Now, it appears we may have another 500m years to thank them for.

http://bit.ly/2YS7CYn

Israeli scientists brew beer with revived ancient yeasts

Israeli researchers raised a glass Wednesday to celebrate a long-brewing project of making beer and mead using yeasts extracted from ancient clay vessels—some over 5,000 years old.

by Ilan Ben Zion

Archaeologists and microbiologists from the Israel Antiquities Authority and four Israeli universities teamed up to study yeast colonies found in microscopic pores in pottery fragments. The shards were found at Egyptian, Philistine and Judean archaeological sites in Israel spanning from 3,000 BC to the 4th century BC.

The scientists are touting the brews made from "resurrected" yeasts as an important step in experimental archaeology, a field that seeks to reconstruct the past in order to better understand the flavor of the ancient world.

"What we discovered was that yeast can actually survive for a very, very long time without food," said Hebrew University microbiologist Michael Klutstein. "Today we are able to salvage all these living organisms that live inside the nanopores and to revive them and study their properties."

Beer was a staple of the daily diet for the people of ancient Egypt and Mesopotamia. Early Egyptian texts refer to a variety of different brews, including "iron beer," "friend's beer," and "beer of the protector."

The yeast samples came from nearly two dozen ceramic vessels found in excavations around the country, including a salvage dig in central Tel Aviv, a Persian-era palace in southern Jerusalem and 'En

Besor, a 5,000-year-old Egyptian brewery near Israel's border with the Gaza Strip. The project was spearheaded by Hebrew University microbiologist Ronen Hazan and antiquities authority archaeologist Yitzhak Paz.

Other researchers of ancient beers, such as University of Pennsylvania archaeologist Patrick McGovern, have concocted drinks based on ancient recipes and residue analysis of ceramics. But the Israeli scientists say this is the first time fermented drinks have been made from revived ancient yeasts.

Aren Maeir, a Bar Ilan University archaeologist, excavates at Tel es-Safi, the biblical city of Gath, where ancient Philistine beer pots yielded yeasts used to brew a beer offered to journalists. He likened the revival of long-dormant yeast to the resurrection of ancient beasts fictionalized in "Jurassic Park," but only to a point.

"In Jurassic Park, the dinosaurs eat the scientists," he said. "Here, the scientists drink the dinosaurs."

"It opens up a whole new field of the possibility that perhaps other microorganisms survived as well, and you can identify foods such as cheese, wine, pickles," opening a portal into tasting cultures of the past, he said.

For this initial experiment, the team paired up with a Jerusalem craft brewer to make a basic modern-style ale using yeast extracted from the pots. The ale had a thick white head, with a caramel color and a distinctly funky nose. The mead, made using yeast extracted from a vessel found in the ruins of a palace near Jerusalem that contained honey wine roughly 2,400 years ago, was champagne bubbly and dry, with a hint of green apple.

The beer incorporates modern ingredients, like hops, that were not available in the ancient Middle East—but it's the revived yeast that provides much of the flavor.

"We tried to recreate some of the old flavors that people in this area were consuming hundreds and thousands of years ago," said Shmuel Naky, a craft brewer from the Jerusalem Beer Center, who helped produce the beer and mead. Yeasts, he said, "have a very crucial impact on flavor."

Naky described the beer as "spicy, and somewhat fruity, and it's very complex in flavor," all attributes produced by the ancient yeast.

Genome sequencing of the yeast colonies extracted from the pots showed that the ancient strain of yeast was different from the yeast used in beer-making today, but similar to those still used to make traditional Zimbabwean beer and Ethiopian tej, a type of honey wine.

The researchers said their next aim is to pair the resurrected yeasts with ancient beer recipes to better reproduce drinks from antiquity.

More information: *Tzemach Aouizerat et al, Isolation and Characterization of Live Yeast Cells from Ancient Vessels as a Tool in Bio-Archaeology, mBio (2019).* *dx.doi.org/10.1128/mBio.00388-19*

http://bit.ly/2WtxETY

The healing power of fish skin for a dog named Stella

Cod skin grafts have anti-inflammatory and antibiotic properties, important for healing and tissue regeneration

EAST LANSING, Mich. - When Stella first entered the emergency department at the Michigan State University Veterinary Medical Center on a Wednesday night, Feb. 13, 2019, she had second- and third-degree burns across 10% of her body.

Stella, a 1-year-old female Rottweiler, had miraculously escaped a house fire in Lansing, Michigan, while her owners were away. Although lucky, she didn't escape burns across her head, nose, ears, hind end and sides of her body, as well as severe smoke inhalation and respiratory problems. She also developed ulcers and scarring in both eyes due to fire exposure.

For two weeks, she fought for her life.

"Stella's will to live was amazing; she never quit fighting," said Rose Wahl, one of the licensed veterinary technicians who was

there when Stella arrived. "Her resilience and strength have astounded everyone who has worked with her."

The immediate threat for Stella upon arrival was the trauma and thermal injuries to her trachea and lungs. So, she was put on intravenous, or IV, fluids and pure oxygen to help her breath. Once stabilized, the MSU soft tissue surgery team went to work, while ophthalmologists cared for her eye injuries.

"We had to get creative with her burns because of the significant trauma to Stella's lungs," said Brea Sandness, a veterinarian and surgical resident at MSU. "She wasn't a great candidate for anesthesia because of her respiratory injuries."

That's when the surgical team turned to a less traditional method - using Icelandic, descaled cod fish skins donated by Kerecis, a company developing fish-skin products for use in burn and other medical procedures in humans and animals.

Because of the makeup of the tissue and high omega-3 fatty acids in the cod skin, these grafts have anti-inflammatory and antibiotic properties, important for healing and tissue regeneration. They don't require heavy sedation, either.

Michigan State University veterinarians used Icelandic, descaled cod fish skins to treat Stella, a 1-year-old Rottweiler, who suffered second- and third-degree burns across 10% of her body from a house fire. **Michigan State University**

"We were able to place them on her with minimal sedation, which not only allowed us to heal her without additional stress to her lungs, but improved the way her burns healed," Sandness said.

The descaling of the cod skins is what differentiates them from other fish grafts, such as tilapia. While scaled tilapia grafts, which gained national attention during the California wildfires earlier this year, are effective, they act more as an organic covering while the skin underneath heals itself.

According to Sandness, descaled grafts have been shown to stimulate the production of cells and become functional, living tissue. In Stella's case, these grafts, which can be changed as often as the burn requires, were absorbed by her body as new tissue grew into the graft.

Today, Stella is back to being a relatively active pup. But even though her burns are healing well, she still struggles with respiratory issues that will likely need close monitoring and care throughout her life.

"Stella is one of the bravest and strongest patients I've ever encountered," Wahl said. "Not only did she show incredible endurance and resilience, she has maintained a sweet and kind attitude throughout this whole ordeal."

Sandness added that beyond her lovable personality, Stella's case, which will be presented at the Society of Veterinary Soft Tissue Surgery convention in June, will help inspire discussions of using fish grafts in the veterinary medical field, potentially helping other animals who have experienced what Stella has.

"Stella's case is an inspiration, and her grafts have the potential to be a new and highly effective treatment tool in the veterinary profession," Sandness said. "She's a living example that the fire within her burned stronger than the fire that injured her."

http://bit.ly/2WskeHZ

Nerve stimulation could provide new treatment option for most common type of stroke

Nerve stimulation therapy increasing blood flow could help those with most common type of stroke up to 24 hours after onset

Research led by a UCLA scientist found that a new nerve stimulation therapy to increase blood flow could help patients with the most common type of stroke up to 24 hours after onset.

A study of 1,000 patients found evidence that the technique, called active nerve cell cluster stimulation, reduced the patients' degree of disability three months after they suffered an acute cortical ischemic stroke, which affects the surface of the brain.

Dr. Jeffrey Saver, director of the UCLA Comprehensive Stroke Center, was the co-principal investigator of the study, which was conducted at 73 medical centers in 18 countries.

"We believe this represents the advent of an entirely new treatment for patients with acute ischemic stroke," said Saver, who also is senior associate vice chair for clinical research in neurology at the David Geffen School of Medicine at UCLA. The study is published today in *The Lancet*.

Unlike the two currently approved therapies for acute stroke, which open blocked arteries by dissolving or removing a clot, the new approach applies electrical stimulation to nerve cells behind the nose, increasing blood flow in the brain by dilating undamaged arteries and bypassing the blockage to treat the threatened region of the brain.

In previous studies to understand the mechanism by which the treatment would work, scientists found that the nerve cell cluster stimulation not only increases blood flow, but also preserves the blood-brain barrier, which prevents brain swelling. It also improved neurons' ability to compensate for injury and form new connections.

In a study subset of 520 people who had major deficits and confirmed injury to the cerebral cortex, 40% of those who did not have the stimulation had favorable outcomes, versus 50% of those who did have the stimulation. Although those results fell just short of statistical significance, when the data is combined with similar findings from an earlier trial, the cumulative statistics indicate that the therapy is effective when administered eight to 24 hours after the onset of a cortical acute ischemic stroke.

The treatment uses a small neurostimulator electrode that is temporarily implanted through the roof of the mouth. (The implant requires only local anesthesia.) During the study, the electrode actively stimulated the nerve cell cluster four hours a day for five consecutive days.

The first treatment for ischemic stroke, the clot-dissolving drug alteplase, was approved by the Food and Drug Administration in 1996. When administered soon after onset, the drug, which is also called tPA, can sometimes clear a blocked artery, restore blood flow and avert stroke damage. However, its effectiveness diminishes if treatment is delayed beyond three hours, it does not work for all patients, and some people have conditions that preclude its use.

More recently, the FDA has approved clot-retrieval devices that are threaded through arteries to capture and remove blockages. Used alone or in conjunction with tPA, those devices have extended treatment time to 24 hours after the onset of stroke in some patients, although earlier treatment is more effective. But the devices require expertise that may be absent outside of major medical centers.

"Stroke continues to be a major cause of death and disability in the United States and around the world, making it imperative that we develop new, effective treatments to complement existing therapies, including in the extended treatment window," Saver said.

The trial found that the new stimulation treatment can be safe and effective for people who are not eligible for clot-dissolving medication, Saver said. Future studies will determine the effectiveness of the new therapy when it is used with clot-dissolving medications and clot-retrieving devices.

Saver and Dr. Natan Bornstein of Tel Aviv University and the Shaare Zedek Medical Center in Israel, were the study's co-first authors.

The research was funded by device manufacturer BrainsGate Ltd. Saver, Bornstein and other authors were paid by BrainsGate for serving on a steering committee that provided guidance on the study's design and approach.

http://bit.ly/2X5Wd6z

Spanish flu may have lingered two years before 1918 outbreak and vaccine could have treated it

Its early manifestation was ignored at the time as a "minor infection"

The most severe pandemic in recent history, killing some 50 million people worldwide, the Spanish influenza, may have emerged up to two years earlier than previously believed. And, according to a new and influential study, its early manifestation was ignored at the time as a "minor infection".

It is believed that, if doctors had recognized that influenza was the cause of an illness which was killing soldiers in Etaples, France, and Aldershot, England, in 1916, scientists would then have had better grounds to embark on a two-year vaccination programme and some of the worst effects of the Spanish influenza could have been avoided. Such are the findings of a new paper, launched by Professor John S. Oxford, the UK's top expert on influenza, and Douglas Gill, a military historian.

Published in *Human Vaccines & Immunotherapeutics*, the study uses modern day scientific technology and delves through literature published in *The Lancet* from the time, to not only track the origins of the virus, but to seek how we can use this information to learn from the past to prevent the spread of an influenza pandemic.

In their quest, Oxford and Gill trace the origins of the Spanish influenza as it emerged in 1915 and 1916 in the Etaples Administrative District in northern France. At the time, up to 30,000 soldiers were admitted each year to British army hospitals in France and England, suffering from typical influenza symptoms. In early 1917, however, a medical group in Etaples treated hundreds of patients infected with what they described as an "unusually fatal disease" presenting "complex" respiratory symptoms.

In Aldershot, in the south of England, three senior physicians were also tackling a problem whose hallmarks looked very much the same. In both instances, the disease was characterized by a 'dusky' cyanosis, a rapid progression from quite minor symptoms to death - with death in any case usually resulting from a superinfection involving staphylococcus, streptococcus, etc.

Both medical groups were encountering a case fatality in the order of 50%, and they were learning from colleagues in England and France (who were publishing in *The Lancet* in 1917) that the malady was occurring elsewhere.

It is this information which has helped Oxford and Gill to track what was then believed to be a minor respiratory infection as the very origins of the biggest killing pandemic of the 20th century.

"We have identified long-neglected outbreaks of infection: outbreaks which, judged as minor at the time, can now be seen as increasingly important, and a portent of the disaster to come," explains Professor Oxford, of Queen Mary University, London.

"The research undertaken in the production of the Etaples paper was particularly exhaustive in its scope and depth. Not only were the usual examinations undertaken, of tissue and sputum, but a postmortem examination was conducted of every single soldier dying of disease, throughout a period of seven weeks in early 1917."

The findings of the literature as to the origins of the Spanish influenza are further supported in modern papers analysed by Oxford and Gill, wherein scientific methods, namely phylogenetic (the study of evolutionary relationships among biological entities - often species, individuals or genes) and molecular clock analysis, point to all eight genes of the H1N1 family of influenza A viruses as emerging in 1915-1916.

These modern studies have also shown that the 'emerging virus' began with aquatic geese, ducks, and swans as a reservoir. It is

likely that this disease was then passed on to the soldiers through the faeces of migrating water birds.

So what happened between 1915-1916 and 1918-1919 to make this pre-pandemic virus to become pandemic?

Professor Oxford explains.

"In essence, the virus must have mutated. It lost a great deal of its virulence, but gained a marked ability to spread. Recent experiments with a pre-pandemic 'bird flu' called H5N1, deliberately mutated in the laboratory, have shown that as few as five mutations could have permitted this change to take place."

"We appreciate today that a unique characteristic of a pre-pandemic virus lies in its inability to spread from person to person," Professor Oxford added. "The teams at Etaples and Aldershot, although strong in clinical diagnosis, were misled by the lack of spread of this infection. Accordingly, they failed to pinpoint influenza as the underlying cause."

There was, however, a silver lining to a very dark cloud.

"Pathologists in the United States and in France strove to construct the first universal vaccines against influenza. Their efforts were not misdirected, because the ultimate cause of death in nearly all cases flowed from superinfections with respiratory bacteria."

Oxford and Gill conclude: "We remain impressed by the care and initiative shown by our predecessors 100 years ago. Their efforts did have an impact on the level of fatalities, but - not unexpectedly - had no effect upon spread: the result, of course, of everyone's misunderstanding of the nature of the pathogen involved.

"Once the virus is able to spread from human to human, disaster strikes. With a generation time of two to three days, from just three patients who were infected originally, a million infections can be caused in around 40 days. And this is probably exactly what happened in 1918-1919."

Today, the World Health Organisationis on full alert; and every nation in the world has been asked to plan for a pandemic of bird influenza A (H5N1) or (H7N9).

By understanding the origins of the Spanish influenza via analyzing modern day research and papers written in 1917, it is hoped this study could help us prevent a new influenza pandemic.

Professor Oxford thinks that existing vaccines have a role to play.

"Something similar to what happened at the beginning of the twentieth century could easily be repeated. As a precaution, governments everywhere are stockpiling vaccines against the pneumococcus that usually develops as a secondary infection after the flu, and which causes fatalities on a very large scale."

http://bit.ly/2VMzuet

High-intensity exercise may restore heart function in people with type 2 diabetes

University of Otago researchers have discovered that high-intensity exercise can reduce or reverse the loss in heart function caused by type 2 diabetes.

The study found that three months of high-intensity interval training (HIIT) improved heart function in adults with type 2 diabetes, without any change in medications or diet.

Former PhD student Genevieve Wilson carried out the study under the supervision of Senior Research Fellow at the Dunedin School of Medicine, Dr Chris Baldi, with cardiologist and Associate Professor in the Department of Medicine, Gerry Wilkins, as her co-adviser. It has just been published in the American College of Sports Medicine's journal, Medicine & Science in Sports & Exercise.

Ms Wilson explains the study is significant because while research to date has shown that improved glycemic control and lifestyle changes can improve some outcomes for people with diabetes, reductions in cardiovascular disease have not been realised and

cardiovascular disease remains the leading cause of death in these patients.

"Our research has found that exercise at sufficiently high intensity may provide an inexpensive, practical way to reverse, or reduce the loss in heart function caused by type 2 diabetes," Ms Wilson says.

High-intensity interval training involves short intervals of near maximal effort (>90 per cent maximum) exercise like sprinting or stair climbing, separated by intervals of moderate intensity exercise, like jogging, or fast walking.

The goal was for people to spend 10 minutes doing very high intensity (vigorous) activity during a 25 minute exercise period.

Dr Baldi says the incidence of type 2 diabetes continues to increase and the prolonged management of the disease is crippling healthcare systems worldwide. Increasing aerobic capacity through exercise is arguably the best prevention for heart disease and exercise is a cornerstone of diabetic treatment. However, impaired function of the diabetic heart often makes it harder for people with diabetes to exercise effectively nd it was not known whether they would train this hard.

But the study showed that the high-intensity exercise programme for middle-aged adults with type 2 diabetes was safe and acceptable and also well-attended, with a greater than 80 per cent adherence rate over the three months.

"There are two important clinical implications of this work," Dr Baldi explains. "The first, that adults with type 2 diabetes will adhere to high-intensity interval training and are capable of comparable increases in aerobic capacity and left ventricular exercise response as those reported in non-diabetic adults.

"Secondly, high intensity exercise is capable of reversing some of the changes in heart function that seem to precede diabetic heart disease."

http://bit.ly/2WnqrFb

First Author Should Be Responsible for Paper Accuracy: Study

An analysis of misconduct investigations finds first authors are more likely to commit transgressions, suggesting they should be held accountable for the integrity of the work.

Ashley Yeager

The first author of a scientific journal article should ensure the integrity of all of the content in a research paper, researchers suggested May 2 in *PLOS One*.

Katrin Hussinger and Maikel Pellens of Katholieke Universiteit Leuven in Belgium analyzed 80 misconduct cases investigated by the US Office of Research Integrity and found that a paper's first author is 38 percent more likely to be found responsible for misconduct than the paper's middle authors. Senior authors, usually listed last, were no more likely than any other to have acted inappropriately. Corresponding authors, typically the first or senior author or sometimes another coauthor, had a 14 percent higher chance of committing misconduct than middle authors.

"These findings suggest that a guarantor-like model where first authors are ex-ante accountable for misconduct is highly likely to not miss catching the author responsible, while not afflicting too many bystanders," the researchers write.

Not everyone agrees with tasking the first author to carry the responsibility. "The rationale suggested [here], that the author roles that are statistically more likely to be responsible for misconduct should for that reason always be held accountable is illogical and non-tenable," Daniele Fanelli, a researcher at the London School of Economics, tells *Chemistry World*. "Only whoever has knowingly lied, cheated or stolen should be punished." Fanelli adds that "a co-author, no matter how vigilant, could be easily fooled by a

dishonest collaborator, and holding someone accountable for the misconduct of another is ethically and legally untenable."

Hussinger and Pellens's model is perhaps the best option, Jeffrey Kovac, a physical chemist and research ethicist at the University of Tennessee, tells *Chemistry World*, but it has weaknesses. The guarantor could take the fall for collaborators who commit misconduct "that isn't easy to detect," he says. "In cases of alleged scientific misconduct it is important to investigate the entire teams to find out who is responsible."

https://wb.md/2Wo66Q1

FDA Clears Assays for Extragenital Chlamydia/Gonorrhea Testing

The US Food and Drug Administration (FDA) has cleared two tests to detect Chlamydia trachomatis and Neisseria gonorrhoeae from throat and rectum samples.

Megan Brooks

The Aptima Combo 2 Assay (Hologic Inc) and the Xpert CT/NG (Cepheid) are the first tests approved for extragenital diagnostic testing for these infections via throat and rectum samples. These tests were previously approved only for testing urine, vaginal, and endocervical samples.

Until now, there were no chlamydia or gonorrhea tests that were approved for use with samples from the throat and rectum, Tim Stenzel, MD, PhD, director of the Office of In Vitro Diagnostics and Radiological Health in the FDA's Center for Devices and Radiological Health, noted in a news release.

"The availability of these two tests will fill an unmet public health need, by allowing for more screening," he said, and "provide a mechanism for more easily diagnosing these infections."

The rate of sexually transmitted infections is steadily increasing. There were an estimated 1.7 million cases of *Chlamydia* infection and more than 500,000 cases of gonorrhea in the United States in 2017, according to the Centers for Disease Control and Prevention.

In evaluating the Aptima Combo 2 Assay and Xpert CT/NG, the FDA reviewed clinical data from a cross-sectional study coordinated by the Antibacterial Resistance Leadership Group, which is funded and supported by the National Institute of Allergy and Infectious Diseases.

The study, which included more than 2500 patients, evaluated the diagnostic accuracy of multiple commercially available nucleic acid amplification tests for detection of *Neisseria gonorrhoeae* and *Chlamydia trachomatis* from throat and rectal sites.

"The results of this study, along with other information reviewed by the FDA, demonstrated that the Aptima Combo 2 Assay and the Xpert CT/NG for extragenital specimens are safe and effective for extragenital testing for chlamydia and gonorrhea," the FDA said.

Both tests were reviewed through the premarket notification 510(k) pathway, which means that the manufacturers demonstrated that the devices are "substantially equivalent" to legally marketed devices.

http://bit.ly/2Mb2Dk0

Population DNA testing for disease risk is coming. Here are five things to know

Screening millions of healthy people for their risk of disease can be cost-effective. But it raises ethical and regulatory concerns.

Paul Lacaze[*] Jane Tiller[**]

DNA testing to predict disease risk has the potential to prevent disease and save lives. Yet few Australians can currently access predictive DNA testing via the health-care system.

That may soon change.

As technology improves, the cost of DNA testing declines, and the Australian government invests in genomics, universal DNA screening is becoming feasible.

DNA screening would involve large numbers of otherwise healthy people having DNA testing, by providing a simple blood or saliva sample, to identify risk of certain conditions. This includes types of cancer or heart disease that run in families – and can be prevented.

Being identified at increased risk doesn't mean you'll get the disease. But identifying risk early and before symptoms appear provides the opportunity for prevention. Prevention can be achieved through regular check ups, medications or even risk-reducing surgeries.

The new opportunities for prevention genomics offers could transform public health. But a number of challenges exist. How would we provide DNA testing to millions of people and deliver the required health services to all those at high risk?

What about genetic discrimination? Could testing cause more harm than good, and lead to over-diagnosis? How would the health-care system fund this level of testing, and would it be cost-effective? Do people even want testing?

The concept of population DNA screening is daunting. But the benefits could be huge. Australia has the chance to do it properly. Here are five things to know.

1. DNA screening is not a crystal ball, but it identifies risk

DNA testing can't tell us everything. It estimates risk well for certain types of diseases, mostly those caused by single gene changes. These are distinct from other common diseases where genetic risk accumulates from hundreds of genes and is harder to predict.

Potential candidates for screening include cancers such as breast and ovarian cancer caused by the BRCA genes, colorectal and other cancers caused by Lynch syndrome, inherited high cholesterol and other types of genetic heart disease.

Although each of these conditions alone are relatively rare, together they put an estimated one in 38 adults at high risk.

Genetic risk for these conditions is often identified too late, after cancer is diagnosed or someone dies from a cardiac arrest. Limited health budgets mean testing is usually offered only to people diagnosed with genetic diseases and their families, not healthy people.

This means thousands of Australians are missing out on DNA testing that could be life-saving, and don't know they're at risk of a condition they might be able to prevent.

2. DNA screening could prevent different types of genetic conditions

There are measures people can take to reduce the risk for many genetic conditions. Once risk is identified through testing, people can enter risk surveillance programs, which are highly effective, especially for some types of cancer and high cholesterol. These can detect symptoms at an early (and more treatable) stage.

Some preventive medications can also reduce risk of breast cancer (tamoxifen), bowel cancer (aspirin), high cholesterol (statins) and genetic heart disease (beta blockers).

In some cases, preventive surgeries are available, such as mastectomy to significantly reduce breast cancer risk.

3. DNA screening would be cost-effective

We modelled the health and economic benefits of offering population DNA screening in Australia, focusing on young adults aged 18-25 years (about 2.6 million Australians).

Young adults are most likely to benefit from screening, being old enough to provide informed consent, but below the average age of onset for preventable adult genetic conditions, and below the average age of having their first child.

We modelled screening for four well-understood cancer genes. We calculated screening for these genes alone would prevent 2,411 cancers and save 1,270 lives in Australia over the populaiton's lifespan, compared with current rates of DNA testing.

At an estimated A$400 per test, this would cost the Australian government around A$600 million (four to five times more than current expenditure on genetic testing for these conditions).

But we estimated screening would save around A$300 million in prevented cancer treatment costs, making DNA screening highly cost-effective in this population.

At A$200 per test (which could be realistic in the near future), savings in treatment costs could outweigh screening costs, saving the health-care system money and saving lives.

We also modelled the impact of providing screening results for family planning. This would identify "carrier" parents for rare genetic diseases that occur when children inherit two defective copies, one from each unaffected parent (such as cystic fibrosis).

Options like prenatal testing to identify affected pregnancies, or using IVF to ensure only unaffected embryos are implanted, are available to high-risk couples. Adding reproductive information to the model further improved the cost-effectiveness.

4. DNA screening raises ethical and regulatory concerns

Despite its potential to save lives and money, DNA screening raises ethical questions. Some people may not want testing due to concerns including DNA privacy, insurance discrimination or the "right not to know". The shared nature of DNA also means testing implicates family members, and issues such as non-paternity may arise.

Those identified as high-risk by DNA screening may be stigmatised. Genetic discrimination already occurs in Australian life insurance, and evidence shows many people at high risk of certain conditions refuse testing for this reason.

Reproductive screening also introduces difficult decisions related to using IVF and termination of pregnancy. Ethical positions vary across religious and cultural groups, and must be respected.

Making screening routine may also risk pressuring some people towards irreversible medical interventions, such as surgery or termination of pregnancy.

As a society, we must carefully consider these ethical issues. A recently-launched nationwide study will offer reproductive carrier-screening to 10,000 Australian couples to see if they are carriers of inheritable conditions. This will be crucial for building public awareness and examining these ethical concerns.

5. DNA screening will be feasible in the near future

As the cost of DNA testing falls, publicly-funded population DNA screening is becoming realistic. Genetic testing for risk of breast and ovarian cancer is already reimbursed on the Medicare Benefits Schedule in Australia for individuals at high risk, and more tests will likley be added in coming years.

If widespread testing is not provided by the health-care system, consumers will likely turn to cheap internet-based alternatives, which don't necessarily follow Australian standards for scientific validity or quality.

Population DNA testing through the health-care system would ensure higher standards of quality control. It would also facilitate equity-of-access to testing that is required to maximise population health benefits.

The federal government has already published guidance on population screening. But before Australia can launch a universal DNA screening program, we need more public education, regulatory protection, and increased funding to expand genetic health services.

*Head, Public Health Genomics Program, Monash University
**Ethical, Legal & Social Adviser - Public Health Genomics, Monash University

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http://bit.ly/2W5yXZU

How corn's ancient ancestor swipes left on crossbreeding

Determining how one species becomes distinct from another has been a subject of fascination dating back to Charles Darwin

Palo Alto, CA-- Determining how one species becomes distinct from another has been a subject of fascination dating back to Charles Darwin. New research led by Carnegie's Matthew Evans and published in Nature Communications elucidates the mechanism that keeps maize distinct from its ancient ancestor grass, teosinte.

Speciation requires isolation. Sometimes this isolation is facilitated by geography, such as mountains chains or islands that divide two populations and prevent them from interbreeding until they become different species. But in other instances, the barriers separating species are physiological factors that prevent them from successfully mating, or from producing viable offspring.

A teosinte plant growing in a corn field on the Stanford University campus. **Courtesy of Yongxian Lu**

"In plants, this genetic isolation can be maintained by features that prevent the 'male' pollen of one species from successfully fertilizing the 'female' pistil of another species," explained Evans.

About 9,000 years ago, maize, or corn, was domesticated from teosinte in the Balsas River Valley of Mexico. Some populations of the two grasses are compatible for breeding. But others grow in the same areas and flower at the same time, but rarely produce hybrids.

It was known that a cluster of genes called Tcb1-s is one of three that confers incompatibility between these rarely hybridizing maize and teosinte populations. Unlike the other two, it is found almost exclusively in wild teosinte. It contains both male and female genes that encode wild teosinte's ability to reject maize pollen.

In sexually compatible plants, the pollen, which is basically a sperm delivery vehicle, lands on the pistil and forms a tube that elongates and burrows down into the ovary, where the egg is fertilized. But that's not what happens when maize pollen lands on the pistil, or silk, of a wild teosinte plant.

Evans and his colleagues--Carnegie's Yongxian Lu (the first author), Samuel Hokin, and Thomas Hartwig, along with Jerry Kermicle of the University of Wisconsin Madison--demonstrated that the Tcb1-female gene encodes a protein that is capable of modifying cell walls, likely making maize pollen tubes less elastic and thus preventing them from reaching the teosinte eggs. When these tubes can't stretch all the way to the eggs, fertilization can't occur, and hybrids won't be possible.

What's more, because teosinte pollen can fertilize itself, the researchers think that the Tcb1-male genes encode an ability that allows teosinte pollen to overcome this pollen tube barrier building.

"Most plants that depend on wind and water, not birds or insects, for pollination have low species diversity," said Evans. "But not grasses, which makes their evolutionary history particularly interesting."

This work was supported by the U.S. National Science Foundation and the U.S. Department of Agriculture National Research Initiative.

http://bit.ly/2K7h7hV

New research shows that mites and ticks are close relatives

Genomic evidence that mites and ticks are part of the same evolutionary line

Scientists from the University of Bristol and the Natural History Museum in London have reconstructed the evolutionary history of

the chelicerates, the mega-diverse group of 110,000 arthropods that includes spiders, scorpions, mites and ticks.

They found, for the first time, genomic evidence that mites and ticks do not constitute two distantly related lineages, rather they are part of the same evolutionary line. This now makes them the most diverse group of chelicerates, changing our perspective on their biodiversity.

Arthropoda, or jointed-legged animals, make up the majority of animal biodiversity. They both pollinate (bees) and destroy our crops (locusts), are major food sources (shrimps and crabs), and are vectors of serious diseases like malaria and Lyme disease (mosquitoes and ticks).

Arthropods are ancient and fossils show that they have been around for more than 500 million years. The secret of their evolutionary success, which is reflected in their outstanding species diversity, is still unknown. To clarify what makes arthropod so successful we first need to understand how the different arthropod lineages relate to each other.

Co-author of the study, Professor Davide Pisani, from the University of Bristol's School of Earth Sciences and Biological Sciences, said: "Finding that mites and ticks constitute a single evolutionary lineage is really important for our understanding of how biodiversity is distributed within Chelicerata.

"Spiders, with more than 48,000 described species, have long been considered the most biodiverse chelicerate lineage, but 42,000 mite and 12,000 tick species have been described. So, if mites and ticks are a single evolutionary entity rather than two distantly related ones, they are more diverse than the spiders."

Dr Greg Edgecombe of the Natural History Museum London added: "Because of their anatomical similarities it has long been suspected that mites and ticks form a natural evolutionary group, which has been named Acari. However, not all anatomists agreed, and genomic data never found any support for this idea before."

Lead author, Dr Jesus Lozano Fernandez, from Bristol's School of Biological Sciences, said: "Spiders are iconic terrestrial animals that have always been part of the human imagination and folklore, representing mythological and cultural symbols, as well as often being objects of inner fears or admiration.

"Spiders have long been considered the most biodiverse chelicerate lineage, but our findings show that Acari is, in fact, bigger."

There is a phenomenal diversity of mites (as shown by these two examples), and ticks are close relatives. **David Walter**

In order to come up with their findings, the researchers used an almost even representation of mites and ticks (10 and 11 species, respectively), the most complete species-level sampling at the genomic level for these groups so far.

Dr Lozano-Fernandez added: "Regardless of the methods we used, our results converge on the same answer - mites and ticks really do form a natural group. Evolutionary trees like the one we've reconstructed provide us with the background information we need to interpret processes of genomic change.

"Our genealogical tree can now be used as the foundation for studies using comparative genomics to address problems of potential biomedical and agricultural relevance, like the identification of the genomic changes that underpinned the evolution of blood-feeding parasitic ticks from ancestors that weren't blood-feeders."

http://bit.ly/2QpI3uL

New neurons form in the brain into tenth decade of life, even in people with Alzheimer's

Neurogenesis may moderate effects of brain pathology

In a new study from the University of Illinois at Chicago, researchers examining post-mortem brain tissue from people ages 79 to 99 found that new neurons continue to form well into old age. The study provides evidence that this occurs even in people with cognitive impairment and Alzheimer's disease, although neurogenesis is significantly reduced in these people compared to older adults with normal cognitive functioning.

They publish their results in the journal Cell Stem Cell.

The idea that new neurons continue to form into middle age, let alone past adolescence, is controversial, as previous studies have shown conflicting results. The UIC study is the first to find evidence of significant numbers of neural stem cells and newly developing neurons present in the hippocampal tissue of older adults, including those with disorders that affect the hippocampus, which is involved in the formation of memories and in learning.

"We found that there was active neurogenesis in the hippocampus of older adults well into their 90s," said Orly Lazarov, professor of anatomy and cell biology in the UIC College of Medicine and lead author of the paper. "The interesting thing is that we also saw some new neurons in the brains of people with Alzheimer's disease and cognitive impairment." She also found that people who scored better on measures of cognitive function had more newly developing neurons in the hippocampus compared to those who scored lower on these tests, regardless of levels of brain pathology.

Lazarov thinks that lower levels of neurogenesis in the hippocampus are associated with symptoms of cognitive decline and reduced synaptic plasticity rather than with the degree of pathology in the brain. For patients with Alzheimer's disease, pathological hallmarks include deposits of neurotoxic proteins in the brain.

"In brains from people with no cognitive decline who scored well on tests of cognitive function, these people tended to have higher levels of new neural development at the time of their death, regardless of their level of pathology," Lazarov said. "The mix of the effects of pathology and neurogenesis is complex and we don't understand exactly how the two interconnect, but there is clearly a lot of variation from individual to individual."

Lazarov is excited about the therapeutic possibilities of her findings. "The fact that we found that neural stem cells and new neurons are present in the hippocampus of older adults means that if we can find a way to enhance neurogenesis, through a small molecule, for example, we may be able to slow or prevent cognitive decline in older adults, especially when it starts, which is when interventions can be most effective," Lazarov said.

Lazarov and colleagues looked at post-mortem hippocampal tissue from 18 people with an average age of 90.6 years. They stained the tissue for neural stem cells and also for newly developing neurons. They found, on average, approximately 2,000 neural progenitor cells per brain. They also found an average of 150,000 developing neurons. Analysis of a subset of these developing neurons revealed that the number of proliferating developing neurons is significantly lower in people with cognitive impairment and Alzheimer's disease.

Lazarov is interested in finding out whether the new neurons she and her team discovered in the brains of older adults are behaving the way new neurons do in younger brains.

"There's still a lot we don't know about the maturation process of new neurons and the function of neurogenesis in older brains, so it is difficult to predict how much it might ameliorate the effects of cognitive decline and Alzheimer's disease. The more we find out, the better able we will be to develop interventions that may help

preserve cognitive function even in people without Alzheimer's. We all lose some cognitive function as we age -- it's normal."

Matthew Tobin, Kianna Musaraca, Ahmed Disouky, Aashutosh Shetti and Abdullah Bheri of UIC; William Honer of the University of British Columbia, Vancouver; and Namhee Kim, Robert Dawe, David Bennett and Konstantinos Arfanakis of Rush University Medical Center are co-authors on the paper.

This research was supported by grants from the National Institute on Aging (AG033570, AG033570-S1, S2, AG060238, AG62251, AG061628, AG17917, AG34374, UH2NS100599) and the Canadian Institutes of Health Research (MT-14037, MOP-81112).

http://bit.ly/2WsMdqZ

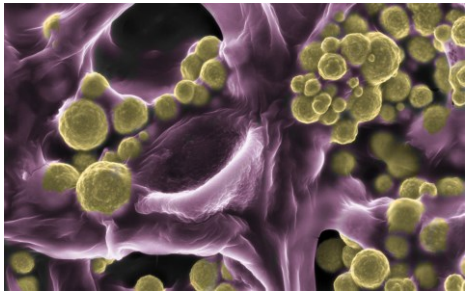
This Fungus Mines For Gold, Then Wears It

Fungus now has a gold standard.

By Mindy Weisberger, Senior Writer

A pink, fluffy fungus found around the world is literally a gold-digger, collecting particles of precious gold along the thread-like strands that it extends into soil, scientists just discovered.

The gold-crusted fungus, called *Fusarium oxysporum*, doesn't just look fancy; it also seems to benefit from the bling, spreading faster and growing larger than unadorned fungi, researchers reported in a new study.



Australian fungus Fusarium oxysporum goes for the gold. **Credit: CSIRO**

The scientists used a scanning electron microscope to create highly magnified images of *F. oxysporum* collected in western Australia, revealing the fungus's tendrils liberally encrusted with tiny bits of gold. The fungus is thought to gather the gold through chemical reactions with underground minerals; it dissolves gold flakes using oxidation and then produces another chemical to make the dissolved gold solidify around the fungal threads, the researchers wrote.

However, it is not yet known how the fungus identifies gold, and though gold decoration seems to benefit the fungus, the precise mechanisms of how that works are unclear, according to the study.

Fungi are among the most ancient forms of life; the oldest fossil fungus, recently discovered in Canada's Northwest Territories, is thought to be a billion years old. Many types of fungi degrade and recycle organic matter, and some are known for their interactions with certain metals, "including aluminium, iron, manganese and calcium," lead study author Tsing Bohu, a researcher with Australia's Commonwealth Scientific and Industrial Research Organisation (CSIRO), said in a statement. "But gold is so chemically inactive that this interaction is both unusual and surprising — it had to be seen to be believed," Bohu said.

This is the first evidence that a fungus may play a role in moving gold through Earth's surface, and could provide clues for detecting subterranean gold reserves, the researchers reported.

That would be a boon for Australia's gold industry — the second-largest in the world — which is already sampling termite mounds and gum leaves for gold traces that might hint at larger deposits hidden underground, study co-author and CSIRO chief research scientist Ravi Anand said in the statement.

Identifying buried gold deposits through surface traces in fungi, trees or insect nests is cheaper and less harmful to the environment than drilling is, Anand added. The findings were published online May 23 in the journal Nature Communications.

http://bit.ly/30IK2z3

The Lucrative Black Market in Human Fat

***In 16th- and 17th-century Europe, physicians, butchers, and executioners alike hawked the salutary effects of* Axungia hominis.**

Christopher Forth

One night in 1731, Cornelia di Bandi burst into flames. When the 62-year-old Italian countess was found the next morning, her head and torso had been reduced to ash and grease.

Only her arms and legs remained intact. After examining what was left of her body, a local physician concluded, in a report cited years later, that the conflagration "was caused in her entrails" by the variety of combustible materials to be found there, including alcohol and fat, "an oily liquid … of an easily combustible nature."

An early instance of what would come to be known as "spontaneous human combustion," di Bandi's case was one of many later studied by the French agronomist Pierre-Aimé Lair. If there was a common denominator to these otherwise unexplained phenomena, Lair concluded, it was the fact that most of them involved corpulent older women with a penchant for drink, thus combining fat and alcohol in a literally explosive mix. In addition to the fuel provided by excess body fat, which was rendered even more combustible when "penetrated by alcoholic substances," surplus fat was said to create higher levels of hydrogen, making the body especially flammable. Lair concluded:

Thus there is no cause for surprise that old women, who are in general fatter and more given to drunkenness, and who are often motionless like inanimate masses, during the moment of intoxication, should experience the effects of combustion.

Heritage Images / Getty

Whatever Lair might have thought about fat old ladies who drank too much, in his report fat is about little more than the chemicals that composed it and the properties that rendered them combustible. Scientifically breaking the stuff of life down into its components was part of a general process of quantification that gained momentum during the 17th century to become pervasive in the 18th and 19th.

This was the period during which corpulence underwent a process of medicalization that would eventually contribute to our present views of obesity as a disease. Older ideas about fatness and mirth were reconceptualized in more mechanistic terms, which would only gain momentum in the following years. With the development of height and weight tables in the 19th century, the stage was set for the further development of ideas about metabolism, nutritional requirements, and eventually the body-mass index of our own time. But at the start of the modern era, fat played a very different role in Western cultures—that of a medical commodity.

Whether procured from plant, animal, or human sources, in one form or another fat has been an important element in the European pharmacopoeia since ancient times. For reasons that are not quite clear, a medicinal interest in human fat was especially pronounced in the 16th and 17th centuries. In 1543, the physician Andreas Vesalius instructed anatomists who boiled bones for the study of skeletons to carefully collect the layer of fat "for the benefit of the masses, who ascribe to it a considerable efficacy in obliterating scars and fostering the growth of nerves and tendons." Vesalius knew what he was talking about. At the time, human fat was widely considered—and not just by "the masses"—to be efficacious in healing wounds, and was typically harvested from the recently deceased. In October 1601, after a particularly bloody battle during the Siege of Ostend, Dutch surgeons descended upon the battlefield to return with "bags full of human fat," presumably to treat their own soldiers' wounds.

If the fat of warriors was efficacious, that of executed criminals was easier to lay one's hands on. What was called "poor sinner's fat" was rendered from the bodies of the recently executed and used to treat sprains, broken bones, and arthritis. Beyond such uses, human

fat was also prescribed as a painkiller or to treat sciatica and rheumatism, while dead men's sweat was collected for the treatment of hemorrhoids. Until the mid-18th century, executioners in the city of Munich, who often prescribed and administered homemade remedies from the corpses of their doomed clients, had a lucrative trade in the fat they delivered to physicians by the pound.

Knowing what would become of their corpses was a source of great anguish for the condemned, many of whom believed in the Christian doctrine of the resurrection of bodies and were not consoled by the thought that their fat, flesh, blood, and bones might be parceled out for the benefit of others. Still, business was business, and against the wishes of donors, executioners continued to supply fat, blood, and other body parts to those willing to buy them. And it wasn't just ordinary people buying such things. The wise druggist kept large supplies of human fat (*Axungia hominis*) on hand alongside numerous other solids and liquids derived from human corpses, a class of *materia medica* known as "mummy." If fortune smiled on the fat trade when the rate of executions increased, it would have been positively beaming during the Terror days of the French Revolution. According to some reports, certain Parisian butchers started offering their customers an exciting new item: *graisse de guillotine*́, supposedly procured from the corpses of the freshly executed.

What was it about human fat that made it so sought-after? And what was so special about the fat of slain criminals in particular? The practice no doubt echoes the Catholic cult of holy relics, whereby saints were considered to be fully present in their bodies after death, as well as in the objects they touched. Yet this mystical appreciation explains only so much, and most executed criminals were no saints. Rather, the use of fat for medical purposes was perceived as a *natural* practice rather than a magical one, and thus was based on assumptions about the physical properties of the substance itself. Despite the apparent obsolescence of many of these beliefs, the claim that fat could heal wounds was not entirely misguided. Physicians today know that adipose tissue is highly "angiogenic," meaning that it promotes the growth of new blood vessels from preexisting ones.

Early-modern people may have used fat in this way simply because it seemed to work. The reasons they gave for *why* it worked seem less convincing to most modern readers. According to the 16th-century Swiss physician Paracelsus and his followers, some of the vital force of the human being lingered in the body after death. This vitality, they contended, was strongest in the bodies of healthy young men who had died violently, especially—as in the case of an execution—when death came so swiftly that the life force had no time to evacuate the body. The provenance of this insight is uncertain, and even Paracelsus admitted to having received much of his medical knowledge from executioners trading in such substances. Nevertheless, the use of human fat remained widespread among laypeople and doctors alike, even among more orthodox Galenic physicians.

This well-known trafficking in human fat inevitably gave rise to fears that the precious matter might be harvested in less legitimate ways, perhaps for nefarious purposes. This fear was made plain in Spanish encounters in the New World. The soldier and chronicler Bernal Díaz del Castillo recorded how, following his first battle with the Tlascans in the Andes, he opened up the body of a plump slain Indian to dress his soldiers' wounds with the dead man's burned fat, and that in subsequent battles more Indian fat was used to heal wounded Spaniards. This was standard medical procedure among the conquistadors, another of whom—Hernando de Soto—was also said to have used Indian fat as a medicine.

Yet harvesting fat was a boon for sailors, too. Before leading the expedition that would bring down the Aztec empire, Hernán Cortés

supposedly caulked 13 boats using the fat of the dead. Insofar as they too ascribed great powers to fat, the native population was understandably terrified by such behavior. In the Andes, rumors that the Spanish were exporting boatloads of fat back to Spain for medical purposes prompted the largest native rebellion of the first 200 years of Spanish rule. So durably entrenched did this fear become that, to the present day, Andeans tell stories about a bogeyman called the *pishtaco* (often depicted as a white man) who harvests Indian fat for medical and cannibalistic purposes. According to the missionary Jean-Baptiste Labat, similar concerns caused alarm among Africans who had been sold into slavery. Upon disembarking in America, the frightened captives told one another, their fat and marrow would be extracted and melted to make oil for the Europeans.

Concerns about the illicit harvesting of fat were not only by-products of colonial violence. Back in Europe, allegations of unauthorized fat extraction cropped up in numerous contexts. In a tradition extending back to the Middle Ages, especially in Germanic cultures, many thieves believed that their nocturnal pilfering would go unnoticed if they burned a candle made of human fat or the fingers of dead babies. As long as these "thieves' candles" burned, it was said, burglars acquired powers of invisibility while homeowners would remain blissfully asleep. So powerful was this belief that in the 16th and 17th centuries, several thieves were convicted of murdering people just to make such candles. How ironic, then, that the murderers' own fat would probably have been parceled off after their executions, to be used in medicines and other concoctions.

That human fat would be a mainstay in European pharmacies is thus not all that surprising. Yet the fact that druggists kept supplies of human fat and other body parts on hand does not mean the practice always had the seal of approval of medical specialists, many of whom had long argued that there was nothing special about human as opposed to any other kind of fat. In fact, by the mid-18th century, professional medical interest in human fat had already started to wane. "At present," wrote the physician John Hill, "we are grown wise enough to know, that the Virtues ascribed to the Parts of the human Body are all either imaginary, or such as may be found in other animal Substances." Such disapproval was compounded by a growing competition between doctors and executioners for access to dead bodies, the result being that the procurement of corpses was eventually taken out of the hands of executioners altogether.

Despite these changes, it took more than the frowning of a few doctors to stamp out the clandestine trafficking in human fat. A thriving fat trade had been reportedly operating for years out of the dissecting theaters of Paris. Its eventual discovery in the early 19th century was kept quiet for fear of alarming the public. Before being caught red-handed by the police agents who had been tipped off to their activities, medical assistants connected to various dissecting rooms had joined forces with their counterparts at the Faculty of Medicine to bring the fat to the people. They were hardly discreet about their activities, which seem to have been well known to everyone except the faculty administrators. Police raids revealed that at least four of the entrepreneurs had been storing the stuff at home. One was caught with massive amounts of it in his apartment. Another, presumably lacking more suitable containers, had filled two decorative sandstone fountains with purloined fat. While a fair amount was sold to medical charlatans and used to grease the wheels of medical carts, it was the city's enamelists and fake-pearl makers who benefited most from this trade, thinking that they were receiving fat procured from horses or dogs. Or so they said.

This post is adapted from Forth's upcoming book, *Fat: A Cultural History of the Stuff of Life*.