http://bit.ly/2T0vmqO

Solitary confinement puts brains at risk

Social isolation and persistent loneliness change brain structures and behaviors

SAN DIEGO -- Some 80,000 Americans are incarcerated in solitary confinement on any given day, a practice that has been deemed cruel and unusual punishment by the United Nations Committee on Torture. Those in solitary confinement typically have no physical contact and little interaction with others. This extreme isolation can be damaging and may cause or worsen depression, anxiety, and other mental illness. A roundtable of scientists, a physician, a lawyer, and an individual held in solitary for 29 years will explore the psychological and neurobiological burdens of solitary confinement at Neuroscience 2018, the annual meeting of the Society for Neuroscience and the world's largest source of emerging news about brain science and health.

Social isolation has been shown to heighten stress hormone responses and change structures within the brain. It may also lead to post-traumatic stress disorder. While solitary confinement is an extreme example affecting a relatively small portion of the population, social isolation and persistent loneliness are a growing problem in the United States. As the population ages, so does the number of individuals living in nursing homes, where isolation and loneliness are common. Social isolation and loneliness are associated with depression, hostility, heightened stress response, sleep fragmentation, and increased mortality.

The Social Issues Roundtable will include personal experiences with extreme social isolation, the legal and social movements against solitary confinement, and scientific discoveries on the physiological and psychological effects of social isolation in humans and other animals.

Speakers at the roundtable will discuss:

- ***A first-hand experience of 29 years of solitary confinement (Robert King).***
- ***Brain health and the evolutionary theory of loneliness (Stephanie Cacioppo).***
- ***How stress alters the brain chemistry and behavior (Huda Akil).***
- ***How motor and sensory regions of the mouse brain shrink after months of isolation (Richard Smeyne).***
- ***The use of neuroscience to fight solitary confinement in court and in print (Jules Lobel).***

"The social and ethical questions raised by this roundtable discussion warrant broad public attention," said moderator Michael Zigmond, PhD, a neurologist at the University of Pittsburgh who studies neurodegeneration and the effects of socialization and environmental enrichment on brain adaptability and health. "Socialization and environmental novelty are key to protecting brain health. The potential for harm caused by isolation due to incarceration or due to aging or disability is significant and the issues raised today are relevant to the entire population."

Find out more about how the brain is affected by social isolation on *BrainFacts.org*.

Related Neuroscience 2018 Presentation Social Issues Roundtable: Solitary Confinement: Psychological and Neurobiological Insights into Isolation, Sunday, Nov. 14, 1-3 p.m., SDCC 10

http://bit.ly/2OzPJYC

Fern plant infusion keeps the doctor away in Medieval Europe

The remains of a medieval skeleton has shown the first physical evidence that a fern plant could have been used for medicinal purposes in cases such as alopecia, dandruff and kidney stones.

The skeleton of a male aged between 21 and 30 years found buried in the medieval necropolis of Can Reiners on the Spanish Balearic Islands, had traces of starch grains consistent with cereal plants, such as wheat and rye, and significantly, a collection of cells in which spores are formed from the underside of a fern leaf.

There is no evidence to suggest that the fern leaf was part of human diets at any point in recorded history, but there are written descriptions dating as far back as the first century AD that suggest the fern leaf was used to alleviate the symptoms of particular non-life-threatening conditions.

A common fern leaf **University of York**

Folk medicine stories collected in various books suggest that the fern was used across Europe, but this is the first time any evidence has been found in actual human remains and the first time the particular species of fern has been identified.

Dr Elena Fiorin, from the University of York's Department of Archaeology, said: "Through analysis of the dental calculus of the skeleton, which we believe dates back to the ninth or 10th century, we were able to determine that the cells were from fern plant, asplenium trichomanes, a common species that grows in rocky areas worldwide.

"These ferns have been used by herbalists, surgeons, doctors, and other healers for centuries across Europe, but until now we have only had written documents that describe their use.

"The finding from the dental remains of this skeleton show just how much information we can get from dental calculus analysis. It demonstrates that in this region of Spain, communities were aware of the medicinal properties of some plants and how to administer them to get the desired result."

Records show that a liquid infusion was made by pouring water into fresh or dried fern leaves, and sometimes the concoction was flavoured with orange flowers or sweetened sugar or honey.

Herbal texts show that the plants were exclusively used to cure particular diseases, most commonly what we would now recognise as dandruff, a common cold, kidney stones, and alopecia. There is also reference to the plant being used to stimulate menstrual flow in women.

Although there is no way of telling from the skeletal remains of the young male what he was treated for, it is likely he drank a fern leaf infusion to potentially cure a condition of the skin, urinary tract, or as a decongestant.

Dr Fiorin said: "The research demonstrates the use of ferns as healing plants in the Mediterranean during the Middle Ages. We now have the potential to look at other dental remains for similar properties that might tell us more about the use of medicinal herbs in the past.

"These ferns were employed, and are still used in Europe today, to cure a variety of diseases and through the archaeological record we can start to see how human beings have used the natural environment to assist in healthcare throughout our evolution."

The research is published in the International Journal of Osteoarchaeology.

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Cardiac arrest survival higher in states with required high school CPR training

American Heart Association Meeting News Brief -- Presentation 22 Session: 15

DALLAS -- Required CPR education in high school may lead to higher bystander CPR and cardiac arrest survival rates, according to preliminary research to be presented in Chicago at the American Heart Association's Resuscitation Science Symposium 2018 - an international conference highlighting the best in cardiovascular resuscitation research.

Researchers analyzed data from more than 109,668 out-of-hospital cardiac arrests patients (64 percent men, 49.4 percent white, 19.1 percent African-American, 2.3 percent Hispanic, 2.9 percent other and 26.4 percent unknown) from the Cardiac Arrest Registry to Enhance Survival database or (CARES) - a surveillance registry tracking out-of-hospital cardiac arrests in communities in 42 states.

The database analysis included all nontraumatic out-of-hospital cardiac arrests from 14 states and the District of Columbia where at least 50 percent of the population was in an area covered by a CARES participating agency from 2013 to 2017.

Researchers found that bystander CPR, survival to hospital discharge and neurologically favorable survival (mild to moderate cerebral incapacity) was higher in states that require CPR training in high school.

Of the cases studied from 2013 through 2017 (with people representing all ages), 59 percent occurred in states with required high school CPR training enacted. In those states:

- ***41.3 percent of people who suffered cardiac arrest outside of a hospital received bystander CPR before emergency medical services arrived, compared to 36.1 percent in states without CPR education laws enacted.***
- ***11.3 percent of people who suffered cardiac arrest outside of a hospital survived to hospital discharge, compared to 8.9 percent for states without the laws enacted.***
- ***Neurologically favorable survival was more likely in states with the laws enacted, 9.5 percent compared to 7.6 percent for states without laws enacted.***

Because CARES is a registry and data are owned by varying local and state agencies, information on specific states included in the study is confidential.

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Two novel studies explore why women receive less CPR from bystanders

American Heart Association Meeting Report -- Poster Presentations 198 and 196, Session: APS.01.09

DALLAS -- Concerns about inappropriate contact or causing injury may help explain why bystanders are less likely to perform CPR on women - even "virtual" women - than on men who collapse with cardiac arrest, according to two studies presented at the American Heart Association's Resuscitation Science Symposium 2018, an international conference highlighting the best in cardiovascular resuscitation research.

Cardiac arrest occurs when the heart's electrical system malfunctions, often in the absence of any previous symptoms. In the United States, more than 350,000 cardiac arrests occur outside hospitals each year. While the survival rate is less than 12 percent, CPR can double or triple a victim's odds of surviving.

Previous research has shown women who suffer out-of-hospital cardiac arrest receive CPR less frequently than men, said Sarah M. Perman, M.D., M.S.C.E., assistant professor of Emergency Medicine at the University of Colorado School of Medicine in Denver and lead author on the survey study.

In a new survey (Poster Presentation 198) Colorado researchers asked 54 people online to explain, with no word limit, why women might be less likely to get CPR when they collapse in public. In the replies, the team identified four themes:

- ***Potentially inappropriate touching or exposure;***
- ***Fear of being accused of sexual assault;***
- ***Fear of causing physical injury;***
- ***Poor recognition of women in cardiac arrest--specifically a perception that women are less likely to have heart problems, or may be overdramatizing or "faking" an incident; or***
- ***The misconception that breasts make CPR more challenging.***

"The consequences of all of these major themes is that women will potentially receive no CPR or delays in initiation of CPR," Perman said. "While these are actual fears the public holds, it is important to realize that CPR is lifesaving and should be rendered to collapsed individuals regardless of gender, race or ethnicity."

Worries about accusations of sexual assault or inappropriate touching were cited twice as many times by men as by women, while more women mentioned fear of causing injury. Although the study

was too small to discern definite trends, these concerns may represent an important challenge in public health messaging, Perman said.

"Bystander CPR has been linked to better survival and neurologic recovery after out-of-hospital cardiac arrest. Quality chest compressions require that rescuers put their hands on the chest and push hard--regardless of (recipient's) gender, the act of CPR is no different," she said.

The pool of responders was about 60 percent male and 85 percent Caucasian. Almost three in 10 reported having received CPR training.

The researchers have expanded this pilot survey and have a manuscript under review that details the outcomes of a large national sample of public perceptions. The research team plans to work with CPR training sites to counteract bystander fears about providing CPR to women, Perman said.

Separate research (Poster Presentation 196) in Philadelphia tested a novel approach to exploring bystander response to cardiac arrest based on the victim's sex - using virtual reality.

Because it happens suddenly, real-world cardiac arrest is hard to study, said Marion Leary, M.S.N., M.P.H., lead study author and director of innovation research at the University of Pennsylvania's Center for Resuscitation Science. But using virtual reality, scientists can learn more about bystander response and how to improve CPR training courses.

This study's 75 participants--adult volunteers from the community--were not told specifically what would happen in the virtual environment and were asked to respond as if they were experiencing a real-life emergency. The setting was a busy city where a pedestrian collapses while someone cries for help.

A CPR manikin was kept out of sight until participants were in the virtual environment. Then the manikin was placed in real life at the location where the victim would collapse in the virtual world, allowing participants to perform CPR (and attach an automated external defibrillator, or AED) in the virtual environment while receiving "hands-on" feedback in the real environment, Leary said.

The team's findings showed that in their descriptive study, participants in their cohort performed CPR or used an AED on virtual-reality female victims less than on virtual male victims. But a study with more participants is needed to statistically identify any significant gender gaps and to confirm the trend found, Leary said.

Regardless of the victim's sex, "if you see someone collapse, call 911, begin CPR, and if there is an AED around, use it," Leary said. "Doing something is better than doing nothing. You have the power to help save someone's life."

Co-authors for the online CPR survey are Shelby K. Shelton, M.P.H.; Christopher Knoepke, Ph.D., M.S.W.; Kathryn Rappaport, M.D.; Daniel D. Matlock, M.D., M.P.H.; Kathleen Adelgais, M.D., M.P.H.; Edward P. Havranek, M.D.; and Stacie L. Daugherty, M.D., M.S.P.H. The project was funded by the Center for Women's Health Research at the University of Colorado School of Medicine. Dr. Perman also receives support from the National Heart, Lung, and Blood Institute.

Co-authors for the virtual reality research are Alfredo Almodovar Jr., B.S.; David Buckler, B.A.; Jaldhi Patel; Zainab A. Chaudhary; Ariel Karwat, B.S.; Benjamin S. Abella, M.D., M.Phil.; and Audrey L Blewer, Ph.D., M.P.H. The project was funded by the Laerdal Foundation and Medtronic Foundation. Author disclosures are on the abstracts.

http://bit.ly/2DbqXfn

Broken heart syndrome was thought to be a short-term condition – the latest evidence suggests otherwise

A stressful event, such as the death of a loved one, really can break your heart.

Nelson Chong *

In medicine, the condition is known as broken heart syndrome or takotsubo syndrome. It is characterised by a temporary disruption of the heart’s normal pumping function, which puts the sufferer at increased risk of death. It’s believed to be the reason many elderly couples die within a short time of each other.

Broken heart syndrome has similar symptoms to a heart attack, including chest pain and difficulty breathing. During an attack, which

can be triggered by a bereavement, divorce, surgery or other stressful event, the heart muscle weakens to the extent that it can no longer pump blood effectively.

In about one in ten cases, people with broken heart syndrome develop a condition called cardiogenic shock where the heart can't pump enough blood to meet the body's needs. This can result in death.

Physical damage

It has long been thought that, unlike a heart attack, damage caused by broken heart syndrome was temporary, lasting days or weeks, but recent research suggest that this is not the case.

A study by researchers at the University of Aberdeen provided the first evidence that broken heart syndrome results in permanent physiological changes to the heart. The researchers followed 52 patients with the condition for four months, using ultrasound and cardiac imaging scans to look at how the patients' hearts were functioning in minute detail. They discovered that the disease permanently affected the heart's pumping motion. They also found that parts of the heart muscle were replaced by fine scars, which reduced the elasticity of the heart and prevented it from contracting properly.

In a recent follow-up study, the same research team reported that people with the broken heart syndrome have persistent impaired heart function and reduced exercise capacity, resembling heart failure, for more than 12 months after being discharged from hospital.

Long-term risk

A new study on the condition, published in Circulation, now shows that the risk of death remains high for many years after the initial attack.

In this study, researchers in Switzerland compared 198 patients with broken heart syndrome who developed cardiogenic shock with 1,880 patients who did not. They found that patients who experienced cardiogenic shock were more likely to have had the syndrome triggered by physical stress, such as surgery or an asthma attack, and they were also significantly more likely to have died five years after the initial event.

People with major heart disease risk factors, such as diabetes and smoking, were also much more likely to experience cardiogenic shock, as were people with atrial fibrillation (a type of heart arrythmia).

A second study from Spain found similar results among 711 people with broken heart syndrome, 11% of whom developed cardiogenic shock. Over the course of a year, cardiogenic shock was the strongest predictor of death in this group of patients.

These studies show that cardiogenic shock is not an uncommon risk factor in broken heart syndrome patients, and it is a strong predictor of death. They shed light on a condition that was previously thought to be less serious than it is.

The evidence now clearly shows that the condition is not temporary and it highlights an urgent need to establish new and more effective treatments and careful monitoring of people with this condition.

* *Senior Lecturer, Department of Life Sciences, University of Westminster*

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How can you eat dairy if you lack the gene for digesting it? Fermented milk may be key, ancient Mongolian study suggests

Analysis of deposits on ancient teeth shows that early Mongolians milked their animals as well

By Andrew Curry

More than 3000 years ago, herds of horses, sheep, and cows or yaks dotted the steppes of Mongolia. Their human caretakers ate the livestock and honored them by burying animal bones with their own.

Now, a cutting-edge analysis of deposits on ancient teeth shows that early Mongolians milked their animals as well. That may not seem surprising. But DNA analysis of the same ancient individuals shows that as adults they lacked the ability to digest lactose, a key sugar in milk.

The findings present a puzzle, challenging an oft-told tale of how lactose tolerance evolved. From other studies, "We know now dairying was practiced 4000 years before we see lactase persistence," says Christina Warinner of the Max Planck Institute for the Science of Human History (MPI-SHH) in Jena, Germany. "Mongolia shows us how."

As University of Copenhagen paleoproteomicist Matthew Collins, who was not on the team, puts it, "We thought we understood everything, but then we got more data and see how naïve we were."

Most people in the world lose the ability to digest lactose after childhood. But in pastoralist populations, the story went, culture and DNA changed hand in hand. Mutations that allowed people to digest milk as adults—an ability known as lactase persistence—would have given their carriers an advantage, enabling them to access a rich, year-round source of fat and protein. Dairying spread along with the adaptation, explaining why it is so common in herding populations in Europe, east and north Africa, and the Middle East.

But a closer look at cultural practices around the world has challenged that picture. In modern Mongolia, for example, traditional herders get more than a third of their calories from dairy products. They milk seven kinds of mammals, yielding diverse cheeses, yogurts, and other fermented milk products, including alcohol made from mare's milk. "If you can milk it, they do in Mongolia," Warinner says. And yet 95% of those people are lactose intolerant.

Warinner wondered whether dairying was a recent development in Mongolia or whether early Mongolians had lactase persistence and then lost it in a population turnover. Ancient people in the region might have picked up such mutations from the Yamnaya herders—about a third of whom were lactase persistent—and who swept east and west from the steppes of central Eurasia 5000 years ago.

To find answers, she and her team analyzed human remains from six sites in northern Mongolia that belonged to the Deer Stone-Khirigsuur Complex, a culture that between 1300 and 900 B.C.E. built burial mounds marked with standing stones. Because those nomads rarely built permanent structures, and constant winds strip away the soil along with remains such as pot fragments and trash pits, archaeological evidence for diet is scarce. So MPI-SHH researcher Shevan Wilkin took dental calculus—the hard plaque that builds up on teeth—from nine skeletons and tested it for key proteins. "Proteomics on calculus is one of the few ways you can get at diet without middens or hearths," Warinner says.

The calculus yielded milk proteins from sheep, goats, and bovines such as yak or cow. Yet analysis of DNA from teeth and leg bones showed the herders were lactose intolerant. And they carried only a trace of DNA from the Yamnaya, as the team reports in a paper published this week in the *Proceedings of the National Academy of Sciences* (*PNAS*). "They're exploiting these animals for dairying even though they're not lactase persistent," Collins says.

That disconnect between dairy and DNA isn't limited to Mongolia. Jessica Hendy, a co-author of the *PNAS* paper, recently found milk proteins on pots at Çatalhöyük in Turkey, which at 9000 years old dates to the beginnings of domestication, 4 millennia before lactase persistence appears. "There seem to be milk proteins popping up all over the place, and the wonderful cultural evolution we expected to see isn't happening," Collins says.

Modern Mongolians digest dairy by using bacteria to digest lactose for them, turning milk into yogurt and cheese, along with a rich suite of dairy products unknown in the Western diet. Ancient pastoralists may have adopted similar strategies. "Control and manipulation of

microbes is core to this whole transformation," Warinner says. "There's an intense control of microbes inside and outside their bodies that enables them to have a dairying culture."

Geneticists who once regarded lactase persistence and dairying as closely linked are going back to the drawing board to understand why the adaptation is common—and apparently selected for—in some dairying populations but totally absent in others. "Why is there a signal of natural selection at all if there was already a cultural solution?" asks Joachim Burger, a geneticist at Johannes Gutenberg University in Mainz, Germany, who was not part of the study.

How dairying reached Mongolia is also a puzzle. The Yamnaya's widespread genetic signature shows they replaced many European and Asian populations in the Bronze Age. But they seem to have stopped at the Altai Mountains, to the west of Mongolia. "Culturally, it's a really dynamic period, but the people themselves don't seem to be changing," Warinner says. She thinks even though the Yamnaya didn't contribute their genes to East Asia, they did spread their culture, including dairying. "It's a local population that has adopted the steppe way of life."

The study's surprising results have given Warinner her next goal: to understand how Mongolians and other traditional dairying cultures harnessed microbes to digest milk and render lactose tolerance irrelevant—and to figure out which of hundreds of kinds of bacteria make the difference.

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Researchers show that a high-protein diet does not affect kidney function

Myth that high-protein diets may cause kidney damage in healthy adults has been debunked

A widely held and controversial myth that high-protein diets may cause kidney damage in healthy adults has been debunked by scientists at McMaster University, who examined more than two dozen studies involving hundreds of participants.

The meta-analysis, published in the Journal of Nutrition, challenges the perceived dangers of a protein-rich diet, a notion first introduced in the 1980s which suggested processing large amounts of protein leads to a progressive decline in kidney function over time.

"It's a concept that's been around for at least 50 years and you hear it all the time: higher protein diets cause kidney disease," says Stuart Phillips, a professor of kinesiology at McMaster who oversaw the study.

"The fact is, however, that there's just no evidence to support this hypothesis in fact, the evidence shows the contrary is true: higher protein increases, not decreases, kidney function," he says.

Health experts routinely advocate the benefits of protein for many reasons: it boosts metabolism, increases satiety making one feel fuller for longer, promotes fat loss, helps build muscle during weight training and helps to preserves muscle, particularly in the elderly.

However, the impact of protein on kidney function is much more contentious, particularly its effect on the glomerular filtration rate (GFR), which is a test to measure how well the kidneys filter blood and remove waste.

"While there is a breadth of evidence showing the benefits of higher protein consumption, some people are still afraid it could cause kidney damage," says Michaela Devries-Aboud, lead author of the study and assistant professor of kinesiology at the University of Waterloo, who conducted the analysis as a postdoctoral fellow at McMaster.

"With these findings, we have shown that a higher protein diet is safe. In fact, it should be viewed as an important tool for muscle health across an entire lifespan."

Researchers analyzed data from 28 papers dating from 1975 to 2016, examining the effects of a low/normal protein intake versus higher protein diets on GFR in health individuals.

The publications involved more than 13-hundred participants, including those who were healthy, obese, or had type 2 diabetes and/or high blood pressure. None of the participants were diagnosed with chronic kidney disease and all consumed either a high, moderate or low-protein diet.

A high-protein diet included either 1.5 grams of protein per kilogram of bodyweight per day, at least 20% of total caloric intake coming from protein or at least 100 grams of protein per day.

"There is simply no evidence linking a high-protein diet to kidney disease in healthy individuals or those who are at risk of kidney disease due to conditions such as obesity, hypertension or even type 2 diabetes," says Devries-Aboud.

According to Phillips, "Protein causing kidney damage just lacks any support. I think we can put this concept to rest."

http://bit.ly/2PMWWJt

Drinking coffee may reduce your chances of developing Alzheimer's, Parkinson's

Drinking coffee may protect you against developing both Alzheimer's and Parkinson's disease

TORONTO - Approximately 500 billion cups of coffee are consumed worldwide each year. A new study out of the Krembil Brain Institute, part of the Krembil Research Institute, suggests there could be more to that morning jolt of goodness than a boost in energy and attention. Drinking coffee may also protect you against developing both Alzheimer's and Parkinson's disease.

"Coffee consumption does seem to have some correlation to a decreased risk of developing Alzheimer's disease and Parkinson's disease," says Dr. Donald Weaver, Co-director of the Krembil Brain Institute. "But we wanted to investigate why that is -- which compounds are involved and how they may impact age-related cognitive decline."

Dr. Weaver enlisted Dr. Ross Mancini, a research fellow in medicinal chemistry and Yanfei Wang, a biologist, to help. The team chose to investigate three different types of coffee - light roast, dark roast, and decaffeinated dark roast.

"The caffeinated and de-caffeinated dark roast both had identical potencies in our initial experimental tests," says Dr. Mancini. "So we observed early on that its protective effect could not be due to caffeine."

Dr. Mancini then identified a group of compounds known as phenylindanes, which emerge as a result of the roasting process for coffee beans. Phenylindanes are unique in that they are the only compound investigated in the study that prevent - or rather, inhibit - both beta amyloid and tau, two protein fragments common in Alzheimer's and Parkinson's, from clumping. "So phenylindanes are a dual-inhibitor. Very interesting, we were not expecting that." says Dr. Weaver.

As roasting leads to higher quantities of phenylindanes, dark roasted coffee appears to be more protective than light roasted coffee.

"It's the first time anybody's investigated how phenylindanes interact with the proteins that are responsible for Alzheimer's and Parkinson's," says Dr. Mancini. "The next step would be to investigate how beneficial these compounds are, and whether they have the ability to enter the bloodstream, or cross the blood-brain barrier."

The fact that it's a natural compound vs. synthetic is also a major advantage, says Dr. Weaver. "Mother Nature is a much better chemist than we are and Mother Nature is able to make these compounds. If you have a complicated compound, it's nicer to grow it in a crop, harvest the crop, grind the crop out and extract it than try to make it."

But, he admits, there is much more research needed before it can translate into potential therapeutic options.

"What this study does is take the epidemiological evidence and try to refine it and to demonstrate that there are indeed components within coffee that are beneficial to warding off cognitive decline. It's interesting but are we suggesting that coffee is a cure? Absolutely not."

http://bit.ly/2SVNYIG

Stanford chemists develop a new way to treat antibiotic-resistant infections

Small molecular attachment helps conventional antibiotics penetrate and destroy their targets

With drug-resistant infections on the rise and the development of new antibiotics on the decline, the world could use a new strategy in the fight against increasingly wily bacteria. Now, Stanford chemists report November 2 in the Journal of the American Chemical Society a possible solution: a small molecular attachment that helps conventional antibiotics penetrate and destroy their targets.

The attachment, known as r8, helps guide antibiotics through a bacterium's outer defenses and encourages them to linger, said Alexandra Antonoplis, a graduate student in chemistry and co-lead author with fellow chemistry graduate student Xiaoyu Zang. That penetration and tenacity help kill bacteria, such as methicillin-resistant Staphylococcus aureus, or MRSA, that doctors would otherwise struggle to stop.

Indeed, adding r8 to vancomycin, a first-line defense against MRSA, made the new drug hundreds of times more effective, according to experiments conducted by Antonoplis, Zang, and their advisers, Lynette Cegelski, an associate professor of chemistry, and Paul Wender, the Francis W. Bergstrom Professor of Chemistry. The same strategy, the researchers believe, could apply beyond MRSA to other drugs and infections.

"You don't have to invent a new drug. You just have to fix the problems with existing drugs," said Wender, who is also a member of Stanford Bio-X, the Stanford Cancer Institute, and Stanford ChEM-H.

The MRSA problem

In the long run, the new approach could be good news for public health officials who have struggled with how to deal with antibiotic-resistant infections like MRSA. That infection, which often begins as a skin infection, causes more than half of hospital-related infections in Asia and the Americas, and it is the leading cause of death among antibiotic-resistant infections.

"It's a global health problem, and we need new treatment strategies, because of the increasing emergence of bacteria that are resistant to antibiotics and the limited number of antibiotics in our pipeline," said Cegelski who is also a member of Stanford Bio-X and Stanford ChEM-H. According to one report, the number of new FDA-approved antibiotics dropped 90 percent over the last three decades.

The current first-line treatment for MRSA has been in use since 1958. That first-line treatment, the antibiotic vancomycin, can keep MRSA from spreading in some cases by preventing the construction of new bacterial cell walls, thus preventing the bacteria from reproducing.

But vancomycin is largely useless against two of the bacteria's key defenses. First, MRSA has a tendency to form biofilms, colonies of the bacteria embedded within a protective membrane that drugs have a hard time penetrating. Second, MRSA bacteria can lie dormant for extended periods, during which time vancomycin doesn't work - meaning doctors need an antibiotic that can stick around until MRSA bacteria start to wake up.

Antibiotic siege tactics

The solution, the Stanford team believed, lies not in designing an antibiotic from the ground up, but rather in modifying vancomycin

with r8 to help it break into a biofilm and stick around long enough to attack cells once they awaken.

To test vancomycin with the attached r8, dubbed V-r8, the team pitted both it and vancomycin against MRSA in a free-floating state and in biofilms. When bacteria were floating around freely in a liquid, both vancomycin and V-r8 were able to kill off most of the bacteria. But in biofilms, V-r8 was around 10 times more effective, demonstrating that it could penetrate a biofilm and kill bacteria inside.

V-r8 also clung to MRSA bacteria twice as well as vancomycin and was vastly more effective at entering MRSA cells, suggesting it could hang around long enough to kill dormant cells.

Those experiments, however, were all conducted in lab dishes. To see how V-r8 would do in a real infection, the team treated mice infected with MRSA with both V-r8 and vancomycin. The new version, they found, killed about 97 percent of bacteria after five hours, about six times more effective than vancomycin without the r8 attachment.

The results do not mean that a new antibiotic is headed straight to the clinic, even for testing - that is likely still years away. Still, Wender said, they do suggest a new way to build antibiotics: by modifying existing antibiotics with synthetic components to give them new abilities, such as the capacity to break through biofilms.

The team next intends to test the drug-modifying strategy in other bacteria in the hope of finding similar results and a way forward in dealing with antibiotic resistance.

"This was just the first effort," Cegelski said.

http://bit.ly/2zCDBAI

Huge numbers of deformities found in ancient human remains

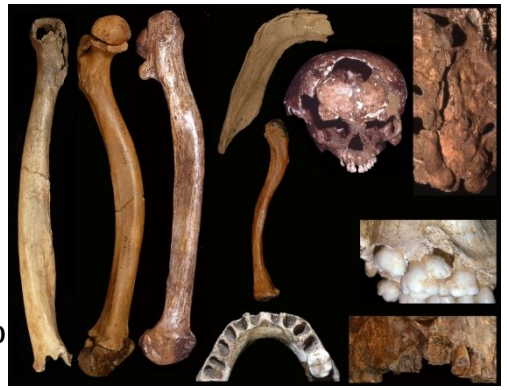
Analysis of late Pleistocene people finds a wide range of bone and dental problems.

Andrew Masterson reports.

Analysis of remains from 66 ancient humans reveals that they suffered from an astonishing number of physical deformities, research reveals.

Anthropologist Erik Trinkaus from Washington University in St Louis, US, compiled examination records for two Late Pleistocene infants, six children, four juveniles, six adolescents, 30 prime age adults, and eight older adults, from several archaeological sites around the world.

He discovered that all up they showed evidence of 75 skeletal or dental abnormalities. Based on rates of similar disorders in modern human populations, Trinkaus finds the probability that the total is merely an artefact of comparatively small sample size to be “vanishingly small”.



Some examples of developmental abnormalities in Pleistocene people. **Erik Trinkaus**

In a paper published in the journal *PNAS*, the author says that there is no single factor that could plausibly account for the high number of deformities.

“A substantial number of these abnormalities reflect abnormal or anomalous developmental processes, whether as a result of genetic variants altering developmental processes or as the products of environmental or behavioural stress patterns altering expected developmental patterns,” he writes.

The deformities found included soft bones caused by the blood disorder hypophosphatemia, hydrocephaly, dwarfism, abnormal bone growth, and a wide variety of skull, jaw and dental problems.

Trinkaus is at pains to stress that finding evidence of disfigurements is not itself unexpected in people who died more than 11,000 years ago. The sheer number of them, however, most definitely is.

"Some of these developmental abnormalities are unusual but not exceptional in recent human samples, and thus it would not be surprising to find examples of them in the … human paleontological record," he writes.

"However, other abnormalities are extremely rare in recent human populations, and the probability of finding such a case in the fossil record would be extraordinary."

He notes that based on their occurrence in modern populations, the chance of finding evidence of the more common abnormalities would be something like 5%, and the chance of finding the rare ones as little as 0.0001%. The chances of finding them in combination, or collectively in evidence in every set of remains to date uncovered and reliably dated, is astronomical.

"The multiplicative cumulative probability of finding the 75 developmental abnormalities is vanishingly small," he writes.

He acknowledges, however, that 66 sets of remains constitutes in itself the merest fraction of the people who lived and died in the late Pleistocene and that a fuller understanding of the frequency of deformities will not be gained until many more skeletons are discovered.

On the current evidence, however, he advances some possible reasons to account for his findings – after first dismissing the idea of sample bias, on the not unreasonable grounds that there is no evidence that people with deformities received different types of burials which might have increased the chances that they would eventually be discovered.

"The abundance of developmental abnormalities among Pleistocene humans may have been enhanced by the generally high levels of stress evident among these foraging populations," he writes.

He also tentatively suggests inbreeding – consanguinity, as he terms it – as a factor. Some abnormalities, he notes, are inherited conditions, and the chances of them being expressed would have greatly increased if breeding occurred among closely related individuals.

With the extent of deformities only recently becoming obvious as a result of increasingly sophisticated examination methods, the reasons why our distant ancestors were such a damaged bunch remain unclear.

"Some of these developmental deficiencies are unexceptional from a recent human perspective, although finding multiple cases of them within and across samples and time periods suggests elevated levels of these more common patterns," writes Trinkaus.

"However, one-quarter of the cases are rare (some extremely so) in extant human samples, and an additional one-fifth of the cases defy proper diagnosis."

http://bit.ly/2Dd4a2M

This lily's cousin is an ear of corn. Now, scientists know how they—and many other plants—are related

As different as they may seem, corn and daylilies have a lot in common.

By Elizabeth Pennisi Nov. 5, 2018 , 12:50 PM

So do towering palm trees and diminutive lady's slipper orchids. Thanks to a common ancestor 137 million years ago, the roots, seeds, and sometimes leaves of these flowering plants—known as monocots—look alike. Now, a new genetic study reveals why: Even though all of these plants are landlubbers today, their ancestor lived in water.

***This lily leek (*Allium moly*) is one of 85,000 monocots that now have a better-defined family history.* Chelsea Specht**

The work is convincing, says Peter Stevens, a systematist at the University of Missouri in St. Louis who was not involved with the study. “It allows you think about the origin of monocot features.”

Scientists have long had trouble placing monocots, whose seeds contain just one embryonic leaf, on the plant family tree. (Most flowering plants are eudicots, which have two such leaves in their seeds.) That tree is key to understanding the evolutionary relationships of the world’s 85,000 monocots, which include staple crops like corn and rice, the grasses eaten by cows, palm trees, and some of the world’s prettiest flowers, such as orchids and lilies.

“In virtually every one of the [monocot] families, you can point to beautiful and economically and ecologically important members,” says Elizabeth Kellogg, a plant biologist at the Donald Danforth Plant Science Center in St. Louis who was not involved with the work.

Knowing how important an accurate family tree was—especially for crop breeding and basic research—Thomas Givnish, an evolutionary biologist at the University of Wisconsin in Madison, pulled together about 19 fellow biologists to draw up the most definitive version to date. They sequenced the DNA in the chloroplasts of 545 monocots and of 22 other plants. Based on similarities in the plants’ DNA, the team worked out family connections and estimated the age of each branch. “We have very strong support for most of the relationships,” Givnish says. Among their discoveries: Bananas branch off closer to gingers and heliconia (flowering plants known as “lobster claws”) than previously thought.

“What is really new is the amount of data that they have thrown at the whole problem,” Stevens says. Many of the relationships—including the banana-ginger one—had been suggested before.

Most striking is what’s at the base of the tree, Givnish says. The nonmonocots most closely related to that base indicate the first monocots were aquatic plants, Givnish’s team reported last month in the *American Journal of Botany*.

Botanists in the 1800s were the first to suggest this idea, and several researchers also explored this origin in the 1990s, but none had the genetic data that now back it up, he says. Not just seeds, but monocot leaves and roots are different from those of other flowering plants, and the aquatic origin may explain why.

For example, monocot leaves tend to have parallel veins running the long way up the leaves, whereas other flowering plant leaves have branching veins. The branching veins keep the paper-thin leaves stiff; otherwise gravity would make them flop over. But leaves in monocots’ aquatic ancestors presumably floated and thus could do with a less extensive—and expensive—support system. Also, leaves in most flowering plants attach to the stem through a base called a petiole. But leaf bases in monocots tend to clasp the stem with an array of “fingers,” which makes sense if swirling water tossed the leaves every which way, Givnish says.

Monocot roots also show little branching, like aquatic plant roots. And most monocots are herbaceous, not woody; if their watery ancestors put on wood layers every year like most trees, the new growth would have interfered with air tubes reaching from leaves to the plants’ underwater parts.

As comprehensive as this new family tree is, it needs refining, Kellogg says, so that more than just monocots’ larger groups are in their proper places. To do that, Stevens says the team would need to compare DNA, not from the chloroplasts, but from the much larger amount of DNA stored in cells’ nuclei. This work is already under way, says Givnish, whose team has analyzed 500 genes from nuclear DNA from a wide array of species.

The team’s new findings “largely support the same patterns of relationships,” and should be published in a few months.

https://nyti.ms/2AWXOmM

Dogs Can Detect Malaria. How Useful Is That?

Canines can sniff out the socks worn by children carrying the mosquito-borne parasites, a study found.

By Donald G. McNeil Jr.

Dogs have such exquisitely sensitive noses that they can detect bombs, drugs, citrus and other contraband in luggage or pockets.

Is it possible that they can sniff out even malaria? And when might that be useful?

A small pilot study has shown that dogs can accurately identify socks worn overnight by children infected with malaria parasites — even when the children had cases so mild that they were not feverish.

The study, a collaboration between British and Gambian scientists and the British charity Medical Detection Dogs, was released last week at the annual convention of the American Society of Tropical Medicine and Hygiene.

In itself, such canine prowess is not surprising. Since 2004, dogs have shown that they can detect bladder cancer in urine samples, lung cancer in breath samples and ovarian cancer in blood samples.

Trained dogs now warn owners with diabetes when their blood sugar has dropped dangerously low and owners with epilepsy when they are on the verge of a seizure. Other dogs are being taught to detect Parkinson's disease years before symptoms appear.

The new study, its authors said, does not mean that dogs will replace laboratories. Inexpensive rapid tests for malaria have been available for over a decade; more than 200 million people in dozens of countries are infected each year.

But for sorting through crowds, malaria-sniffing dogs could potentially be very useful.

Some countries and regions that have eliminated the disease share heavily trafficked borders with others that have not. For example, South Africa, Sri Lanka and the island of Zanzibar have no cases but get streams of visitors from Mozambique, India and mainland Tanzania.

And when a region is close to eliminating malaria, dogs could sweep through villages, nosing out silent carriers — people who are not ill but have parasites in their blood that mosquitoes could pass on to others.

Dog noses are 10,000 to 100,000 times as sensitive as human noses. Scientists are not sure exactly what dogs are smelling, but it is known that malaria parasites produce volatile aldehydes like those found in perfumes.

The parasites may have evolved the ability to exude odoriferous chemicals in order to attract mosquitoes to carry them to new hosts. Studies have shown that mosquitoes prefer to bite people who have malaria.

If just one chemical indicated cancer or malaria, "we'd have discovered it by now," said Claire Guest, who founded Medical Detection Dogs in 2008 and oversaw dog training in the study. "It's more like a tune of many notes, and the dogs can pick it up."

Most breeds have good noses, she said, but the best for this task are dogs bred to hunt — like pointers, spaniels and Labradors — and dogs with relaxed relationships with their owners.

The initial trials were just to prove that detection was feasible, said Steve W. Lindsay, an entomologist at Durham University in Britain who said he was inspired by a dog sniffing luggage for contraband food at Washington Dulles airport.

This preliminary study involved training just two dogs to sniff rows of jars containing bits of thin nylon socks that had been worn overnight by Gambian children.

When the dogs, a Labrador-golden retriever mix named Lexi and a Labrador named Sally, recognized the telltale odors, they were supposed to stop and point at the jar.

They were only about 70 percent accurate at spotting socks from children with malaria, but 90 percent accurate at not giving false positives.

Their accuracy might have been higher under different circumstances, Dr. Lindsay said. Some children had probably shared beds with infected siblings, and the socks had to be stored in a freezer for a year while the dogs were trained and the study design approved.

“W.C. Fields said, ‘Never work with children or animals,’ and here we are working with both,” he said.

Because some Muslims avoid dogs or their saliva as unclean, Dr. Lindsay worried that African Muslims — of which there are millions — would object to being sniffed.

But the Quran permits dogs used for hunting or guarding homes, and after discussing the issue with Gambian imams, he brought dogs wearing red “Medical Detection” jackets into villages.

“Once we explained what we were doing, people were quite O.K. with it,” he said.

He was asked if smaller, cheaper or more local animals could be trained — African giant pouched rats, for example, have been used to detect land mines and tuberculosis.

“Yes, I suppose,” he said. “But at ports of entry, I think people would rather see dogs running around than rats.”

https://wb.md/2DbWxK0

Ignoring Patient Input Tied to Diagnostic Error

Patients' views are not often included in records of diagnostic errors, but new data released on November 5 suggest that patient and family narratives may contain key information that should formally be included in the system.

Marcia Frellick

To learn more about how patient experience and patient-physician interactions might affect the risk for diagnostic error, Traber Davis Giardina, PhD, MSW, and colleagues analyzed reports submitted from January 2010 to February 2016 to the nonprofit Empowered Patient Coalition.

The coalition began collecting family experiences to learn more about safety events from the patient's point of view. Patients, family members, and caregivers voluntarily submit data by responding to questions and adding their own text.

Davis Giardina, from the Center for Innovations in Quality, Effectiveness, and Safety at the Michael E. DeBakey Veterans Affairs (VA) Medical Center and assistant professor of medicine at Baylor College of Medicine in Houston, Texas, and colleagues reported their results in an article published online in *Health Affairs*.

The researchers identified 184 unique patient stories of diagnostic error. Amid those narratives, problems in patient-physician interactions emerged as a major factor in the errors.

"Our analysis identified 224 instances of behavioral and interpersonal factors that reflected unprofessional clinician behavior, including ignoring patients' knowledge, disrespecting patients, failing to communicate, and manipulation or deception," they write.

Researchers found 92 narratives by patients and families that included mention of clinicians ignoring or dismissing their reports of such indicators as worrisome symptoms, change in the patient, or failure to improve and that resulted in a diagnostic error.

About two thirds (67.9%) of the narratives were contributed by female patients, and most of the reported diagnostic errors (79.9%) took place in a hospital. Although more than half of participants said that they had reported the incident either to the institution where it happened or to a governing body, only 9% said they were satisfied by the response, the authors write.

Sometimes the narratives told of painful experiences that were brought on by their not being heard and that would last beyond the medical experience.

One woman wrote, "I was her first-born child, had worked in a major teaching hospital for years and thought I could manage her care, and make certain she was well taken care of.... I found I was unable to do so, since I was continually ignored.... I failed her."

In another case reported by a family member, a patient's reports of abdominal pain that lasted over 3 years were ignored.

"One physician even had the audacity to 'listen' to her chest with his stethoscope and NOT put the ear pieces in his ears.... [T]hey were around his neck and then he patted her on the shoulder and told her she was fine and walked out of the room." According to the family member, she was later diagnosed with advanced metastatic colorectal cancer.

The authors call for health systems to develop formal programs to include patients' narratives in the records of diagnostic process.

They highlight as an example the Vanderbilt Patient Advocacy Reporting System, which collects and codes unsolicited patient and family complaint narratives. Reports are reviewed and scored.

High scores bring about an intervention that involves working with clinicians to gradually change behavior.

Coauthors of the study have received funding from the Veterans Affairs Health Services Research and Development (HSR&D) Service and the Presidential Early Career Award for Scientists and Engineers USA, the Agency for Healthcare Research and Quality, the VA National Center for Patient Safety, the Houston VA HSR&D Center for Innovations in Quality, Effectiveness, and Safety, the Gordon and Betty Moore Foundation and the National Cancer Institute.

Health Aff. Published online November 5, 2018. Abstract

http://bit.ly/2PoGG27

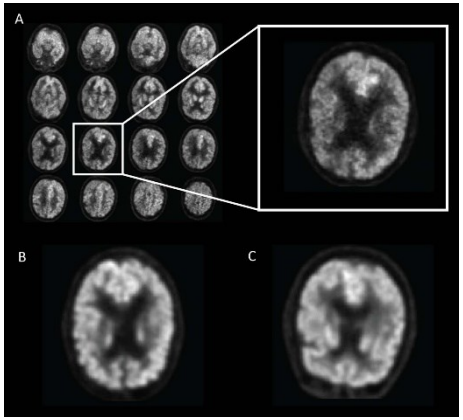
Artificial intelligence predicts Alzheimer's years before diagnosis

AI improves the ability of brain imaging to predict Alzheimer's disease

OAK BROOK, Ill. - Artificial intelligence (AI) technology improves the ability of brain imaging to predict Alzheimer's disease, according to a study published in the journal *Radiology*.

Timely diagnosis of Alzheimer's disease is extremely important, as treatments and interventions are more effective early in the course of the disease. However, early diagnosis has proven to be challenging. Research has linked the disease process to changes in metabolism, as shown by glucose uptake in certain regions of the brain, but these changes can be difficult to recognize.

"Differences in the pattern of glucose uptake in the brain are very subtle and diffuse," said study co-author Jae Ho Sohn, M.D., from the Radiology & Biomedical Imaging Department at the University of California in San Francisco (UCSF). "People are good at finding specific biomarkers of disease, but metabolic changes represent a more global and subtle process."



Example of fluorine 18 fluorodeoxyglucose PET images from Alzheimer's Disease Neuroimaging Initiative set preprocessed with the grid method for patients with Alzheimer disease (AD). One representative zoomed-in section was provided for each of three example patients: A, 76-year-old man with AD, B, 83-year-old woman with mild cognitive impairment (MCI), and, C, 80-year-old man with non-AD/MCI. In this example, the patient with AD presented slightly less gray matter than did the patient with non-AD/MCI. The difference between the patient with MCI and the patient with non-AD/MCI appeared minimal to the naked eyes. **Radiological Society of North America**

The study's senior author, Benjamin Franc, M.D., from UCSF, approached Dr. Sohn and University of California, Berkeley, undergraduate student Yiming Ding through the Big Data in

Radiology (BDRAD) research group, a multidisciplinary team of physicians and engineers focusing on radiological data science. Dr. Franc was interested in applying deep learning, a type of AI in which machines learn by example much like humans do, to find changes in brain metabolism predictive of Alzheimer's disease.

The researchers trained the deep learning algorithm on a special imaging technology known as 18-F-fluorodeoxyglucose positron emission tomography (FDG-PET). In an FDG-PET scan, FDG, a radioactive glucose compound, is injected into the blood. PET scans can then measure the uptake of FDG in brain cells, an indicator of metabolic activity.

The researchers had access to data from the Alzheimer's Disease Neuroimaging Initiative (ADNI), a major multi-site study focused on clinical trials to improve prevention and treatment of this disease. The ADNI dataset included more than 2,100 FDG-PET brain images from 1,002 patients. Researchers trained the deep learning algorithm on 90 percent of the dataset and then tested it on the remaining 10 percent of the dataset. Through deep learning, the algorithm was able to teach itself metabolic patterns that corresponded to Alzheimer's disease.

Finally, the researchers tested the algorithm on an independent set of 40 imaging exams from 40 patients that it had never studied. The algorithm achieved 100 percent sensitivity at detecting the disease an average of more than six years prior to the final diagnosis.

"We were very pleased with the algorithm's performance," Dr. Sohn said. "It was able to predict every single case that advanced to Alzheimer's disease."

Although he cautioned that their independent test set was small and needs further validation with a larger multi-institutional prospective study, Dr. Sohn said that the algorithm could be a useful tool to complement the work of radiologists--especially in conjunction with other biochemical and imaging tests--in providing an opportunity for early therapeutic intervention.

"If we diagnose Alzheimer's disease when all the symptoms have manifested, the brain volume loss is so significant that it's too late to intervene," he said. "If we can detect it earlier, that's an opportunity for investigators to potentially find better ways to slow down or even halt the disease process."

Future research directions include training the deep learning algorithm to look for patterns associated with the accumulation of beta-amyloid and tau proteins, abnormal protein clumps and tangles in the brain that are markers specific to Alzheimer's disease, according to UCSF's Youngho Seo, Ph.D., who served as one of the faculty advisors of the study.

"If FDG-PET with AI can predict Alzheimer's disease this early, beta-amyloid plaque and tau protein PET imaging can possibly add another dimension of important predictive power," he said.

"A Deep Learning Model to Predict a Diagnosis of Alzheimer Disease Using 18F-FDG PET of the Brain." Collaborating with Drs. Sohn, Franc, and Seo and Ms. Ding were Michael G. Kawczynski, M.S., Hari Trivedi, M.D., Roy Harnish, M.S., Nathaniel W. Jenkins, M.S., Dmytro Lituiev, Ph.D., Timothy P. Copeland, M.P.P., Mariam S. Aboian, M.D., Ph.D., Carina Mari Aparici, M.D., Spencer C. Behr, M.D., Robert R. Flavell, M.D., Ph.D., Shih-Ying Huang, Ph.D., Kelly A. Zalocusky, Ph.D., Lorenzo Nardo, Ph.D., Randall A. Hawkins, M.D., Ph.D., Miguel Hernandez Pampaloni, M.D., Ph.D., and Dexter Hadley, M.D., Ph.D.

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Novel Compound Strongly Inhibits Botulinum Neurotoxin

A newly-identified natural compound called nitrophenyl psoralen could be used as a treatment to reduce paralysis induced by botulism, a rare illness caused by toxins that attack the nervous system.

Botulinum neurotoxins, the most poisonous proteins known to mankind, are a family of seven (types A-G) immunologically distinct

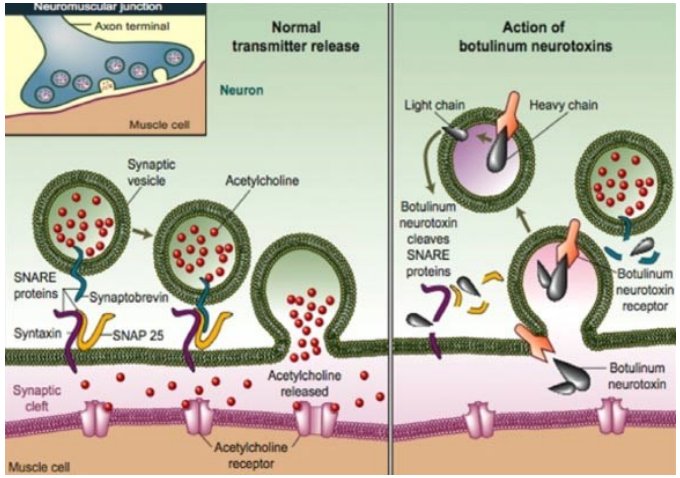
proteins synthesized primarily by different strains of the anaerobic bacteria *Clostridium botulinum*.

"Although fewer than 200 botulism cases occur worldwide, annually, these cost more to treat than the millions of salmonella outbreaks that occur, making botulism the most expensive form of food poisoning," said lead author Professor Bal Ram Singh, from the Institute of Advanced Sciences, Dartmouth.

In the study, Professor Singh and colleagues first identified the enzyme within botulinum neurotoxins that damages neurons, causing paralysis.

They then screened a library containing more than 300 small natural compounds from extracts of Indian medicinal plants, searching for enzymes that could neutralize the neuron-damaging activity.

"Using high throughput screening, we identified one of the compounds, nitrophenyl psoralen (NPP), as having particularly strong activity against the neuron-damaging enzyme," Professor Singh said.



***Mechanism of action of botulinum toxin: the light chain of (BT-A) cleaves SNAP-25 (synaptosome-associated protein of 25 KDa) and consequently prevents the release of acetylcholine into the neuromuscular junction.* Ali S. Al-Ghamdi *et al*, doi: 10.1016/j.jdds.2014.06.002.**

The team then tested NPP's activity in vitro and in cell culture against botulinum neurotoxin type A, which is the most potent serotype among the seven serotypes of botulinum toxin.

NPP type A had powerful anti-botulinum toxin activity, with low toxicity to human cells.

"NPP also showed activity to reverse the mouse muscle paralysis induced by botulinum neurotoxin type A," Professor Singh said.

"Psoralen derived drugs are already approved by the FDA in the United States. That would likely hasten the drug approval process for NPP."

The team's results were published in the journal *Applied and Environmental Microbiology*.

Kruti B. Patel et al. *Natural Compounds and their Analogues as Potent Antidotes against the Most Poisonous Bacterial Toxin.* Applied and Environmental Microbiology, *published online November 2, 2018; doi: 10.1128/AEM.01280-18*

http://bit.ly/2qGbsoq

How a Meteor Crash Formed Stunning Desert Glass

It was precious enough for King Tut's tomb.

by Evan Nicole Brown

Let's go back in time roughly, oh, 20 million years. It's the Miocene era, which formally began 3.03 million years prior, and India and Asia are just beginning to collide and form the impressive mountain ranges we know today. Kelp forests and brown algae are appearing and diversifying oceans at rapid rates; in Europe and Africa, around 100 different species of early apes are monkeying around.

***A piece of the precious Libyan Desert Glass.* Public Domain**

With this as the backdrop, let's zoom in on North Africa specifically. Libya, bordered by the Mediterranean Sea on the north and Egypt to the east, is about to experience a geological miracle. Unbeknown to the colliding mountains and swinging apes of the Miocene, the 420,000 square miles that make up the Libyan desert (which is part of the Sahara) would soon be caramelized into shards of foggy green

glass. This rare and precious material, known as Libyan Desert Glass, was found in King Tutankhamun's burial tomb millions of years later. Libyan Desert Glass' value comes from the miraculousness of its origin story. As Dr. Jane Cook, chief scientist at The Corning Museum of Glass in Corning, New York, explains, "glass happens when just the right ingredients are heated up and cooled down quickly." But in the case of Libyan Desert Glass, the series of events was much more elaborate.

Libyan Desert Glass found in the Great Sand Sea along the border of Libya and Egypt. This specimen weighs 22 grams and is about 55 mm wide. H. Raab/(CC BY-SA 3.0)

"About 20 million years ago, either a meteor impact or atmospheric explosion got to the desert part of the lower atmosphere, heated it up and fragmented and exploded," she says. "It dumped a huge amount of heat, like in thousands of Fahrenheit degrees, into that portion of the desert, which was a relatively pure deposit of quartz sand. And it brought it up hot enough that it was able to liquefy for a short period of time." When this liquefied quartz cooled down, desert glass was formed. Cook adds: "Because it was almost pure silica it was able to solidify without crystallizing," making it glass instead of geological crystal structures.

When British archaeologist Howard Carter began searching through King Tut's treasure chests in 1922, he found a decorative breastplate depicting the Sun God Ra. Housed in the center of this armor sits a chartreuse scarab: a beetle symbol, usually cut from gemstones, that ancient Egyptians held sacred. This particular 18th-Dynasty scarab was carved from the rare and precious Libyan Desert Glass, as confirmed by Italian mineralogist Vincenzo de Michele in 1998.

Though other meteor impact glasses do exist, in contrast to the more common man-made glass, Libyan Desert Glass is widely regarded as being "the most spectacular," says Cook. Considering glass was formally "invented" in 1500 B.C., it's no surprise that the 20-million-year-old translucent matter was considered precious enough to be placed at the center of King Tut's breastplate. Dr. Katherine Larson, assistant curator of ancient glass at Corning, studies the cultural importance of the material. "We identify Libyan Desert Glass as glass based on the material properties of it, but in the Ancient Egyptian mind, the glass and the stone are really closely linked," she says. "In fact, the Ancient Egyptian word we have for glass, that's preserved in hieroglyphic texts of this period, actually means 'stone that pours.' "

Breastplate found in King Tutankhamun's tomb. The center scarab is made of Libyan Desert Glass. Public Domain

At the time King Tut's breastplate was made, Libyan Desert Glass was probably not seen as that different from other naturally occurring semi-precious stones, like amethyst, lapis lazuli, or quartz. What we now understand to be an impactite (glass formed from impact), would have been a generally beautiful and valuable stone from the ancient point of view—but still with a high prestige factor. "The general index we use for preciousness is that we equate it with rarity, and that's probably true in the ancient world as well," Larson says. "So the more resources that it takes to acquire something, the further it comes from, [or] the more exotic it is, those are all things that can contribute to [the material] being considered precious or rare." Though unidentified at the time, this milky yellow-green glass birthed from the "Great Sand Sea" would have had an even higher value rating because it wasn't harvested or

used as a trade good, whereas most man-made glasses were. Plus, Larson says, “in this case, it is a pretty rare type of stone, and it would’ve come from relatively far away, so that certainly contributed to its preciousness. And then there’s the aesthetic properties of it as well. There’s an attractiveness to it.”

Libyan Desert Glass comes in many shapes and sizes. Corning Museum of Glass

When that fateful meteor crashed into the Libyan desert all those millions of years ago, whatever contaminants dissolved into the silica’s liquid state ended up affecting the color and opacity of the solid Libyan Desert Glass. Specimens range from a cloudy dark brown to a stunningly luminous lemon yellow, and are still being found today. “[The Libyan desert is] a large area, hundreds of square miles perhaps, so that explosion was gigantic,” Cook says. “And it glassified—vitrified would be the technical term—a huge area in a relatively remote and underpopulated part of the [country].” All these years later, people are still digging up fragments of the glass that graced the most famous Egyptian pharaoh’s tomb.

http://bit.ly/2PqL3JR

World's Oldest Animal Drawing, Discovered in Borneo Cave, Is a Weird Cow Beast

A 40,000-year-old painting of a mysterious, wild cow-like beast discovered in a Borneo cave is the oldest human-made drawing of an animal on record, a new study finds.

By Laura Geggel, Senior Writer

The discovery indicates that figurative cave art — one of the most significant innovations in human culture — didn't begin in Europe as many scientists thought, but rather in Southeast Asia during the last ice age, the researchers said.

Drawing animals, an accomplishment in itself, may have been a gateway for illustrating other aspects of the human experience, including hunting and dance. "Initially, humans made figurative painting of large animals and they later start depicting the human world," said study co-lead researcher Maxime Aubert, an archaeologist and geochemist at Griffith University in Australia.

The ancient artwork covers the walls of secluded limestone caves in the rugged and remote mountains of the East Kalimantan province of Indonesian Borneo. Researchers have known about these human-made drawings since 1994, but they didn't know when the illustrations were created until now, said Aubert, who worked with Indonesia's National Research Centre for Archaeology (ARKENAS) and the Bandung Institute of Technology (ITB).

The researchers collected calcium-carbonate samples from the Kalimantan cave drawings so they could do uranium-series dating — a technique made possible by radioactive decay. When rainwater seeps through limestone, it dissolves a small amount of uranium, Aubert told Live Science. As uranium (a radioactive element) decays, it turns into the element thorium. By studying the ratio of uranium to thorium in the calcium carbonate (limestone) that is coating the cave art, researchers determined how old the initial coating was, he said.

This cow-like beast is the oldest known figurative artwork in the world. It's at least 40,000 years old. **Luc-Henri Fage**

The oldest figurative art — the mystery animal that is likely a species of wild cattle that once stomped around the jungles of Borneo — was at least 40,000 years old, Aubert said. Previously, the oldest known animal painting in the world was an approximately 35,400-year-old babirusa, or "pig-deer," on the Indonesian island of Sulawesi, he said.

Artwork through the ages

The team's results showed that the ancient artwork in East Kalimantan was made during three distinct periods. The first phase, which dates to between 52,000 and 40,000 years ago, includes hand stencils and reddish-orange ochre-drawn animals — mostly the banteng (*Bos javanicus*), a type of wild cattle that still lives in Borneo, and the mysterious, unknown wild cow, Aubert said.

A major change happened to the culture during the icy Last Glacial Maximum about 20,000 years ago, which led to a new style of rock art — one that focused on the human world. The artists in this phase favored a dark mulberry-purple color and painted hand stencils, abstract signs and human-like figures wearing elaborate headdresses and engaging in various activities, such as hunting or ritualistic dancing, the researchers said.

"We don't know if these [different types of cave art] are from two different groups of humans, or if it represents the evolution of a particular culture," Aubert said. "We are planning archaeological excavation in those caves in order to find more information about these unknown artists."

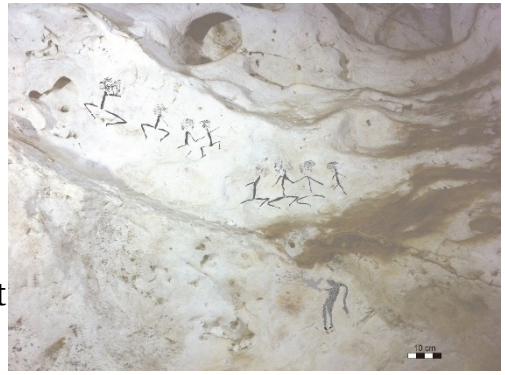
These mulberry-colored hands were painted over the older, reddish hand stencils found in the Indonesian cave. These two styles were created at least 20,000 years apart. **Kinez Riza**

The final phase of rock art includes humanlike figures, boats and geometric designs that were mostly drawn with black pigments, the researchers said. This type of art is found elsewhere in Indonesia and may come from Asian Neolithic farmers who moved into the region about 4,000 years ago, or more recently, the researchers said.

Location, location

During the last ice age, Borneo (Earth's third-largest island) sat on the easternmost edge of Eurasia.

"It now seems that two early cave art provinces arose at a similar time in remote corners of Paleolithic Eurasia: one in Europe, and one in Indonesia at the opposite end of this ice age world," study co-researcher Adam Brumm, an associate professor of archaeology at Griffith University, said in a statement.



It's possible that rock art spread from Eurasia to Sulawesi, where the babirusa drawing resides, before colonizing humans spread it farther to places like Australia, Aubert said.

These human figures date to at least 13,600 years ago. It's possible they drawn at the height of the last Glacial Maximum, about 20,000 years ago. **Pindi Setiawan**

The new finding shows further evidence that "the earliest art consisted of large animals painted in a remarkably naturalistic style, with emphasis on the musculature and form of the animal's body," said Susan O'Connor, a professor of archaeology at the College of Asia & the Pacific at Australian National University, who wasn't involved with the research.

"The location of these ancient paintings of animals and hand stencils perhaps marks the passage of the first modern humans as they moved

through mainland Asia and out into the islands of Wallacea, lying between the mainland and continental Sahul (Australia and New Guinea which were joined at this time)," O'Connor told Live Science in an email. "They may have used art to mark and 'humanize' these new and unfamiliar landscapes."

The newly dated cave art fits in with the emerging picture of early humans. *Homo sapiens* left Africa between about 70,000 and 60,000 years ago, and "once they spread out across Eurasia, they developed, after about 40,000 years ago, the desire (or ability) to produce figurative art," Christopher Henshilwood, director of the Centre for Early Sapiens Behaviour at the University of Bergen in Norway, who wasn't involved with the study, told Live Science in an email. "This find in Indonesia thus adds to our knowledge regarding the evolution of figurative art, perhaps first in Asia, then in Europe and Africa." (Africa's oldest figurative art dates to about 30,000 years ago at the Apollo 11 Cave in Namibia, Henshilwood noted.)

The study was published online today (Nov. 7) in the journal Nature.

http://bit.ly/2qHZmLr

Scientists theorize new origin story for Earth's water

Earth's water may have originated from both asteroidal material and gas left over from the formation of the Sun

WASHINGTON -- Earth's water may have originated from both asteroidal material and gas left over from the formation of the Sun, according to new research. The new finding could give scientists important insights about the development of other planets and their potential to support life.

In a new study in the *Journal of Geophysical Research: Planets*, a journal of the American Geophysical Union, researchers propose a new theory to address the long-standing mystery of where Earth's water came from and how it got here.

The new study challenges widely-accepted ideas about hydrogen in Earth's water by suggesting the element partially came from clouds of dust and gas remaining after the Sun's formation, called the solar nebula.

To identify sources of water on Earth, scientists have searched for sources of hydrogen rather than oxygen, because the latter component of water is much more abundant in the solar system.

Many scientists have historically supported a theory that all of Earth's water came from asteroids because of similarities between ocean water and water found on asteroids. The ratio of deuterium, a heavier hydrogen isotope, to normal hydrogen serves as a unique chemical signature of water sources. In the case of Earth's oceans, the deuterium-to-hydrogen ratio is close to what is found in asteroids.

But the ocean may not be telling the entire story of Earth's hydrogen, according to the study's authors.

"It's a bit of a blind spot in the community," said Steven Desch, a professor of astrophysics in the School of Earth and Space Exploration at Arizona State University in Tempe, Arizona and co-author of the new study, led by Peter Buseck, Regents' Professor in the School of Earth and Space Exploration and School of Molecular Sciences at Arizona State University. "When people measure the [deuterium-to-hydrogen] ratio in ocean water and they see that it is pretty close to what we see in asteroids, it was always easy to believe it all came from asteroids."

More recent research suggests hydrogen in Earth's oceans does not represent hydrogen throughout the entire planet, the study's authors said. Samples of hydrogen from deep inside the Earth, close to the boundary between the core and mantle, have notably less deuterium, indicating this hydrogen may not have come from asteroids. Noble gases helium and neon, with isotopic signatures inherited from the solar nebula, have also been found in the Earth's mantle.

In the new study, researchers developed a new theoretical model of Earth's formation to explain these differences between hydrogen in

Earth's oceans and at the core-mantle boundary as well as the presence of noble gases deep inside the planet.

Modeling Earth's beginning

According to their new model, several billion years ago, large waterlogged asteroids began developing into planets while the solar nebula still swirled around the Sun. These asteroids, known as planetary embryos, collided and grew rapidly. Eventually, a collision introduced enough energy to melt the surface of the largest embryo into an ocean of magma. This largest embryo would eventually become Earth.

Gases from the solar nebula, including hydrogen and noble gases, were drawn in by the large, magma-covered embryo to form an early atmosphere. Nebular hydrogen, which contains less deuterium and is lighter than asteroidal hydrogen, dissolved into the molten iron of the magma ocean.

Through a process called isotopic fractionation, hydrogen was pulled towards the young Earth's center. Hydrogen, which is attracted to iron, was delivered to the core by the metal, while much of the heavier isotope, deuterium, remained in the magma which eventually cooled and became the mantle, according to the study's authors. Impacts from smaller embryos and other objects then continued to add water and overall mass until Earth reached its final size.

This new model would leave Earth with noble gases deep inside its mantle and a lower deuterium-to-hydrogen ratio in its core than in its mantle and oceans.

The authors used the model to estimate how much hydrogen came from each source. They concluded most was asteroidal in origin, but some of Earth's water did come from the solar nebula.

"For every 100 molecules of Earth's water, there are one or two coming from solar nebula," said Jun Wu, assistant research professor in the School of Molecular Sciences and School of Earth and Space Exploration at Arizona State University and lead author of the study.

An insightful model

The study also offers scientists new perspectives about the development of other planets and their potential to support life, the authors said. Earth-like planets in other solar systems may not all have access to asteroids loaded with water. The new study suggests these exoplanets could have obtained water through their system's own solar nebula.

"This model suggests that the inevitable formation of water would likely occur on any sufficiently large rocky exoplanets in extrasolar systems," Wu said. "I think this is very exciting."

Anat Shahar, a geochemist at the Carnegie Institution for Science, who was not involved with the study, noted the hydrogen fractionation factor, which describes how the deuterium-to-hydrogen ratio changes when the element dissolves in iron, is currently unknown and difficult to measure. For the new study, this property of hydrogen had to be estimated.

The new model, which fits in well with current research, could be tested once experiments reveal the hydrogen fractionation factor, Shahar said.

"This paper is a very creative alternative to what is an old problem," Shahar said. "The authors have done a good job of estimating what these different fractionation factors would be without having the experiments."

The new study was funded by the Keck Foundation.

Notes for Journalists

This paper is open access for 30 days. Journalists and public information officers (PIOs) can download a PDF copy of the article by clicking on this link:
https://agupubs.onlinelibrary.wiley.com/doi/full/10.1029/2018JE005698

http://bit.ly/2zJfQXM

Culture may explain why brains have become bigger

"Cultural brain hypothesis" could explain extraordinary increases in brain size in humans

A theory called the cultural brain hypothesis could explain extraordinary increases in brain size in humans and other animals over the last few million years, according to a study published in *PLOS Computational Biology* by Michael Muthukrishna of the London School of Economics and Political Science and Harvard University, and colleagues at the University of British Columbia and Harvard University.

Humans have extraordinarily large brains, which have tripled in size in the last few million years. Other animals also experienced a significant, though smaller, increase in brain size. These increases are puzzling, because brain tissue is energetically expensive: that is, a smaller brain is easier to maintain in terms of calories. Building on existing research on learning, Muthukrishna and colleagues analytically and computationally modeled the predictions of the cultural brain hypothesis and found that this theory not only explains these increases in brain size, but a variety of other relationships with group size, learning strategies, knowledge and life history.

The theory relies on the idea that brains expand to store and manage more information. Brains expand in response to the availability of information and calories. Information availability is affected by learning strategies, group size, mating structure, and the length of the juvenile period, which co-evolve with brain size. The model captures this co-evolution under different conditions and also describes the specific and narrow conditions that can lead to a take-off in brain size--a possible pathway that led to the extraordinary expansion in our own species. The authors called this set of predictions the cumulative cultural brain hypothesis. These theories were supported by tests using existing empirical data. Taken together, the findings may help explain the rapid expansion of human brains and other aspects of our species' life history and psychology.

"This is a brand-new theory to explain the evolution of the human brain as well as brains more generally. It shows how various characteristics of a species are actually intrinsically connected through a common evolutionary process," says Muthukrishna. "The limits to larger brains is our ability to birth them, but as this theory suggests, this process is ongoing - we're now expanding our juvenile period, hitting a new biological limit in our ability to reproduce at an older age".

Next, the researchers plan to test the predictions made by the theory that relate to individual, rather than social, learning, as well as developing extensions to the theory.

Peer-reviewed; Simulation/modelling; N/A

Citation: Muthukrishna M, Doebeli M, Chudek M, Henrich J (2018) The Cultural Brain Hypothesis: How culture drives brain expansion, sociality, and life history. PLoS Comput Biol 14(11): e1006504. https://doi.org/10.1371/journal.pcbi.1006504

http://bit.ly/2Df4PAN

AI Won't Replace Doctors, It Will Augment Them

The future of medicine is a physician-patient-AI golden triangle, one in which machines augment clinical care and diagnostics—one with the patient at its heart.

By Shelly Fan

That is the takeaway message of DeepMind researcher Dr. Alan Karthikesalingam, who presented his vision of AI-enabled healthcare Monday at Singularity University's Exponential Medicine conference in San Diego.

You've probably heard of DeepMind: it's the company that brought us the jaw-dropping Go-playing AI agent AlphaGo. It's also the company that pioneered a powerful deep learning approach called deep reinforcement learning, which can train AI to solve increasingly complex problems without explicitly telling them what to do.

"It's clear that there's been remarkable progress in the underlying research of AI," said Karthikesalingam. "But I think we're also at an interesting inflection point where these algorithms are having concrete, positive applications in the real world."

And what better domain than healthcare to apply the fledgling technology in transforming human lives?

Caution and Collaboration

Of course, healthcare is vastly more complicated than a board game, and Karthikesalingam acknowledges that any use of AI in medicine needs to be approached with a hefty dose of humility and realism.

Perhaps more than any other field, medicine puts safety first and foremost. Since the birth of medicine, it's been healthcare professionals acting as the main gatekeepers to ensure new treatments and technology can demonstrably benefit patients. And for now, doctors are an absolutely critical cog in the healthcare machinery.

The goal of AI is not to replace doctors, stressed Karthikesalingam. Rather, it is to optimize physician performance, releasing them from menial tasks, and providing alternative assessments or guidance that may have otherwise slipped their notice.

This physician-guided approach is reflected by a myriad of healthcare projects that DeepMind is dipping its toes into.

A collaboration with Moorfields Eye Hospital, one of the "best eye hospitals in the world," yielded an AI that could diagnose eye disease and perform triage. The algorithm could analyze detailed scans of the eye to identify early symptoms and prioritize patient cases based on severity and urgency.

It's the kind of work that normally requires over twenty years of experience to perform well. When trained, the algorithm had a success rate similar to that of experts, and importantly, didn't misclassify a single urgent case.

Roughly 300 million people worldwide suffer from eyesight loss, but if caught early the symptoms can be preventable in 80 to 90 percent of cases. As technologies that image the back of the eye become increasingly sophisticated, patients may have access to methods to scan their own eyes with the use of smartphones or other portable devices. Combined with AI that diagnoses eye disease, the outcome could dramatically reduce personal and socio-economic burden for the entire world.

"This was an incredibly exciting result for our team. We saw here that our algorithm was able to allocate urgent cases correctly, with a test set of just over a thousand cases," said Karthikesalingam.

Another early collaborative success for DeepMind is in the field of cancer. Eradicating tumors with radiation requires physicians to draw out the targeted organs and tissues on a millimeter level—a task that can easily takes four to eight (long, boring) hours.

Working with University College London, DeepMind developed an algorithm that can perform clinically-applied segmentation of organs. In one example, the AI could tease out the delicate optic nerve—the information highway that shuttles data from the eyes to the brain—from medical scans, thereby allowing doctors to treat surrounding tissues without damaging eyesight.

Interpretable and Scarce

"There's a real potential for AI to be a useful tool for clinicians that benefits patients," said Karthikesalingam.

But perhaps the largest challenge in the next five to ten years is bringing AI systems into the real world of healthcare. For algorithms to cross the chasm between proof-of-concept to useful medical associates, they need an important skill outside of diagnosis: the ability to explain themselves.

The doctors need to be able to scrutinize the decisions of deep learning AI—not to the point of mathematically understanding the inner workings of the neural networks, but at least having an idea of how a decision was made.

You may have heard of the "black box" problem in artificial neural networks. Because of the way they are trained, researchers can observe the input (say, MRI images) and output decision (cancer, no cancer) without any insight into the inner workings of the algorithm.

DeepMind is building an additional layer into its diagnostic algorithms. For example, in addition to spitting out an end result, the eye disease algorithm also tells the doctor how confident (or not) it is in its own decision when looking through various parts of an eye scan.

"We find this to be particularly exciting because it means that doctors will be able to assess the algorithm's diagnosis and reach their own conclusions," said Karthikesalingam.

Even deep learning's other problem—it's need for millions of training data—is rapidly becoming a non-issue. Compared to online images, medical data is relatively hard to come by and expensive. Nevertheless, recent advances in deep reinforcement learning are drastically slashing the amount of actual training data needed. DeepMind's organ segregation algorithm, for example, was trained on only 650 images—an extremely paltry set that makes the algorithm much more clinically applicable.

Towards the Future

"At DeepMind we strongly believe that AI will not replace doctors, but hopefully will make their lives easier," said Karthikesalingam.

The moonshot for the next five years isn't developing better AI diagnosticians. Rather, it's bringing algorithms into the clinic in such a way that AI becomes deeply integrated into clinical practice.

Karthikesalingam pointed out that the amount of AI research that actually crosses into practice will depend not just on efficacy, but also trust, security and privacy.

For example, the community needs to generate standard medical image datasets to evaluate a variety of algorithmic diagnosticians on equal footing. Only when backed by ample, reproducible evidence can AI systems be gradually accepted into the medical community and by patients.

"In the end, what we're doing is all about patients," said Karthikesalingam. "I think this is perhaps the most important part of all. Patients are ultimately who we hope to benefit from all the exciting progress in AI. We've got to start placing them at the heart of everything we do."

http://bit.ly/2DydTl7

Replaying the tape of life: Is it possible?

Evolutionary biologists explore the role of history in evolution

GAMBIER, Ohio -- How predictable is evolution? The answer has long been debated by biologists grappling with the extent to which history affects the repeatability of evolution.

A review published in the Nov. 9 issue of *Science* explores the complexity of evolution's predictability in extraordinary detail. In it, researchers at Kenyon College, Michigan State University and Washington University in St. Louis closely examine evidence from a number of empirical studies of evolutionary repeatability and contingency in an effort to fully interrogate ideas about contingency's role in evolution.

The question of evolution's predictability was notably raised by the late paleontologist Stephen Jay Gould, who advocated the view that evolution is contingent and unrepeatable in his 1989 book Wonderful Life. "Replay the tape a million times ... and I doubt that anything like Homo sapiens would ever evolve again," Gould mused, noting that being able to "replay the tape" and give history a do-over would be impossible. Yet since the publication of Wonderful Life, many evolutionary biologists have taken up this challenge and conducted their own versions of Gould's experiment, albeit on smaller scales. In doing so, they have reached different conclusions about the interplay between randomness of mutations, chance historical events, and directionality imparted by natural selection.

"How history plays out isn't really predictable. Historical outcomes are contingent on long chains of events loaded with tiny little details. A dropped packet of cigars wrapped with the Confederate army's marching orders was found by a Union soldier, which led to the

Battle of Antietam, which led to Lincoln announcing the Emancipation Proclamation. What if those cigars hadn't been dropped, or if they hadn't been found by a Union soldier? Evolution is similar, in that it plays out over vast periods of time with long, unique chains of events involving a lot of chance. Unlike history, though, evolution has the deterministic force of natural selection, but that determinism is always in tension with the chanciness. How does that tension affect what evolves? Which is more important: contingency on details of history, or determinism?" said Zachary Blount, a senior research associate at MSU and visiting assistant professor of biology at Kenyon College who served as lead author of the review.

Blount was joined in his work by Richard Lenski, the Hannah Distinguished Professor of Microbial Ecology at MSU, and Jonathan Losos, the William H. Danforth Distinguished University Professor at Washington University in St. Louis.

"The idea of replaying life's tape -- having a fresh start -- is something almost everyone has thought about at some point in their own lives. It's also something that has long interested biologists, but on the grand scale of the history of life on Earth," Lenski said. "Since Gould introduced the metaphor of replaying life's tape, many studies have tried to characterize the repeatability of evolution. What our review shows is that there's no easy answer: Sometimes evolution produces strikingly similar solutions, and other times evolving lineages take very different paths even under the same circumstances. I think that's part of the fascination and beauty of evolution, that it produces both the expected and unexpected, perhaps like in our individual lives, but on a vastly larger scale."

Gould's thought experiment still stimulates robust debate, in part due to inconsistencies Gould introduced in how he described his replay metaphor, as well as confusion around the concept of contingency. Gould often conflated two common meanings of "contingency": as dependence on something else, and as a chance event.

"There are multiple, different literatures on Gould's idea, and these literatures are not talking to each other," Losos said. "There are microbial evolution studies. There are all the studies of convergent evolution, or lack of convergent evolution. And there's also a philosophical literature on what Gould meant when he said, 'replay the tape.' That is, more generally, when you talk about the role of contingency -- which is the term Gould used - what does that actually mean?"

Their review of existing empirical studies focused on primarily on three types of "replay studies": laboratory evolution experiments with fast-evolving organisms; experiments carried out in nature; and natural experiments that compare lineages that evolved under similar conditions. The comprehensive analysis revealed a complex picture of evolutionary change in which both contingency and determinism are evident.

Blount, Lenski and Losos examined a number of different types of laboratory experiments, including parallel replay experiments, in which identical populations of an organism are separately evolved under identical conditions, and analytic replay experiments, in which specimens are frozen from a parallel replay experiment and then resurrected and re-evolved from different points in time. This review included study of the long-term evolution experiment with Escherichia coli (LTEE), started by Lenski in 1988. The LTEE has followed 12 populations of E. coli, founded from a single clone, for more than 70,000 generations. Samples of each population were frozen every 500 generations, allowing researchers to directly compare the evolving bacteria with their ancestors.

Blount, Lenski and Losos also examined experiments that attempt to replicate evolution in natural settings. Only a few such experiments exist to date, and their review of these experiments indicated a high

degree of repeatability in evolutionary responses to different historical conditions.

Their review of comparative studies of "natural experiments" further illuminated evidence of evolution's predictability. Similar features can independently evolve in multiple species -- for example, anole lizards of the Caribbean, which separately evolved traits such as the length of their legs and tails to ease their life in their specific habitats. Yet convergence in evolution does not always occur, as their review shows; contingency can play a strong role in divergent evolution of various traits.

"What we clearly see is that both convergence and lack of convergence occur a lot in the natural world," Losos said. "It's not useful just to keep adding to the two lists. The real question that people are now turning to is: Why does convergence occur sometimes and not others? That is where research is now headed. That's the question we need to focus on."

Their review was supported in part by a grant from the National Science Foundation, the BEACON Center for the Study of Evolution in Action, Michigan State University and Harvard University.

https://wb.md/2Dy2H8d

Single Dose of New Oral Antibiotic Cures Most Gonorrhea

Single oral dose of zoliflodacin performs as well as intramuscular ceftriaxone for treatment of gonococcal infections

Susan London

A single oral dose of the investigational antibiotic zoliflodacin performs as well as intramuscular ceftriaxone (*Rocephin*, Hoffman-LaRoche) for treatment of uncomplicated urogenital and rectal gonococcal infections, a multicenter phase 2 trial suggests.

"*N [Neisseria] gonorrhoeae* has developed resistance to every class of antibiotic recommended for treatment, which now includes cephalosporins and macrolides. Reports of multidrug-resistant *N gonorrhoeae* and the possibility of untreatable gonorrhea underscore the need for the development of new antimicrobial agents," Stephanie N. Taylor, MD, and coinvestigators note.

"This phase 2 trial creates equipoise for larger, more definitive studies of zoliflodacin," they write. Trial results were published online November 7 in the *New England Journal of Medicine*.

Taylor, from the Department of Microbiology, Immunology and Parasitology, Louisiana State University Health Sciences Center, New Orleans, and coinvestigators enrolled men and women who had signs or symptoms of uncomplicated urogenital gonorrhea or untreated urogenital gonorrhea or who had recently had sexual contact with an infected person.

The trial randomly assigned patients to receive a single oral 2-g dose (72 patients) or 3-g dose (67 patients) of zoliflodacin (Entasis Therapeutics), a first-in-class inhibitor of DNA biosynthesis, and 41 patients to receive a single 500-mg intramuscular dose of ceftriaxone on an open-label basis. Microbiologic cure was assessed with culture a mean of 6 days later.

Among evaluable patients in the intention-to-treat population, the rate of microbiologic cure at urogenital sites was 96% for those who received 2 g of zoliflodacin, 96% for those who received 3 g of zoliflodacin, and 100% for those who received ceftriaxone. Confidence intervals were overlapping.

All three regimens cured 100% of rectal infections, which were seen in small numbers of patients.

However, the rate of cure of pharyngeal infections, also uncommon, was 50% with 2 g of zoliflodacin and 82% with 3 g of zoliflodacin, compared with 100% with ceftriaxone.

"[I]t has been speculated that poor drug penetration into pharyngeal tissue may be responsible for most pharyngeal treatment failures rather than reinfection or resistant organisms," the authors explain.

Findings were essentially the same in per-protocol analyses.

At safety visits conducted about a month after treatment, 24 adverse events were reported in the group given 2 g of zoliflodacin, 37 in the group given 3 g of zoliflodacin, and 23 in the group given ceftriaxone. Twenty-one patients experienced adverse events that were deemed to be related to zoliflodacin. These events were predominantly gastrointestinal and were self-limiting.

Single-drug regimens were used in the trial to facilitate comparison, according to the investigators. "However, current US and European guidelines recommend dual therapy for gonorrhea — theoretically, to slow the development of antimicrobial resistance and to treat concomitant chlamydial infection," they note. "Should the development of zoliflodacin for gonorrhea therapy be pursued, its use in combination with another active agent would probably be the goal."

New Antibiotics Needed as Treatment Options Dwindle

In a related editorial, Susan Blank, MD, MPH, from the Division of Disease Control, New York City Department of Health and Mental Hygiene, and the Centers for Disease Control and Prevention, and Demetre C. Daskalakis, MD, MPH, from the Division of Disease Control, New York City Department of Health and Mental Hygiene, agree that new antibiotics are needed at a time when gonorrhea infections are on the rise and treatment options are dwindling.

"Given the challenges in clinical follow-up in this patient population, the single-dose regimen is promising," they write. "Though the study was small, the efficacy shown is encouraging, and zoliflodacin has the potential to be an effective antibiotic for treating gonorrhea, though the limited activity observed in key anatomical sites of infection such as the pharynx will need to be better defined....

"With more dedicated research on sexually transmitted infections to advance biomedical innovation and develop better diagnostics, therapeutics, and even vaccines, we may be able to avoid the advent of gonorrhea that is either treatable only with expensive intravenous or intramuscular agents or entirely untreatable," the editorialists add.

Dr Taylor received grants from the National Institutes of Health during the conduct of the study, as well as grants from Melinta, Becton-Dickinson, Roche Molecular, Hologic, and Beckman Coulter and grants and personal fees from GlaxoSmithKline outside the study. Several coauthors report various financial relationships with Activbiotics, AstraZeneca (the parent company of Entasis), Becton-Dickinson, Cepheid, Gilead, GlaxoSmithKline, Hologic, Melinta Therapeutics, National Institute of Allergy and Infectious Diseases, National Institutes of Health, Roche Molecular, and Warner-Chlicott. Dr Blank and Dr Daskalakis have disclosed no relevant financial relationships.

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https://go.nature.com/2zFxmvO

Ancient genomics is recasting the story of the Americas' first residents

Trove of DNA from prehistoric inhabitants reveals that the continents' early settlers moved far and fast.

Ewen Callaway

Ancient genomics is finally beginning to tell the history of the Americas — and it's looking messy.

An analysis of genomes from dozens of ancient inhabitants of North and South America, who lived as long ago as 11,000 years — one of the largest troves of ancient DNA from the region studied so far — suggest that the populations moved fast and frequently. The findings were published on 8 November in *Cell*[1] and *Science*[2].

The studies suggest that North America was widely populated over a few hundred years, and South America within one or two thousand years by related groups. Later migrations on and between the continents connected populations living as distantly as California and the Andes.

"These early populations are really blasting across the continent," says David Meltzer, an archaeologist at Southern Methodist University in Dallas, Texas, who co-led the *Science* study.

The studies also suggest that prehistory of the Americas — the last major land mass to be settled — was just as convoluted as that of other parts of the world.

"I think this series of papers will be remembered as the first glimpse of the real complexity of these multiple peopling events," says Ben Potter, an archaeologist at the University of Alaska Fairbanks. "It's awesome."

Archaeological guesswork

For decades, the peopling of the Americas was painted in broad brushstrokes, using data from archaeological finds and DNA from modern humans.

Scientists discerned that groups crossed the Bering land bridge from Siberia into present-day Alaska and then moved steadily south as the last Ice Age ended. Humans carrying artefacts from a culture known as Clovis, including sophisticated projectile points, began to populate the interior of North America around 13,000 years ago. For decades, researchers thought that people associated with this culture were the continents' first inhabitants.

But the discovery of 'pre-Clovis' settlements — including a nearly 15,000-year-old site at the southern tip of Chile — pointed to an even earlier wave of migration to the Americas, presumably also over the Bering land bridge.

The first ancient-DNA studies from the region, the first of which were published in 2014, began to add detail to this picture. The genome of a baby boy buried roughly 12,700 years ago in Montana alongside Clovis artefacts[3], and genomes from other ancient individuals[4], hinted at two early populations of Native Americans.

The Montana baby, known as the Anzick boy, belonged to a population known as the Southern Native Americans, who are most closely related to present-day Indigenous populations from South America. They split from Northern Native Americans, who are genetically closer to many contemporary groups in eastern North America, around 14,600–17,500 years ago. The common ancestor of these two groups split from East Asians some 25,000 years ago, scientists established this year by sequencing the genome of 11,500-year-old human remains from Alaska[5].

But this timeline was based on a small number of ancient genomes from the Americas, and scientists expected that further data would paint a much more detailed and complex picture of the continents' early history, as well as reveal later migrations in the region.

Same genes, far apart

The two latest studies include genome data from 64 ancient Americans, including more than a dozen specimens older than 9,000 years.

They also provide the first detailed look at the ancient inhabitants of Central and South America and their early movements into the region.

To chart these migrations, Meltzer and his colleague Eske Willerslev, a palaeogeneticist at the University of Copenhagen and the University of Cambridge, UK, compared genetic data from the 12,700-year-old Anzick boy with genome sequences from 10,700-year-old remains from a Nevada cave and 10,400-year-old remains from southeastern Brazil.

The genomes were remarkably similar, despite the great distance between them, Willerslev says, pointing to a rapid population expansion from Alaska. "As soon as they get south of the continental ice caps, they're exploding and occupying the land," he says.

An independent team led by David Reich, a population geneticist at Harvard Medical School in Boston, Massachusetts, also found evidence[1] for a rapid expansion into South America, through analysing 49 ancient genomes from Central and South Americans. These included a 9,300-year-old individual from Belize, a 9,600-year-old from southeastern Brazil and 10,900-year-old remains from Chile.

Both teams documented multiple later human migrations into South America. For instance, Reich's team found that the genetic signal of the earliest inhabitants, closely related to the Anzick boy, had largely vanished from later South Americans, suggesting that different groups had by then moved in from the north.

Reich and his colleagues also found a perplexing connection between a 4,200-year-old human in the Central Andes and ancient inhabitants of the Channel Islands off the coast of California. The team does not think that humans migrated directly between these two regions — but instead that they are linked by migrations by a population that was once more widespread.

Gaps down under

Potter says that the main conclusions of the two papers are broadly consistent, painting a nuanced picture that will become clearer with more data. "Complex and realistic are the two adjectives I would use," he says.

Even with dozens more newly discovered ancient genomes from the Americas, researchers are still probably missing important aspects of the region's population history, says Reich. "There are many dots that are not filled in," he says. "I think as these studies scratch the surface, they make things more, rather than less, complicated."

For instance, the earliest migrations deduced by the researchers seem to have involved people associated with the Clovis culture, but Meltzer wonders what became of humans associated with pre-Clovis sites. "If you're moving that far that fast across space, there probably wasn't anybody else in the way."

Another lingering mystery surrounds a 2015 discovery, made independently by both Reich's[6] and Willerslev's[7] teams, that some modern inhabitants of the Amazon seem to share genetic ancestry with Australasian groups that include both the Papua New Guineans and Aboriginal Australians. Reich posited that this commonality points to a hitherto unknown migration to the Americas that vanished from all but the most isolated groups in the Amazon.

But Reich is now questioning that hypothesis because his team did not find significant evidence of Australasian ancestry in any of the ancient South and Central American genomes it analysed.

Willerslev, however, did link the genome of the 10,400-year-old individual from southeastern Brazil to an Australasian lineage. The finding has him wondering if there were migrations to the Americas that predated even those behind the pre-Clovis sites. "I think we are in for major surprises," he says.

Jennifer Raff, an anthropological geneticist at the University of Kansas in Lawrence, says that the emerging picture of the Americas is less a revision of the earlier models, and more of an elaboration. "It's not that everything we know is getting overturned. We're just filling in details," she says. "We're now moving to a much more detailed, much more accurate and richer history. That's where the field was always going, and it's nice to be there now."

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http://bit.ly/2z6tULl

How massive solar eruptions 'probably' detonated dozens of US sea mines

An extraordinary account of the impact space weather had on military operations in Vietnam in 1972 was found buried in the US Navy archives, according to a newly published article in Space Weather.

by Brett Carter, The Conversation

On August 4, 1972, the crew of a US Task Force 77 aircraft flying near a naval minefield in the waters off Hon La observed 20 to 25 explosions over about 30 seconds. They also witnessed an additional 25 to 30 mud spots in the waters nearby.

Destructor sea mines had been deployed here during Operation Pocket Money, a mining campaign launched in 1972 against principal North Vietnamese ports.

There was no obvious reason why the mines should have detonated. But it has now emerged the US Navy soon turned its attention to extreme solar activity at the time as a probable cause. The more we can understand the impact of such space weather on technology then the better we can be prepared for any future extreme solar activity.

A solar theory

As detailed in a now declassified US Navy report, the event sparked an immediate investigation about the potential cause(s) of the random detonations of so many sea mines.

The sea mines deployed had a self-destruct feature. But the minimum self-destruct time on these mines was not for another 30 days, so something else was to blame.

On August 15, 1972, the Commander in Chief of the US Pacific Fleet, Admiral Bernard Clarey, asked about a hypothesis that solar activity could have caused the mine detonations.

Many of the mines deployed were magnetic influence sea mines that were designed to detonate when they detected changes in the magnetic field.

Solar activity was then well known to cause magnetic field changes, but it wasn't clear whether or not the Sun could cause these unintentional detonations.

Solar flares

Early August in 1972 saw some of the most intense solar activity ever recorded.

A sunspot region, denoted MR 11976, set off a series of intense solar flares (energetic explosions of electromagnetic radiation), coronal mass ejections (eruptions of solar plasma material that typically accompany flares) and clouds of charged particles travelling close to the speed of light.

Those conducting the investigation into the mine incident visited the Space Environment Laboratory at the National Oceanographic and Atmospheric Administration (NOAA) near Boulder, Colorado, to speak to space scientists.

One of the scientists at NOAA at the time was the now Emeritus Professor Brian Fraser, from Australia's Newcastle University, and it's an event he told me he remembers well: "I was on my first sabbatical leave at NOAA working with Wallace (Wally) Campbell's group, and one day in Wally's office I noticed a group of US Navy brass hat gentlemen and a couple of dark suits."

Brian said he had later quizzed Wally on what was going on, and Wally explained they were concerned about geomagnetic field changes triggering sea mines laid in Hai Phong, North Vietnam. "There was no mention whether or not they had exploded but maybe Wally was being coy. And of course it was all probably top secret then."

The outcome of this investigation, as stated in the declassified US Navy report, detailed "a high degree of probability" that the Destructor mines had been detonated by the August solar storm activity.

Solar interference

Solar storms cause strong magnetic field fluctuations, which impact large power grid infrastructure, particularly in the high-latitude regions beneath the northern and southern auroras.

The storms of early August 1972 were no different. There were numerous reports across North America of power disruptions and telegraph line outages. Now that light has been shone on the impact of these events on sea mine operations in 1972, the scientific community has another clear example of space weather impacts on technologies.

The intensity of the early August activity peaked when an X-class solar flare at 0621 UT August 4, 1972, launched an ultra-fast coronal

mass ejection that reached Earth in the record time of 14.6 hours. The solar wind normally takes two to three days to reach Earth.

Scientists think that the previous slower ejections from earlier flares had cleared the path for this fast disturbance, similar to what was observed by the STEREO spacecraft in July 2012. It's the impact of this fast disturbance in the solar wind on the Earth's magnetosphere that probably caused the detonation of the Destructor mines.

Using the past to predict the future

The Dst index, measured in nano-Tesla (nT), is a typical measure of the disturbance level in the Earth's magnetic field – the more negative, the more intense the storm.

Some recent extreme solar storms, according to this scale, include the 2015 St Patrick's Day storm (-222 nT) and the 2003 Halloween storm (-383 nT). Interestingly, the extreme activity in August 1972 was far less intense on this scale, only weighing in at -125 nT.

Exactly why this storm reached extreme level on some measures, such as its high speed from the Sun, but not on the typical Dst scale is a topic of significant discussion within the scientific literature.

Given the complexities of this event, this new paper lays out a grand challenge to the space weather community to use our modern modelling techniques to reexamine this solar event. Hopefully, understanding these strange events will better prepare us for future solar eruptions.

http://bit.ly/2OEipQn

Scientist gets the dirt on what could be the planet's oldest soil

UO geologist Greg Retallack has dirt on his hands—and at 3.7 billion years old, it might be some of the oldest dirt on Earth.

by Kristin Strommer, University of Oregon

Found in a metamorphic rock formation in southwestern Greenland, the soil in question was exposed beneath a retreating ice cap and spotted during a helicopter survey by study co-author Nora Noffke. A sedimentologist at Old Dominion University, Noffke noticed certain soil-like characteristics in the exposed rock, including mudcracks and sand crystals.

She returned to the U.S. with samples in tow and teamed with Retallack, director of fossil collections at the Museum of Natural and Cultural History and an expert in fossil soils, to test the samples in the laboratory.

As the authors reported in a study published recently in the journal *Palaeogeography*, *Palaeoclimatology*, *Palaeoecology*, a series of geochemical and microscopic tests identified the sample as a likely paleosol: an ancient soil that formed as physical, chemical or biological processes altered it from its parent rock.

Retallack said that the paleosol provides a glimpse into landscapes and climates early in the planet's history.

"This soil profile is exceptional in giving us a view of conditions on land much earlier than was available before," Retallack said. "The Earth would have been uninhabitable by humans or other animals, because the minerals in the soil show that there was very little oxygen in the air. Weathering back then was also odd, because it was more like acid-sulfate weathering of desert crusts than modern weathering by rain and plants. Such acid sulfate paleosols have also been found on Mars, where they are also about 3.7 billion years old."

The authors also found signs that living organisms may have inhabited the soil, making it some of the earliest evidence of life on land.

"The characteristic isotopic ratios of carbon throughout the paleosol are tantalizing indications of life on land much further back in time than previously thought," Retallack said. "Although the origin of life has been envisaged in warm little ponds or scalding hot submarine springs, this discovery encourages those who think that life originated in soil."

Thin sections of the rock have been archived as specimens in the museum's Condon Collection of Fossils, and Retallack and Noffke are planning additional investigations to find out more about the organic compounds in the rock.

More information: *Gregory J. Retallack et al. Are there ancient soils in the 3.7 Ga Isua Greenstone Belt, Greenland?, Palaeogeography, Palaeoclimatology, Palaeoecology (2018). DOI: 10.1016/j.palaeo.2018.10.005*

http://bit.ly/2PmWDG4

Not Just the Flu: Gonorrhea, Chicken Pox Also Go Through Seasons

You probably know when flu season happens, but what about chicken-pox season or gonorrhea season?

By Rachael Rettner, Senior Writer

Well, according to a new review study, a whole host of infectious diseases have "seasons" during which their activity peaks.

The study, which reviewed information from dozens of scientific papers, found evidence of seasonality in at least 69 different infectious diseases.

These diseases ranged from common maladies such as pneumonia and *Salmonella* infections to relatively rare diseases such as Ebola and African sleeping sickness.

Some of the best-described seasonal infectious diseases in the U.S. are flu, which (as you might know) peaks in winter; chicken pox, which peaks in spring; and gonorrhea, which peaks in the summer and autumn.

The study even found evidence that certain chronic diseases have a seasonal component. For example, some studies suggest that hepatitis B infections rise in spring and summer in certain parts of the world. And early research suggests that HIV/AIDS may also be seasonal in certain areas in Africa, where seasonal nutritional deficiencies may affect the progression of HIV to AIDS.

"Seasonality is a powerful and universal feature of infectious diseases, although the scientific community has largely ignored it for the majority of infections," study author Micaela Martinez, an assistant professor at the Columbia Mailman School of Public Health, said in a statement. The study was published today (Nov. 8) in the journal PLOS Pathogens.

Indeed, for many infectious diseases, there's little research on exactly why they peak in certain seasons. Martinez called for more studies so scientists can better understand the specific reasons behind seasonal peaks and dips in infectious disease rates. "Much work is needed to understand the forces driving disease seasonality and understand how we can leverage seasonality to design interventions to prevent outbreaks and treat chronic infections," Martinez said.

But in general, there appear to be four main drivers of infectious-disease seasonality, according to the review:

- Environmental factors, such as temperature and humidity, which are thought to play a role, for example, in flu transmission. (Studies suggest that flu-virus particles can remain in the air for longer, and travel longer distances, under cold, dry conditions.) In addition, temperature plays a role in the spread of certain insect-borne diseases. For instance, mosquitos reproduce in warmer temperatures, boosting transmission of mosquito-borne diseases such as Zika in hotter months.
- ***Host behaviors, such as children starting school in fall, thus coming into close contact with each other, which plays a role in the spread of, for example, measles.***
- ***Ecological factors, such as proliferation of algae in water, which aids in the spread of the bacterial disease cholera.***
- ***Biological rhythms, migration and hibernation in animals, or fluctuations in hormones levels in people, which may affect the immune system.***

To better understand exactly why individual diseases peak in certain seasons, researchers could start by analyzing databases that contain information on "notifiable diseases," or diseases that must be reported to health officials regularly. Researchers could then combine this data with models of disease transmission and potential drivers of transmission, whether they be environmental, ecological, behavioral or physiological.

"Uncovering the mechanisms of seasonality for disease systems would empower the public health community to better control infection," Martinez wrote. And with this information, researchers would know the best season to undertake measures to control these infections.

Martinez is currently studying whether seasonal fluctuations in the hormone melatonin could affect the immune system and play a role people's susceptibility to certain infectious diseases.

http://bit.ly/2qFb9dd

Bad molars? The origins of wisdom teeth

The surgical removal of wisdom teeth is far more common than the problems they cause.

Julia Boughner *

Our grandparents and parents tell stories about the time when kids routinely had their tonsils removed. But for people born in the 1960s and later, their routine surgery stories are about having third molars, a.k.a. wisdom teeth, taken out.

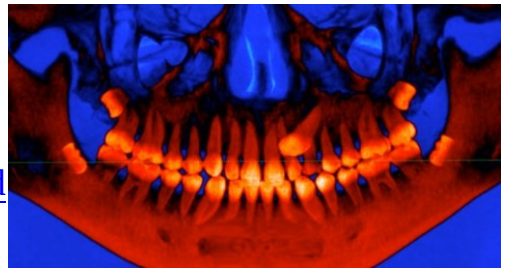
As a scientist who studies the evolution and development of faces and teeth in humans and other animals, whenever I ask a room of people if they've had any wisdom teeth removed, the hands of at least half the audience shoot up.

People want to share their wisdom tooth stories as well as to ask: Why do we have wisdom teeth? Why do they get impacted? Why don't we just evolve them away?

Humans are primates. Our species' closest living cousins are African apes, specifically chimpanzees. Apes have wisdom teeth, so do monkeys. Having wisdom teeth is just part of our evolutionary legacy.

Evolved wisdom?

Just like the rest of your teeth, wisdom teeth form inside your jawbone. But they form very late compared to our other teeth.



Second molars start developing around age three. Wisdom teeth often don't start growing until age nine, but they're highly variable, starting as young as five and as old as 15. They erupt from the gum between ages 17 and 24, if not older.

Wisdom teeth start forming much later than all the other teeth in your jawbone. **(Denver Marchoiri/University of Saskatchewan)**

A tooth that doesn't properly emerge through your gums and into your mouth is "impacted." Impacted teeth can be linked to problems including gum disease, cysts or damage to the second molar.

Even when wisdom teeth start out badly angled, they can rotate and shift position in your 20s or 30s.

Wisdom teeth are not only the teeth most often impacted, but also the teeth that often fail to form at all.

Because wisdom teeth aren't essential to modern human survival, people often ask whether evolution is weeding out this bothersome trait. But I don't think so.

First, impacted wisdom teeth may cause us problems, but they rarely kill us. Even if they did, for evolution to select against wisdom teeth, impacted molars would have to cull us from the gene pool before we had kids. This would stop us from passing on any genes that might lead to impaction.

But it's unlikely that specific "impaction genes" exist in the first place. There are, however, several risk factors for impaction, including what we eat.

Cramped quarters

The main reason we get impacted wisdom teeth is lack of space at the back of the jawbone. Our team found that when wisdom teeth develop and emerge very late, most of this space is already claimed by the first and second molars, so the wisdom tooth can't move upwards and through the gums.

A related problem is jaw growth and overall length. If the jaw doesn't grow long enough, fast enough, later-forming wisdom teeth also run out of space and can't erupt properly, if at all.

But space isn't the whole story. Scientists still can't explain why some wisdom teeth become impacted. We need new ways to help dentists reliably predict which wisdom teeth are at risk.

Something to chew on

Based on what we do know, can we prevent impaction? Maybe.

Apes rarely have impacted wisdom teeth. The same holds true for humans who eat non-industrialized diets.

Our jaws evolved to expect biomechanical stimulation from a diet of, say, nuts, uncooked veggies and raw meats. These days, we tend to feed our jaws soft, processed foods, like smooth peanut butter on squishy bread. As a result, for the past few decades, we've probably not been maxing out the growth potential of our jawbones.

If you're still growing, you can act now. Start eating crunchier, chewier foods, such as nuts and raw vegetables. And if you have kids, encourage them to eat jaw-moving foods as early as it's healthy to do so. While science can't yet say for sure that it will work, it probably can't hurt.

A public health problem?

Millions of wisdom tooth extraction surgeries are performed worldwide each year. The treatment rate for wisdom tooth problems is higher than the rate of impaction itself. Up to one-third of these surgeries are needless.

Extraction surgery carries its own risks, too, including injury to nearby teeth, nerves, jawbone or sinuses. That's a big waste of time, energy, money, avoidable pain and risk. Shunning non-essential surgery is why we no longer routinely send kids for tonsillectomies.

Healthy, erupted wisdom teeth aren't usually a big problem for most people. They may have to brush these hard-to-reach teeth extra carefully to avoid decay.

Some impacted wisdom teeth don't pose risk. But others can damage the second molar and surrounding jawbone, or cause infection and pain. These molars probably will need to come out.

When should you get them taken out? Some surgeons prefer to remove wisdom teeth early, at age 16 or 17, even though these molars may still rotate and emerge properly. On the other hand, removing molars late in life can be harsh on elderly, fragile or ill patients.

Watchful waiting may be a reasonable approach, and one advocated by several federal and public health agencies, as well as dentists.

Wisdom teeth are not necessarily essential but they're not useless, either. They're tools for eating, a part of our bodies, and a fascinating case study of how the evolution of human culture and diet can impact human development and growth.

Associate Professor, Evolutionary Developmental Anthropology, University of Saskatchewan

Disclosure statement

Julia Boughner does not work for, consult, own shares in or receive funding from any company or organisation that would benefit from this article, and has disclosed no relevant affiliations beyond their academic appointment.

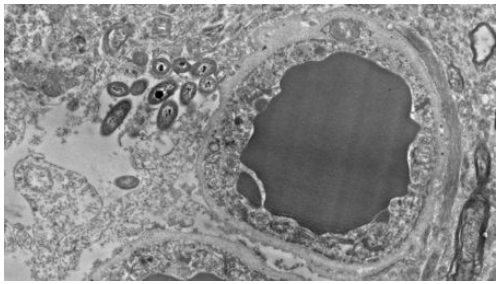
http://bit.ly/2FqSej4

Do gut bacteria make a second home in our brains?

Could some gut microbes be making a home in our brains?

By Kelly Servick

SAN DIEGO, CALIFORNIA—We know the menagerie of microbes in the gut has powerful effects on our health. Could some of these same bacteria be making a home in our brains? A poster presented here this week at the annual meeting of the Society for Neuroscience drew attention with high-resolution microscope images of bacteria apparently penetrating and inhabiting the cells of healthy human brains. The work is preliminary, and its authors are careful to note that their tissue samples, collected from cadavers, could have been contaminated. But to many passersby in the exhibit hall, the possibility that bacteria could directly influence processes in the brain—including, perhaps, the course of neurological disease—was exhilarating.



Images of human brain slices reveal bacteria, shown here to the left of a blood vessel—tantalizing but preliminary evidence of a "brain microbiome."
Rosalinda Roberts, Courtney Walker, and Charlene Farmer

"This is the hit of the week," said neuroscientist Ronald McGregor of the University of California, Los Angeles, who was not involved in the work. "It's like a whole new molecular factory [in the brain] with its own needs. … This is mind-blowing."

The brain is a protected environment, partially walled off from the contents of the bloodstream by a network of cells that surround its blood vessels. Bacteria and viruses that manage to penetrate this blood-brain barrier can cause life-threatening inflammation. Some research has suggested distant microbes—those living in our gut—might affect mood and behavior and even the risk of neurological disease, but by indirect means. For example, a disruption in the balance of gut microbiomes could increase the production of a rogue protein that may cause Parkinson's disease if it travels up the nerve connecting the gut to the brain.

Talking hoarsely above the din of the exhibit hall on Tuesday evening, neuroanatomist Rosalinda Roberts of The University of Alabama in Birmingham (UAB), told attendees about a tentative finding that, if true, suggests an unexpectedly intimate relationship between microbes and the brain.

Her lab looks for differences between healthy people and those with schizophrenia by examining slices of brain tissue preserved in the hours after death. About 5 years ago, neuroscientist Courtney Walker, then an undergraduate in Roberts's lab, became fascinated by unidentified rod-shaped objects that showed up in finely detailed images of these slices, captured with an electron microscope. Roberts had seen the shapes before. "But I just dismissed them, because I was looking for something else," she says. "I would say 'Oh, here are those things again.'"

But Walker was persistent, and Roberts started to consult colleagues at UAB. This year, a bacteriologist gave her unexpected news: They were bacteria. Her team has now found bacteria somewhere in every brain they've checked—34 in all—about half of them healthy, and half from people with schizophrenia.

Roberts wondered whether bacteria from the gut could have leaked from blood vessels into the brain in the hours between a person's death and the brain's removal. So she looked at healthy mouse brains, which were preserved immediately after the mice were killed. More bacteria. Then she looked at the brains of germ-free mice, which are carefully raised to be devoid of microbial life. They were uniformly clean.

RNA sequencing revealed that most of the bacteria were from three phyla common to the gut: Firmicutes, Proteobacteria, and Bacteroidetes. Roberts doesn't know how these bacteria could have gotten into the brain. They may have crossed from blood vessels, traveling up nerves from the gut, or even come in through the nose. And she can't say much about whether they're helpful or harmful.

She saw no signs of inflammation to suggest they were causing harm, but hasn't yet quantified them or systematically compared the schizophrenic and healthy brains. If it turns out that there are major differences, future research could examine how this proposed "brain microbiome" could maintain or threaten the health of the brain.

In the initial survey of the electron micrographs, Roberts's team observed that resident bacteria had puzzling preferences. They seemed to inhabit star-shaped cells called astrocytes, which interact with and support neurons. In particular, the microbes clustered in and around the ends of astrocytes that encircle blood vessels at the blood-brain barrier. They also appeared to be more abundant around the long projections of neurons that are sheathed in the fatty substance called myelin. Roberts can't explain those preferences but wonders whether the bacteria are attracted to fat and sugar in these brain cells.

Why haven't more researchers seen bacteria in the brain? One reason could be that few researchers subject postmortem brains to electron microscopy, Roberts says. "Pairing up a neuroanatomist with a brain collection just doesn't happen very often." And neuroscientists may—as she did until recently—disregard or fail to recognize bacteria in their samples.

Roberts acknowledges that her team still needs to rule out contamination. For example, could microbes from the air or from surgical instruments make it into the tissue during brain extraction? She plans to hunt for such evidence. She also wants to rule out that the solutions that preserve mouse brains introduce or nourish bacteria.

Among visitors to the poster, "There were a few skeptics," Roberts notes. "I have that part of me, too." But even if the bacteria were never really thriving in living brains, the patterns of their postmortem invasion are intriguing, she says.

If we really have the brain microbiome Roberts proposes, "There is much to investigate," says Teodor Postolache, a psychiatrist at the University of Maryland in Baltimore. He has studied the protozoan parasite *Toxoplasma gondii*, which invades the brain but doesn't always cause obvious disease. "I'm not very surprised that other things can live in the brain, but of course, it's revolutionary if it's so," he says. If these common gut bacteria are a routine, benign presence in and around brain cells, he says, they might play a key role in regulating the brain's immune activity. "It's a long road to actually prove that," he says, but "it's an exciting path."

http://bit.ly/2z30spK

Researchers find further link between a-fib, brain injury, and possible neurodegeneration

New study has found that patients with atrial fibrillation (AF) also show signs of asymptomatic brain injury.

A new study presented at the American Heart Association Scientific Session conference has found that patients with atrial fibrillation (AF) also show signs of asymptomatic brain injury.

Researchers from the Intermountain Medical Center Heart Institute in Salt Lake City enrolled 246 patients in the study: 198 with atrial fibrillation and 48 without AF. They then obtained plasma samples from Intermountain Healthcare's Intermountain Heart Collaborative INSPIRE registry and tested them for the circulating levels of four biomarkers associated with brain injury: glial specific GFAP and S100b; GDF15, a stress response marker; and neuron-specific au-protein.

They found that levels of three of those biomarkers - Tau, GDF15, and GFAP - were significantly higher in patients with atrial fibrillation. Findings from the study were presented at the American Heart Association Scientific Session conference in Chicago.

"We think patients with atrial fibrillation experience chronic, subclinical cerebral injuries," said Oxana Galenko, PhD, a molecular biologist at the Intermountain Medical Center Heart Institute, and the study's lead investigator. "It becomes absolutely critical to identify the early markers of this injury and help these patients who are at

higher risk of having subsequent neurodegenerative problems, such as cognitive decline and dementia."

Atrial fibrillation is an irregular and sometimes rapid heartbeat that can lead to blood clots, stroke, heart failure, and other heart-related problems. Between 2.7 and 6.1 million Americans suffer from the condition, according to the Centers for Disease Control. It causes 750,000 hospitalizations and 130,000 deaths each year.

If people with atrial fibrillation are indeed suffering from ongoing brain injuries, they can also be at higher risk of developing everything from depression to neurodegeneration, which is the deterioration or death of the body's nerve cells, especially neurons in the brain, which could cause losses in mental function, said Dr. Galenko.

Dr. Galenko said that could be because atrial fibrillation alters blood flow through the body, including to and from the brain, which could lead to cerebral injury and disruption of the blood-brain barrier, which filters blood to and from the brain and spinal cord. If it's not working correctly, neuro-specific molecules like GFAP and Tau get into the bloodstream, which was seen in this study.

Dr. Galenko said the next step is to do the same kind of analysis on a larger group of patients. She also said recent results from the Swiss Atrial Fibrillation Cohort Study points in the same direction -- that atrial fibrillation causes brain injury.

In the study, researchers performed MRIs on atrial fibrillation patients and found that 41 percent showed signs of at least one kind of a silent brain damage.

She believes a blood test would be the way to move forward if a method was developed to see which atrial fibrillation patients are also experiencing brain injury, for the simple reason that it's a lot cheaper and easier to do than an MRI.

"At this stage, we're at the very beginning of studying this link, but it's a step forward toward addressing the problem," she said.

https://bbc.in/2FiCdZZ

Dementia risk: Five-minute scan 'can predict cognitive decline'

A five-minute scan could be used to spot people at risk of dementia before symptoms appear, researchers claim.

By Alex Therrien Health reporter, BBC News

Scientists used ultrasound scanners to look at blood vessels in the necks of more than 3,000 people and monitored them over the next 15 years.

They found those with the most intense pulses went on to experience greater cognitive decline over the next decade than the other study participants.

An international team of experts, led by University College London (UCL), measured the intensity of the pulse travelling towards the brain in 3,191 people in 2002.

A more intense pulse can cause damage to the small vessels of the brain, structural changes in the brain's blood vessel network and minor bleeds known as mini-strokes.

Over the next 15 years, researchers monitored participants' memory and problem-solving ability.

Those with the highest intensity pulse (the top quarter of participants) at the beginning of the study were about 50% more likely to show accelerated cognitive decline over the next decade compared with the rest of the participants, the study found.

Researchers said this was the equivalent of about an extra one to one-and-half years of decline.

Cognitive decline is often one of the first signs of dementia, but not everyone who experiences it will go on to develop the condition.

Researchers said the test could provide a new way to identify people who are at risk of developing dementia, leading to earlier treatments and lifestyle interventions.

Controlling blood pressure and cholesterol, having a healthy diet, doing regular exercise and not smoking can all help to stave off dementia, evidence suggests.

Dr Scott Chiesa, from UCL, said: "Dementia is the end result of decades of damage, so by the time people get dementia it's too late to do anything.

"What we're trying to say is you need to get in as early as possible, identify a way to see who's actually progressing towards possibly getting dementia and target them."

However, the study does not contain data on which study participants went on to develop dementia.

Researchers next plan to use MRI scans to check if people in the study also display structural and functional changes within the brain that may explain their cognitive decline.

They also want to test whether the scan improves predictive risk scores for dementia which already exist.

Dr Carol Routledge, director of research at Alzheimer's Research UK, said it was not yet clear if the scan could improve the diagnosis of dementia.

She added: "What we do know is that the blood supply in the brain is incredibly important, and that maintaining a healthy heart and blood pressure is associated with a lower risk of developing dementia."

The study is being presented at the AHA Scientific Sessions conference in Chicago.