

<http://bit.ly/2IA0YDq>

Study shows planet's atmospheric oxygen rose through glaciers

Planet's oxidation resulted from a number of different continents

A University of Wyoming researcher contributed to a paper that determined a "Snowball Earth" event actually took place 100 million years earlier than previously projected, and a rise in the planet's oxidation resulted from a number of different continents -- including what is now Wyoming -- that were once connected.

"Isotopic dating of the Ongeluk large igneous province, South Africa, revealed that the first Paleoproterozoic global glaciation and the first significant step change in atmospheric oxygenation likely occurred between 2,460 and 2,426 million years ago, approximately 100 million years earlier than previous estimates," says Kevin Chamberlain, a UW research professor in the Department of Geology and Geophysics. "And the rise of atmospheric oxygen was not monotonic but, instead, was characterized by significant oscillations before irreversible oxygenation of the atmosphere 2,250 million years ago."

Chamberlain is the second author of a paper, titled "Timing and Tempo of the Great Oxidation Event," which appears in the Feb. 6 (today's) issue of the Proceedings of the National Academy of Sciences (PNAS). The journal is one of the world's most prestigious multidisciplinary scientific serials, with coverage spanning the biological, physical and social sciences.

Ashley Gumsley, a doctoral student at Lund University in Lund, Sweden, is the paper's lead author. Other contributors were from the Geological Survey of Canada in Ottawa; Swedish Museum of Natural History; University of Johannesburg, South Africa; and the University of California-Riverside.

The research relates to a period in Earth's history about 2.45 billion years ago, when climate swung so extremely that the polar ice caps extended to the equator and the Earth was a snowball, and the

atmosphere was largely isolated from the hydrosphere, Chamberlain says. Recovery from this Snowball Earth led to the first and largest, rapid rise in oxygen content in the atmosphere, known as the Great Oxygenation Event (GOE), setting the stage for the dominance of aerobic life, he says.

A later, and better known, Snowball Earth period occurred at about 700 million years ago, and led to multicellular life in the Cambrian period, Chamberlain says. The events show there was not one event, but an oscillation of oxygen over time that led to the Earth's conditions today.

"So, both Snowball Earth periods had extreme impacts on the development of life," he says. "It helps us understand the evolution of Earth and Earth's atmosphere, and evolution of life, for that matter."

Chamberlain's contribution focuses on igneous rocks exposed in South Africa that record the existence of equatorial glaciers and contain chemical indicators for the rise of atmospheric oxygen. Chamberlain's in situ method to determine the age of the rocks does not require removing baddeleyite crystals from the rock. This process allows for analysis of key samples with smaller crystals than previously allowed. Using a mass spectrometer, the age of the rocks is determined by measuring the buildup of lead from the radioactive decay of uranium, he says.

"The basic story had been worked out earlier by others, but our results have significantly refined the timing and duration of the 'event,' which is more of a transition actually," Chamberlain explains. "With all the discussion of climate change in the present day, understanding how Earth responded and the effects on the atmosphere in the past may help us predict the future."

Chamberlain points to a Wyoming connection in this research. From paleomagnetic data, many of the continents, at the time, including the basement rocks of Wyoming, were all connected into a single, large continent and situated near the equator. Other continents connected

included parts of what are now Canada and South Africa. This situation is part of the trigger for the "Snowball Earth" conditions.

"There are glacial deposits exposed in the Medicine Bow Mountains and Sierra Madre that are from this same event," he says.

These rocks, known as diamictites, have large drop stones that depress very fine-grained mudstone. The large stones dropped from the underside of glacial sheets as they spread out and melted over shallow seas, similar to sediments beneath the Ross sea ice sheet of Antarctica today. "The fact that these sediments were at the equator at 2.45 billion years ago comes from the paleomagnetic data from associated igneous rocks," Chamberlain says.

<http://bit.ly/2lti88B>

Flies are spreading antibiotic resistance from farms to people

Flies seem to be spreading bacterial resistance genes

By Debora MacKenzie

It is now the year of the chicken in China – in more ways than we knew. The first systematic study of bacterial resistance to last-resort antibiotics on farms and hospitals in China has revealed far more resistance than standard tests had previously suggested, especially on chicken farms and meat. Worse, the study reveals for the first time that the genes that give bacteria their resistance are being spread by flies.

Antibiotics of last resort constitute our final weapons against bacterial infections that have resisted all other drugs. Carbapenems are often used as such drugs, but bacteria with genes for resisting carbapenems are spreading.

When carbapenems fail, one of the few options left is the antibiotic colistin, but in 2015, colistin resistance was discovered in China. The genes for both types of resistance can spread between different types of bacteria.

The colistin resistance gene, *mcr-1*, has now been found in 25 countries, on four continents. It was first detected in China, though it

is not known if it evolved there. It could well have, however: unlike in western countries, in China colistin is not used as an antibiotic in people, but 8000 tonnes of the drug is given to animals as a growth promoter every year, mainly to pigs and chickens.

In April, this practice will be banned in China, and colistin will begin to be used to treat people instead. But it may be too late.

Carried by flies

In a systematic search for colistin and carbapenem resistance in several regions of China, Tim Walsh at Cardiff University, UK and colleagues found colistin resistance in around one per cent of hospital patients in two large cities – even though the drug has not been used to treat people there. Their results were published last week ([The Lancet, 10.1016/S1473-3099\(16\)30527-8](http://www.thelancet.com/journal/2016/S1473-3099(16)30527-8)).

Now we know that the resistance genes probably came from a farm. In a related study, published today, the same team reports that a third of the *Escherichia coli* bacteria sampled from chicken farms and meat in grocery stores resisted carbapenems, and a quarter of those also resisted colistin.

What's more, the genes have wings. The team found high rates of bacteria with colistin and carbapenem resistance genes in dog faeces from chicken farms, and in the flies at these farms. This is the first time such a result has been reported, and suggests that flies could be spreading resistance from farm animals.

"Their ability to contaminate the environment has immense public health concerns," the team concludes. It may be why hospital patients who lived far away from farms were not less likely to have a resistant infection during summer, says Walsh. "In the summer flies will carry those bacteria everywhere."

Spread by swallows

Unexpectedly, when the team sequenced the entire genomes of the bacteria, far more turned out to be silently carrying those resistance genes than actively using them. Nearly all the bacteria sampled on chicken farms had *mcr-1*, though only half resisted colistin. This

means the potential for antibiotic resistance is likely vastly underestimated by standard tests.

The team concluded that the DNA sequences of bacteria from chicken farms, slaughterhouses, supermarkets and people were so similar that colistin and carbapenem resistance must have spread first in the poultry sector and then to people. It's compelling evidence, to add to previous studies, that antibiotic resistance in agriculture affects people, says Lance Price at George Washington University, Washington D.C., who has found resistant bacteria on supermarket meat in the US.

"It worries me that Chinese officials are going to start using colistin in human medicine," says Price, saying that this could cause an explosion of human infections that are already silently carrying *mcr-1* from chickens.

The problem could spread. Walsh's team also found resistant bacteria in faeces from swallows on farms in China. These birds will likely carry this resistance with them as they migrate to southeast Asia. Walsh fears that, when antibiotic manufacturers can no longer sell tonnes of colistin to farmers in China, they will export it countries like Vietnam and Thailand, laying the foundations for an explosion in resistance there too.

Journal reference: *Nature Microbiology*, DOI: 10.1038/nmicrobiol.2016.260

<http://bit.ly/2kYuqW9>

How Plants Evolved into Carnivores

Distantly-related plants acquired their ability to eat meat through similar genetic changes

Any insect unlucky enough to land on the mouth-like leaves of an Australian pitcher plant will meet a grisly end. The plant's prey is drawn into a vessel-like 'pitcher' organ where a specialized cocktail of enzymes digests the victim.

Now, by studying the pitcher plant's genome—and comparing its insect-eating fluids to those of other carnivorous plants—researchers have found that meat-eating plants the world over have hit on the

same deadly molecular recipe, even though they are separated by millions of years of evolution.

"We're really looking at a classic case of convergent evolution," says Victor Albert, a plant-genome scientist at the University of Buffalo, New York, who co-led the study, published in *Nature Ecology and Evolution* on February 6.



Carnivorous plants the world over, including the Australian pitcher plant (pictured), co-opted proteins used in defense to digest their prey. Auscape Getty Images

Carnivorous plants occur across the flowering-plant family tree. The Australian pitcher plant (*Cephalotus follicularis*)—native to a sliver of coastline in Southwest Australia—is closer kin to the starfruit (*Averrhoa carambola*) than to other species of pitcher plants found in the Americas and southeast Asia. This suggests that carnivory has evolved repeatedly in plants, probably to cope with the nutrient-scarce soils in which they grow, Albert says. "What they're trying to do is capture nitrogen and phosphorus from their prey."

Deadly recipe

Australian pitcher plants produce deadly 'pitcher' leaves—which resemble a toothy grin—as well as flat leaves. After sequencing the species' genome, Albert's team identified genes that are activated differently between the pitcher-like leaves and the plant's other, non-carnivorous, leaves. These included genes involved in making starches and sugars that may help to produce the nectar that lures insects to their deaths, as well as genes encoding waxy substances that may make it hard to escape from the pitcher.

To determine how pitchers eat their prey, the researchers sampled the digestive cocktail from *Cephalotus* and several other unrelated carnivorous plants and identified a total of 35 proteins, using mass spectrometry. Many of the proteins are related to those that other

flowering plants use to fend off pathogens. For instance, plants typically produce enzymes that break down a polymer called chitin as a defence against fungi, which make their cell walls out of the chemical. But Albert suspects that Australian pitchers and other carnivorous plants have repurposed the enzyme to digest insect exoskeletons, which are also made of chitin.

In the new analysis, Albert and his colleagues also found that in distantly related carnivorous plants, including species of pitcher plants, the genes deployed to make the digestive-fluid proteins have a common evolutionary origin. What's more, some of these genes have independently evolved to change the shape of the enzymes they encode in similar ways in the different species. The researchers don't have proof yet, but they think that the mutations might help to stabilize the enzymes when they are present together in digestive fluid. While researchers already appreciated the importance of convergent evolution for carnivorous plants, says Aaron Ellison, an ecologist at Harvard Forest in Petersham, Massachusetts, the new study is important because it demonstrates how this convergence can occur down to the molecular level, he says.

Gaining the ability to eat an insect is of little use if a plant cannot first entrap one, and here evolution has come up with more diverse solutions, Albert notes. Venus fly-traps ensnare their prey, whereas bladderworts immobilize their victims using tiny suction cups. In his 1875 book *Insectivorous Plants*, Charles Darwin included detailed drawings of the tentacles that sundews use to pin insects to their leaves. "It's no wonder Darwin wrote an entire book on carnivorous plants," Albert says.

<http://wb.md/2ly6K7i>

2017 Child Vaccine Schedule: Goodbyes and Hellos

Changes with 2017 child and adolescent immunization schedule

William T. Basco, Jr., MD, MS |February 06, 2017

The [2017 child and adolescent immunization schedule](#), a joint statement by the Advisory Committee on Immunization Practices

(ACIP) of the US Centers for Disease Control and Prevention (CDC), the American Academy of Pediatrics, the American Academy of Family Physicians, and the American College of Obstetricians and Gynecologists, was published on February 6, 2017. As usual, there are some new things in the schedule this year ("hellos"), things leaving the schedule this year ("goodbyes"), and things that fall somewhere in between.

The Biggest Changes: Goodbyes

LAIV. Say [goodbye to live attenuated influenza vaccine \(LAIV\)](#). Most pediatric providers have already heard of this recommendation and all of the hubbub that went along with it, but the updated recommendations formally remove LAIV from the recommended schedule. This was actually announced in June 2016, so practitioners have heard about this.

Three-dose HPV vaccine. Say goodbye to a three-dose human papillomavirus (HPV) series. Again, most pediatric providers have likely heard that [new recommendations are for a two-dose series for any individual who begins the series before turning 15 years old](#). This recommendation came about on the basis of a comparison of antibody responses among patients who received two- versus three-dose regimens and the field data on infections after two- versus three-dose regimens.^[1] The two doses of vaccine should be given 6-12 months apart. Current recommendations are to vaccinate any female under 26 years of age and any male under 21 years. Any individual who starts the series after turning 15 should continue with the previous three-dose series, as should individuals who might be considered immunocompromised.

Products off the market. Say goodbye to products that are now off the market. All 7-valent pneumococcal conjugate vaccine (PCV-7) vaccines have expired and are no longer part of any recommended schedule. All subjects should now receive PCV-13 vaccines.

Goodbye also to divalent and quadrivalent HPV vaccines. Beginning in [May 2017, when the last doses of quadrivalent HPV vaccine have](#)

[expired](#), the only HPV vaccine available in the United States will be the 9-valent formulation.

The Biggest Changes: Hellos

Two-dose HPV vaccine. Say hello to a recommendation that one may begin the two-dose HPV series at age 9 years. The recommendation is to begin the series at that age in any child who is a victim of sexual abuse or assault. In fact, those who receive it at age 9 appear to have a more robust immune response. In the same vein, giving the two-dose series 12 months apart appears to provoke a better immune response than giving it at 6 months apart, but any time 6-12 months after the initial vaccine is acceptable.

Hepatitis B vaccine. Say hello to a new recommendation that the hepatitis B vaccine should be administered to newborns during the first 24 hours after birth. This represents a more stringent recommendation to get the vaccine in early.

Tdap in pregnancy. Say hello to a clear recommendation that [every pregnant adolescent should receive one dose of tetanus-diphtheria-acellular pertussis vaccine \(Tdap\)](#), ideally administered between 27 and 36 weeks of gestation. This should really be repeated for each pregnancy, consistent with recommendations for older mothers.

The Biggest Changes: Things in Between

MenB Vaccine. Unchanged is a discretionary recommendation regarding administration of meningococcal serogroup B vaccine (MenB). This vaccine is available to be administered for individuals 16-23 years of age but at a discretionary agreement between the provider and the patient.

Online charts. [Online charts](#) have been slightly updated. Colored bars indicate the level of recommendation for different vaccines. Yellow bars indicate the ranges of recommended vaccines for all children, while green bars indicate ranges of recommended ages for catch-up vaccines, and purple bars indicate recommended age ranges for vaccines indicated only for high-risk groups. Blue bars indicate

vaccines that may be given to non-high-risk groups at patient/provider discretion.

Figure 2 is the catch-up tool to help providers with certain vaccines that have different catch-up schedules depending on the age of the subject. For many of the vaccines, such as *Haemophilus influenzae* type b, pneumococcus, and pertussis, the number of vaccines needed varies depending on the age of the recipient.

There is a new table (Figure 3) that gives various recommendations for people 0-18 years old with specific medical conditions. For example, this table now gives guidance on which vaccines to consider during pregnancy and which vaccines should be recommended for children with immunocompromising conditions (eg, cochlear implants) or other potential chronic medical conditions associated with immune alteration.

As a reminder, the CDC site contains many helpful visual aids, including those suitable to print and hang in the office, as well as parent-friendly vaccine reminder schedules in several languages.

References

1. Dobson SR, McNeil S, Dionne M, et al. Immunogenicity of 2 doses of HPV vaccine in younger adolescents vs 3 doses in young women: a randomized clinical trial. *JAMA*. 2013;309:1793-1802. [Abstract](#)

<http://bit.ly/2keNrPl>

Immigration and crime: What does the research say?

What does research say about how immigration impacts crime in U.S. communities? We turned to our experts for answers.

Editor's note: In his first week in office, President Donald Trump showed he intends to follow through on his immigration promises. A major focus of his campaign was on removing immigrants who, he said, were increasing crime in American communities.

In his [acceptance speech](#) at the Republican National Convention, Trump named victims who were reportedly killed by undocumented immigrants and said:

“They are being released by the tens of thousands into our communities with no regard for the impact on public safety or resources...We are going to build a great border wall to stop illegal immigration, to stop the

gangs and the violence, and to stop the drugs from pouring into our communities.”

Now as president, he has signed executive orders that [restrict entry](#) of immigrants from seven countries into the U.S. and authorize the construction of [a wall](#) along the U.S. border with Mexico. He also signed an order to [prioritize](#) the removal of “criminal aliens” and withhold federal funding from “sanctuary cities.”

But, what does research say about how immigration impacts crime in U.S. communities? We turned to our experts for answers.

Across 200 metropolitan areas

Robert Adelman, University at Buffalo, and Lesley Reid, University of Alabama

Research has shown virtually no support for the enduring assumption that increases in immigration are associated with increases in crime.

Immigration-crime research over the past 20 years has widely corroborated the conclusions of a number of early 20th-century presidential [commissions](#) that found no backing for the immigration-crime connection. Although there are always individual exceptions, the literature demonstrates that immigrants commit [fewer crimes](#), on average, than native-born Americans.

Also, large cities with substantial immigrant populations have [lower crime rates](#), on average, than those with minimal immigrant populations.

In a [paper](#) published this year in the Journal of Ethnicity in Criminal Justice, we, along with our colleagues Gail Markle, Saskia Weiss and Charles Jaret, investigated the immigration-crime relationship.

We analyzed census data spanning four decades from 1970 to 2010 for 200 randomly selected metropolitan areas, which include center cities and surrounding suburbs. Examining data over time allowed us to assess whether the relationship between immigration and crime changed with the broader U.S. economy and the origin and number of immigrants.

The most striking finding from our research is that for murder, robbery, burglary and larceny, as immigration increased, crime decreased, on average, in American metropolitan areas. The only crime that immigration had no impact on was aggravated assault. These associations are strong and stable evidence that immigration does not cause crime to increase in U.S. metropolitan areas, and may even help reduce it.

There are a number of ideas among scholars that explain why more immigration leads to less crime. The most common [explanation](#) is that immigration reduces levels of crime by revitalizing urban neighborhoods, creating vibrant communities and generating economic growth.

Across 20 years of data

Charis E. Kubrin, University of California, Irvine, and Graham Ousey, College of William and Mary

For the last decade, we have been studying how immigration to an area impacts crime.

Across [our studies](#), one finding remains clear: Cities and neighborhoods with greater concentrations of immigrants have lower rates of crime and violence, all else being equal.

Our research also points to the importance of city context for understanding the immigration-crime relationship. In [one study](#), for example, we found that cities with historically high immigration levels are especially likely to enjoy reduced crime rates as a result of their immigrant populations.

Findings from our most recent study, forthcoming in the inaugural issue of The Annual Review of Criminology, only strengthen these conclusions.

We conducted a meta-analysis, meaning we systematically evaluated available research on the immigration-crime relationship in neighborhoods, cities and metropolitan areas across the U.S. We examined findings from more than 50 studies published between 1994

and 2014, including studies conducted by our copanelists, Adelman and Reid.

Our analysis of the literature reveals that immigration has a weak crime-suppressing effect. In other words, more immigration equals less crime.

There were some individual studies that found that with an increase in immigration, there was an increase in crime. However, there were 2.5 times as many findings that showed immigration was actually correlated with less crime. And, the most common finding was that immigration had no impact on crime.

The upshot? We find no evidence to indicate that immigration leads to more crime and it may, in fact, suppress it.

<http://bbc.in/2kvdOla>

Do you have an underactive thyroid?

Hypothyroidism - or an underactive thyroid - affects one in 70 women and one in 1,000 men according to the NHS. But it can be a tricky disease to diagnose and treat. Dr Michael Mosley, of Trust Me I'm a Doctor, asks if sufferers are slipping through the net.

By Dr Michael Mosley BBC

Someone emailed me the other day to ask me if I had ever considered the possibility that I might have hypothyroidism; an underactive thyroid. The reason he contacted me is because he had seen me on television and noticed that I have quite faint eyebrows, which can be a sign of this disorder.

I have none of the other symptoms such as weight gain, tiredness and feeling the cold easily, so I've decided not to go and get myself tested. But if you do - and you think you could you have it - what should you do about it?

To get some answers I've been talking to Dr Anthony Toft, who is a former president of the British Thyroid Association.

He tells me that the thyroid gland is a bit like the accelerator pedal on your car. It produces hormones which help control the energy balance in your body. If it's underactive, then your metabolic rate will be

slower than it should be. This means that you are likely to put on weight. Other symptoms can include feeling too cold or too hot, lacking in energy, being constipated, low mood, poor attention or "brain fog".

The main hormones involved are thyroid stimulating hormone (TSH), T4 and T3. TSH is released by the pituitary gland and tells your thyroid to get going.

In response your thyroid should release the hormones T4 and T3. T4 is converted in your body into T3, the active hormone that revs up your cells.

If you have symptoms of hypothyroidism then your GP will probably test your blood. The signs they're looking for are high levels of TSH, together with low levels of T4.

If your TSH is higher than normal this suggests that the gland that produces this hormone - the pituitary gland - is working hard to tell the thyroid gland to produce more hormone, but for some reason the thyroid gland is not listening. The pituitary then ups its game and produces more and more TSH, but T4 levels stay low.

So if you have a high TSH coupled with a low T4, it's likely that the body is saying "I need more thyroid hormone!" but the thyroid gland isn't doing what it's being told. The result is hypothyroidism.

When this happens patients are often prescribed levothyroxine (T4). Symptoms diminish and patients are happy.

So if it's so straightforward, why are there so many forums full of dissatisfied patients? Why do we at Trust Me get so many emails about this subject?

One of the issues with the blood tests is that there are no standard international reference ranges. In the UK, for example, we set the bar rather higher than many other countries. Certainly Dr Toft thinks that current UK guidelines are sometimes interpreted too rigidly.

"If the T4 is right down at the lower limit of normal," he says, "and the TSH is at the upper limit of normal, then that is suspicious. It doesn't often arouse suspicion in GPs, but it should."

He is also concerned that when a GP does diagnose an underactive thyroid, then patients are almost always prescribed a synthetic version of T4.

This works most of the time but in some cases the symptoms don't improve. This might be because with some patients the problem is not an underactive thyroid, but the fact that they can't convert enough T4 into the active hormone T3.

One way round this is to take T3 hormone in tablet form, but here price is a problem. "The cost of T3 has escalated incredibly," says Dr Toft. "It's now about £300 for two months' supply of T3, whereas it costs pennies to make."

So if you have been put on T4 and it doesn't work, what about asking for a trial of T3? Because it is so expensive your GP may well say no. So instead some patients are going online and buying T3 from foreign websites. But it's important that if you are taking T3 you are being properly monitored, because it can cause serious side effects, including heart problems.

A slightly less expensive hormone supplement taken from the glands of cows and pigs is available. It contains both the T3 and T4 hormones, and there is a growing call to prescribe it for patients who don't respond to T4 alone. So does Dr Toft think patients should be offered this combination?

"I suspect that in time that's what will happen," he says. "The trouble is the evidence base is not as strong as we would wish it to be, and I suspect it will be a long time before we have sufficient evidence."

Dealing with thyroid problems can be complicated. If you've had a blood test and the results have come back normal, then you can ask to look at the actual numbers. But you may also have to accept that medication is not for you and lifestyle changes may be more appropriate.

<http://bit.ly/2lyxzZ0>

Humans are driving a new burst of evolution including possibly our own

Did you know that humans are now responsible for an explosive new shift in evolution

Darren Curnoe ¹

The unprecedented impact that humans are having on the planet is well known to us all. Scarcely a day passes by without a media report or two on the effects of human economic activity on the world's climate or some charismatic species under threat because of illegal wildlife trade or logging.

Our impact on the planet is so profound in fact that some scientists are urging that our period in history be dubbed the 'Anthropocene', owing to the fact that humans have become the dominant influence on the planet, discernible even in the geological record.

But did you know that humans are now responsible for an explosive new shift in evolution? That the changes we are making to the planet have become so profound that we seemingly hold the evolutionary fate of millions of species in our hands?

Just what are these changes that are so profoundly shaping evolution? Pollution, eutrophication, urbanisation, land clearance, habitat fragmentation, global climate change, over-hunting/fishing, invasion by exotic species, domestication, emerging new diseases and disappearing old ones, to name just a few.

Many (probably all) of them are having evolutionary effects. Impacts that can be measured today, on contemporary timescales. Some of them are playing out on a global scale - such as anthropogenic climate change - while others are more local - including pollution and growing urbanisation.

Just how rapidly and profoundly our modern lifestyle and economic systems are shaping evolution is outlined in a series of scientific studies published just last month. New research by Marina Albert and her team published in PNAS and a set of articles just published in

Philosophical Transactions of the Royal Society B leave little room for doubt that humans are responsible for a new and rapid burst of evolutionary change.

A few examples will help to illustrate the point.

It's well known among biologists that commercial fishing has had a profound impact on wild fish species. By targeting large animals, as commercial fisheries have typically done, some species have become smaller and an increasing proportion have reached maturity at a younger age and smaller size.

In urban areas, where human impact is most obvious, many studies have shown that plants and animals, native and introduced, are evolving in response to human transformation of the environment.

A famous example is so-called 'industrial melanism'. It led to a dramatic drop in the numbers of light-coloured peppered moths in England during the 1800s when industrialisation led to pollution covering tree trunks, camouflaging dark-coloured individuals from bird predators. But when the pollution was finally cleaned up in the 1970s the situation reversed and dark-coloured moths began to be preyed upon in ever increasing numbers shifting the population accordingly.

Other documented changes include shifts in the colouration of feathers in bird populations living in urbanised areas, resistance to severe pollution of waterways by fish, and weeds growing in paved areas ceasing to disperse their seeds.

But antibiotic resistance stands as one of the clearest examples we have of evolution in action among contemporary species. It's clearly also bad news for human health and our attempts to control infectious disease, with the race to discover new kinds of antibiotics to combat widespread microbial resistance faltering.

What about humans then? Perhaps most surprising is that these impacts will very likely alter the course of our evolution as well. We are still evolving after all, and in sometimes surprising ways. And

what affects other species affects us too, as we can't possibly escape the profound environmental changes underway at present.

We can find dramatic examples of human evolution in the past, and they have chilling parallels with the present. The best one is the development of agriculture between 10,000 and 5,000 years ago. It happened in at least nine different places, independently, and was in most cases associated with major environmental, social and economic changes.

It led to large-scale human migrations, the rapid spread and homogenisation of languages and culture, and major changes in technology. There were major shifts in human settlement patterns, lifestyles and social conditions, with people occupying smaller areas of land, living in higher densities, becoming much more sedentary, and for the first time, urbanised.

There was a major shift in the human diet including a huge reduction in the diversity of foods consumed. Dramatic increases in population growth occurred with an explosion in numbers, setting us on track for today's growth.

And a major epidemiological transition happened whereby modern 'textbook' infectious diseases emerged, the result of crowded and unsanitary conditions, handling of domesticated animals, and pest species attracted to human settlements; dramatically shifting the number and kinds of pathogens experienced.

Any of this sound familiar? It should. Almost all of these changes are happening today, and at a much faster rate than ever before. Only this time round there are more than 7 billion of us, we are rapidly becoming a highly urbanised species, and our environmental impact is now global.

The signatures of these profound changes can be seen today in the human genome, with more than 86% of present day disease causing genes in living Europeans and African Americans arising as a result of changes accompanying the prehistoric shift to agriculture.

And we need to remember that most people in the world today don't enjoy the benefits of modern medical care, so are subject to more intense natural selection than people from wealthier nations.

For the first time in our history as a species we need, and have the capacity to, think about the future. To draw on our collective past, and understand and plan for how our actions today are setting in place a chain of events that will shape our evolution for hundreds or even thousands of years to come.

We need to be urging policy makers to start thinking about the future of human health and well-being over a multi-generational timescale, not just the present electoral cycle. The future may well depend on it.

¹ Chief Investigator and Co-Leader of Education and Engagement Program ARC Centre of Excellence for Australian Biodiversity and Heritage, and Director, Palaeontology, Geobiology and Earth Archives Research Centre, UNSW

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<http://bit.ly/2kYzucX>

Dirty Doctors Finished What an Assassin's Bullet Started

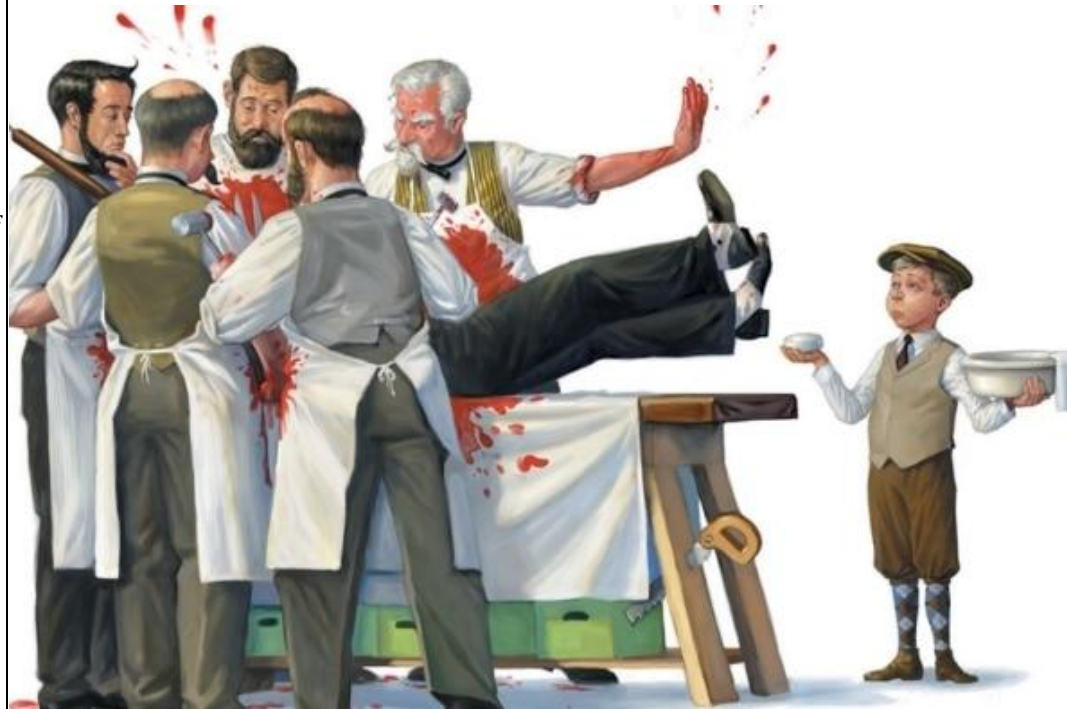
Disregarding new scientific information can be deadly

By Steve Mirsky | Scientific American February 2017 Issue

On July 2, 1881, Charles Guiteau shot President James Garfield in the back. On September 19, 1881, Garfield died, with a bullet still lodged in fatty tissue behind his pancreas. At his trial, Guiteau denied killing the president. "Garfield died from malpractice," the gunman said. His point was made incredibly moot when he was executed by hanging. But he'd made a decent argument.

Historian David Oshinsky discusses Garfield's medical care in his fascinating new book *Bellevue: Three Centuries of Medicine and Mayhem at America's Most Storied Hospital*: "Had the responding physicians ... done nothing more than make Garfield comfortable," Oshinsky writes, "he almost certainly would have survived. Instead they searched clumsily for the bullet, inserting unwashed fingers and filthy probes into the open wound."

Two days after the shooting, experts, including Frank Hamilton, a surgeon in his late 60s from Bellevue, examined the president, "without pausing to wash their hands or clean their instruments," Oshinsky notes. Hamilton's age was a factor, with the old guard less receptive to newfangled ideas about handwashing and instrument cleaning.



Matt Collins

As fellow Bellevue veteran Alfred Loomis put it at the time, according to Oshinsky, "The [germ] theory, which so recently has occupied medical men, especially in Germany, is rapidly being disproved, and consequently is rapidly being abandoned." Loomis, respected enough to also serve as president of the New York Academy of Medicine, mockingly told an audience of his fellow physicians, "People say there are bacteria in the air, but I cannot see them."

Of course, bacteria don't care if you believe in them. Infections caused Garfield to lose almost 100 pounds between the shooting and his death,

and his autopsy showed that a good part of what was left of him was pus. Adding insult to literal injury, Hamilton sent Congress a bill for what we'll call his services in the sum of \$25,000—equivalent to about \$600,000 today. Congress approved a \$5,000 payment, which is still about \$120,000 in modern money for not washing your hands.

The Garfield section of Oshinsky's book (as much a history of New York City and of American medicine as it is of Bellevue) made me think of the subject considered in this space last month. That write-up dealt with the revolution in the statistical analysis of baseball. But the larger issue was, if I may quote myself, "information availability and decision making in baseball as a microcosm of the larger problem that a wide array of human enterprises face: insisting on remaining stupid when becoming smarter is an option."

Which, speaking of Congress, brings us to the House of Representatives Committee on Science, Space, and Technology. On December 1 the committee's Twitter account announced that global temperatures were in fact plummeting and that what they called "climate alarmists" had clammed up (perhaps in their rapidly acidifying ocean habitat).

The committee's source for this welcome info was Breitbart News. If you were lucky enough to spend the 2016 presidential election campaign in a medically induced coma, Breitbart regularly produces the other stuff that comes out of a cow's backside besides the greenhouse gas methane.

The committee chair, Representative Lamar Smith of Texas, has harassed legitimate climate scientists and does not buy global climate change. He easily could buy it, given that the fossil-fuel industry has given him more than \$600,000. That's not just dirty money—it's full of soot.

According to Oshinsky, Loomis finally accepted germ theory when Robert Koch showed that the tuberculosis bacterium was indeed visible, if you used a microscope. Climate change is also obvious if you use worldwide surveillance, including that recorded by NASA

satellites. But as I write these words, the new presidential administration is planning to do away with NASA's Earth observation mission because—why?—it's become political. (Don't think about that reasoning too much, or the smoke coming from your ears will further contribute to the greenhouse effect.)

This move is like Loomis gouging his eyes out rather than seeing through the microscope. And we insist on staying stupid when becoming smarter is an option.

<http://bbc.in/2kvqYif>

Orangutan squeaks reveal language evolution, says study
Scientists who spent years listening to the communication calls of one of our closest ape relatives say their eavesdropping has shed light on the origin of human language.

Dr Adriano Reis e Lameira from Durham University recorded and analysed almost 5,000 orangutan "kiss squeaks". He found that the animals combined these purse-lipped, "consonant-like" calls to convey different messages. This could be a glimpse of how our ancestors formed the earliest words. The findings are published in the journal Nature Human Behaviour.

"Human language is extraordinarily advanced and complex - we can pretty much transmit any information we want into sound," said Dr Reis e Lameira. "So we tend to think that maybe words evolved from some rudimentary precursor to transmit more complex messages.

"We were basically using the orangutan vocal behaviour as a time machine - back to a time when our ancestors were using what would become [those precursors] of consonants and vowels."

The team studied kiss squeaks in particular because, like many consonants - the /t/, /p/, /k/ sounds - they depend on the action of the lips, tongue and jaw rather than the voice.

"Kiss squeaks do not involve vocal fold action, so they're acoustically and articulatory consonant-like," explained Dr Reis e Lameira.

In comparison to research into vowel-like primate calls, the scientists explained, the study of consonants in the evolution of language has

been more difficult. But as Prof Serge Wich from Liverpool John Moores University, a lead author in the study, said, they are crucial "building blocks" in the evolution of language. "Most human languages have a lot more consonants than vowels," said Prof Wich. "And if we have more building blocks, we have more combinations." The scientists recorded and analysed 4,486 kiss-squeaks collected from 48 animals in four wild populations.

With thousands of hours of listening as the apes communicated, the researchers found that the animals embedded several different bits of information in their squeaks.

The team compared this to how we might use more than one word to convey the same meaning - saying "car" but also "automobile" and "vehicle." "They seemed to make doubly sure that the message was received, so they would send the same message with different [kiss squeak combination] signals,"

The scientists say their study suggests that, rather than a concerted effort to form complex words, it might have been this "redundancy" - forming different sounds that had the same meaning, in order to reinforce a message - that drove early language evolution.

Dr Reis e Lameira added: "It's a way of making sure you don't end up in a game of Chinese whispers."

<http://bit.ly/2ICjmue>

Magnetic meteorites narrow down solar system's birthdate

They grow up so fast. A new limit on how long the early solar system was full of dust and gas gives us clues about how and when the sun and planets grew and evolved.

By Leah Crane

Some 4.56 billion years ago, our solar system consisted of a baby sun engulfed in its solar nebula – a disc-shaped cloud of dust and gas that fed the early sun and planets.

The nebula also created a strong magnetic field, which was crucial to the solar system's early development. Such fields drive the growth of

stars, create turbulence in dust and gas, and mediate the formation of planets. Gaining information about the magnetic field in our early solar system can teach us about how everything was transformed into what we see now.

One way we can learn about this is by examining meteorites that formed there. When a hot magnetic rock is exposed to a magnetic field, the electrons in that rock align like tiny compasses. As the rock cools, the orientations of those electrons are preserved in stone.

Ben Weiss at the Massachusetts Institute of Technology and his colleagues examined three meteorites that cooled about 3.8 million years after the sun began to form, locking in information about the solar system's magnetic field at that time.

"It's amazing that something so old – there's no rock on Earth that old – can preserve information about the birth of the solar system," says Weiss. "They're just this amazingly well-preserved time capsule."

The researchers then compared the strength of the magnetic field recorded in the rocks to those of meteorites that formed a few million years earlier, which members of the same team had studied in 2014.

The younger meteorites experienced a much smaller magnetic field than the older rocks. Because the solar nebula drove the magnetic field, its lower strength in the younger rocks means the planet-supporting nebula must have dissipated by the time the younger meteorites cooled.

Forming and shifting

Previous constraints established from observations of other stars suggested that such gas clouds have lifetimes ranging from 1 to 10 million years, leaving room for a wide variety of solar system evolution.

In our solar system, the new result indicates that many things were set by 3.8 million years in. Without sustenance from the solar nebula, the growth of the sun and its large gas planets would have slowed or stopped.

Establishing more precise constraints on when the giant planets formed allows us to get a more detailed picture of how the solar

system formed. The most popular idea is called core accretion, in which small rocks crashed into each other until they built a big enough solid core to hold on to their thick gaseous atmospheres. This process takes longer than some other methods, but 3.8 million years might just be enough.

The findings also suggest a timeline for the planets' movements around the solar system. A theory called the "grand tack" suggests that some of the gas planets migrated closer to the sun and then back out again before reaching their current orbits. This must have happened within the first 3.8 million years, because after that they could no longer interact with the cloud that aided those movements.

"This is a nice new constraint, with some quite wide-ranging implications for how things formed early on in our solar system," says Richard Harrison at the University of Cambridge.

But Weiss says we have still only scratched the surface. "Right now, we have just the barest sketch of what the gas and magnetic field distributions were like in space and time in the early solar system," says Weiss. He hopes that space missions to chip samples off asteroids, such as the OSIRIS-REx and Hayabusa 2 missions that are already en route, will give us a more complete picture.

Journal reference: Science, DOI: 10.1126/science.aaf5043

<http://bit.ly/2kGngq9>

Allow some people to continue to self-injure as part of harm minimization, says researcher

Some people in mental health units should be allowed to continue to injure themselves as part of a harm reduction regime

Some people in mental health units should be allowed to continue to injure themselves as part of a harm reduction regime, says a researcher with experience of mental health care in the *Journal of Medical Ethics*. For those who are not in immediate danger, such an approach is likely to be less confrontational and distressing, more respectful of their autonomy, and potentially less harmful than the standard methods of

dealing with this type of behaviour, argues PhD student Patrick Sullivan, of the Centre for Social Ethics and Policy, University of Manchester.

Harm minimisation is widely used in public health interventions, such as substance misuse. It aims to curb the potentially harmful consequences of engaging in high risk behaviours by providing an alternative to abstinence, in recognition that this may be the best possible outcome.

Critics claim that it sends out mixed messages, fails to get people to kick their addictions, and is not necessarily the most cost effective option.

However, Sullivan argues that the high rates of self-injury among people admitted to mental health units suggest that the standard method of dealing with this behaviour--forcibly stopping that person from doing it--doesn't seem to work.

"There is a strong moral reason to consider alternatives, and harm minimisation provides an alternative to traditional ways of working," he writes. "Although evidence is weak or not available, proponents suggest it is a more realistic and pragmatic response to a complex health and social issue."

It could include provision of sterile cutting implements, education on how to self-injure more safely to avoid blood poisoning (sepsis) and infection, as well as therapy to help individuals understand what underpins their behaviour, develop alternative coping strategies, and deal with crises without resorting to self-injury, he suggests.

In support of his argument, he says that focusing on restriction could actually make the problem worse: many of those who injure themselves have a history of abuse or trauma, and stopping them from doing it could intensify their feelings of powerlessness.

"This increases the risk that individuals will self-injure covertly, in more dangerous ways, or attempt suicide," he contends, citing anecdotal evidence indicating the increasing use of other forms of

self-injury, such as ligatures, among those in mental health units who prefer to cut their skin.

"In some cases this can be fatal. This occurs in spite of high levels of observation," he warns.

People who self-injure do so because the negative feelings they experience threaten to overwhelm them: injury reduces tension and increases control, providing a coping mechanism, says Sullivan.

Infringements of this are likely to be seen as confrontational and distressing rather than therapeutic, he contends. Those who self-injure usually understand the nature and consequences of their actions, so denying them this freedom thwarts their autonomy.

"Where the risks of serious injury are low, limitations on basic freedoms are more difficult to justify," he suggests.

He emphasises that he is not advocating a blanket ban on restrictive measures: where a person's life is in immediate danger, these are, of course, justified, he insists. Nor is he advocating blanket permission for self-injury. Rather, it is about permitting a lesser harm to prevent a more serious one, he says.

He accepts that many organisations may struggle with the practical and legal implications of such an approach, while healthcare professionals may balk at the idea of tolerating harm in the context of a therapeutic relationship.

"However, it has been argued that healthcare professionals may sometimes have good reasons to allow harm, in fact, they routinely do so; allowing harm is not necessarily contrary to the professional's duty of care," he insists.

"Harm minimisation provides a means of working with an individual in a way that recognises their autonomy and accepts that they have a different way of coping with distress," he writes.

"By trying to prevent their injury, we harm them, we may fail to help them. I conclude that healthcare professionals sometimes have an obligation to allow harm."

In a linked blog, Sullivan reiterates: "Harm minimisation is not treatment in its own right, but an adjunct to [appropriate psychological therapy], and must be seen in this way." But he says: "No one who has listened to the stories of people who self-injure can fail to be concerned by the picture they paint of a system that just fails to understand."

In a linked commentary, Drs Hanna Pickard and Steve Pearce, of, respectively, the University of Birmingham, and Oxford Health NHS Foundation Trust, accept that supporting autonomy and independence among vulnerable people is "fundamental to good clinical practice."

But they point out that Sullivan doesn't distinguish between secure and non-secure units, and that allowing a patient to self-injure in the former would be unethical. But even in non-secure units, the approach would not only be impractical, but also clinically, ethically, and legally dubious, they suggest.

It could also be dangerous for patients as self-injury can be contagious, and extremely distressing for staff, particularly if the continued cutting unintentionally or deliberately resulted in life-changing injury or death. Furthermore, "sanctioning" such behaviour could reinforce the low self-esteem already associated with self-injury, they contend.

"Of all the various measures that could, in principle, be adopted to help [patients with a history of self-injury], the forms of harm minimisation that Sullivan advocates in inpatient settings do not strike us as the measures we ought to promote," they write.

"For self-injuring patients themselves--let alone when we factor in the potential impact on other patients and staff--the balance between costs and benefits of these forms of harm minimisation for self-injury does not tip in their favour," they conclude.

Clinical ethics paper: [Should healthcare professionals sometimes allow harm? The case of self-injury](#)

Blog: <http://blogs.bmj.com/medical-ethics/2017/02/07/harm-could-it-sometimes-be-a-good-thing>

Commentary: [Balancing costs and benefits: a clinical perspective does not support a harm minimisation approach for self-injury outside of community settings](#)

<http://bit.ly/2l33ZP7>

Potential breakthrough for treating hypertension with ultra low-dose combinations

A small but clinically important trial of a new ultra-low dose four-in-one pill to treat high blood pressure has produced remarkable results.

Every patient on the pilot trial conducted by The George Institute for Global Health saw their blood levels drop to normal levels in just four weeks.

Recognising the need to check whether trial results were "too good to be true", the researchers also completed a systematic review of past trials, including 36 trials with 47,500 patients testing single and dual quarter-dose therapy. This previous evidence also indicated little or no side effects with very low doses, and important benefits with three or four drug combinations.

Professor Clara Chow, of The George Institute, said the results published in The Lancet were exciting but larger trials were still needed to see if these high rates could be maintained and repeated.

Professor Chow, director of the Cardiovascular Division at The George Institute in Sydney, said: "Most people receive one medicine at a normal dose but that only controls blood pressure about half the time. In this small trial blood pressure control was achieved for everyone. Trials will now test whether this can be repeated and maintained long-term.

"Minimising side effects is important for long-term treatments - we didn't see any issues in this trial, as you would hope with very low dose therapy, but this is the area where more long-term research is most needed.

"We know that high blood pressure is a precursor to stroke, diabetes and heart attack. The need for even lower blood pressure levels has been widely accepted in the last few years. So this could be an incredibly important step in helping to reduce the burden of disease globally."

Hypertension or high blood pressure affects around 1.1 billion people worldwide.

Over four weeks 18 patients in Sydney were either given a quadpill -- a single capsule containing four of the most commonly used blood pressure-lowering drugs each at a quarter dose -- or a placebo. This was then repeated for a further four weeks with the patients swapping their course of treatment.

Blood pressure levels were measured hourly over a 24 hour period at the end of each treatment, allowing researchers to significantly reduce the amount of patients normally required in a clinical trial.

Key Findings

100 per cent of patients on trial saw their blood levels drop below 140 over 90. Just 33 per cent of patients on the placebo achieved this rate.

None of the patients experienced side effects commonly associated with hypertension lowering drugs, which can vary from swollen ankles to kidney abnormalities depending on the type of class of the drug.

Professor Chow said: "What makes these result every more exciting is that these four blood pressure medications are already in use. We are increasingly finding there are opportunities to treat many commons diseases hiding in plain sight. This ultimately means we will be able to deliver life changing medications much more quickly, and more affordably."

Researchers at The George Institute are just about to commence a much larger trial into the quadpill which has been funded by the NHMRC. For more information go to:

<http://www.georgeinstitute.org.au/projects/quartet-a-quadruple-ultra-low-dose-treatment-for-patients-with-hypertension>

<http://bit.ly/2lE2OTv>

Brain damage is not always damaging

Strokes are usually, but not always, debilitating. This case report documents the extraordinary resilience of a woman in Argentina who endured multiple strokes

Stroke is a type of lesion caused by reduced blood flow to the brain, which results in the death of some of the brain's neurons. Such lesions typically cause severe difficulties for the person who endures them.

We base this understanding on the "lesion method," which has shown that damage to particular parts of the brain harms specific cognitive functions that regulate everyday activities. Damage to multiple parts of the brain has been shown to be especially harmful.

It turns out that this is often but not always the case. In a recent paper, a team of researchers from INCYT, based in Argentina, describes a woman who remains remarkably functional after enduring first a hemorrhagic and then an ischemic stroke. These events combined to create multiple lesions, which damaged many areas on both the right and left hemispheres of her brain. Normally such disturbances would be deeply harmful. For the woman in question here, a 44-year old known as CG, these events had only mild impacts.

The research team verified CG's resilience in multiple ways. First they assessed her sense of smell, taste and emotional recognition (the ability to interpret emotions in other people's facial expressions) in comparison to a control group of women without brain lesions. Despite a reduced sense of smell, CG performed within a normal range on almost every respect. Additional comparisons showed that CG exhibited no impairments of attention, memory, language or social cognition skills (such as inferring the meaning of others' emotions and thoughts).

Two members of the research team also visited CG at her home, which is a more true-to-life setting than a somewhat artificial research lab environment. As her mother and a long-time friend confirmed that CG's functioning was normal, CG herself was an exemplary host who was highly attuned to everyone's needs. This revealed high cognitive functioning, almost as though her lesions had never occurred at all. Indeed, the only impacts that endured over time were her compromised sense of smell as well as a loss of sensitivity in CG's right hand.

Other people with brain lesions have also shown surprising resilience - for example, some people can maintain their language skills even after the left hemisphere of their brain is removed. In general these

cases involve lesions to a single brain region. CG's case is unique because she endured multiple lesions extended across the brain and yet maintained strong functioning. One possible cause for this is that her brain "re-wired" itself to maintain its former level of functioning, which often occurs in similar cases. This process involves "plastic changes" in the brain.

However, study authors Adolfo García and Agustín Ibáñez are not convinced that this occurred for CG, because re-wiring usually takes a long time. They note that "her cognitive repertoire was near-optimal shortly after her stroke, which rules out the possibility of slow-paced plastic changes coming in to compensate for missing functions."

In short, CG's experience is an enigma that reveals just how much we still have to learn about the way the brain works. As García and Ibáñez note, "We simply have no full-fledged theory to account for almost immediate neuroplastic changes in adulthood." That work continues. Meanwhile, "these reports open a small window of hope, suggesting that, though very exceptionally, some people can maintain high levels of functionality even after sustaining severe, extended brain damage."

<http://bit.ly/2kGwqty>

Malaria mosquitos sensitive to horseradish

Horseradish, mustard, cinnamon and wasabi have a similar effect to temperature in triggering pain associated with cold or heat

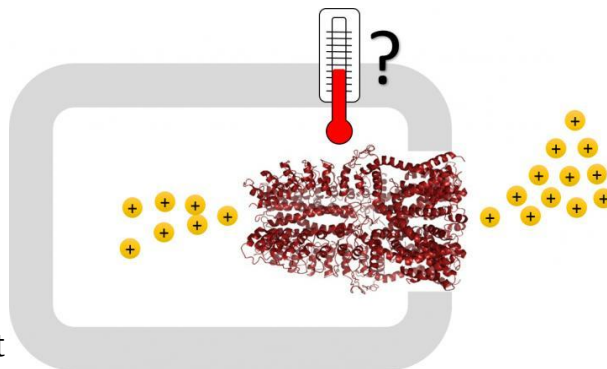
WATCH VIDEO STORY: <https://www.youtube.com/watch?v=qqlbTOVdF8s>

Researchers at Lund University in Sweden have taken an important step on the road to understanding the underlying mechanism of how and why animals can feel pain in connection with cold or heat. However, according to the study, temperature is just one triggering factor - horseradish, mustard, cinnamon and wasabi have a similar effect.

A few years ago, the research group produced a human receptor protein and tested it in an artificial cell membrane. Similar studies have now been conducted on a receptor of the malaria mosquito, and

the results are consistent. All the evidence suggest that the basic underlying mechanism of the temperature sensor function is the same in insects as in vertebrates.

The new study shows that the inherent ion channel in the mosquito receptor is activated by heat. It also shows that the first part of the receptor can be removed without destroying ion channel or the ability to react to temperature.



The dark red illustration shows the human counterpart to the temperature receptor of the malaria mosquito which has now been studied. The mechanism of how the flow of positive ions through the channel is controlled by the temperature is unclear, but the study shows that most of the part inside the cell is unnecessary. Sabeen Survery and Urban Johanson

So far, potential applications are relatively far off into the future. However, the researchers do know the areas in which the findings may be of significance:

"Different ways of preventing activation of the receptor protein may lead to new drugs and treatments for pain and itching. The substances that activate can instead be developed into effective treatments, designed to deter specific insects that carry various infectious agents", says Urban Johanson, professor at the Department of Chemistry.

In this new study, the researchers produced two versions of the pure protein: one complete protein and one without the first half. Subsequently, they inserted the protein into an artificial cell membrane and measured the flow through individual ion channels -- both at different temperatures, and after adding substances which can be found in, for instance, wasabi and cinnamon. Using spectroscopy, they were able to monitor the structural changes in the ion channel.

"There are similarities in the structural changes, regardless of whether the change is caused by heat or wasabi. The molecular mechanism of

how this happens is not yet clear, so we will now proceed with a more detailed study", says Urban Johanson.

<http://bit.ly/2lxzCAY>

New simple method quickly reveals kidney damage *Researchers from Aarhus University have developed a method for diagnosing kidney damage that is both quick and precise.*

Once the first patients are placed in the scanner, it will not take more than 45 minutes to make a diagnosis.

Researchers from Aarhus University have recently developed a new method for diagnosing kidney damage.

"If a patient is admitted with a suspected kidney injury, we can screen the injury using blood/urine with the help of an enzyme called fumarase, and then a scan can pinpoint where in the tissue the injury is," says one of the researchers behind the study, PhD student from the Department of Clinical Medicine at Aarhus University, Per Mose Nielsen.

The method is transferable to patients

An examination that does not take more than three-quarters of an hour. "The fumarase enzyme is released from cells when they are damaged from the outside. We found that the greater the renal injury, the higher the level of fumarase measured. This means that we can very quickly and precisely see which kidney is damaged. We can see the damage already after half an hour and for up to one week afterwards," says Per Mose Nielsen. Their findings have just been published in the journal Scientific Reports.

Until now, the method has only been tested on rats with acute renal damage, but the researchers expect the method to be transferable to patients very soon. "We are testing on patient blood and urine samples, but we have not yet begun to place patients in the scanner. At the moment, we are analysing blood samples taken from dialysis patients with varying degrees of renal damage. If this functions, then we can in principle move directly to clinical practice with fumarase measurements," explains Per Mose Nielsen

Partners: Technical University of Denmark (DTU)

Read the scientific article: <http://www.nature.com/articles/srep40812>

<http://bit.ly/2kWdDjU>

Antibiotic use for travelers' diarrhea favors particularly resistant super bacteria

About 1/3 of travellers return carrying antibiotic-resistant ESBL intestinal bacteria

Every year, millions of travellers visit countries with poor hygiene, and approximately one third of them return home carrying antibiotic-resistant ESBL intestinal bacteria. Most of them remain unaware of this, as the bacteria cause no symptoms. High-risk areas for contracting ESBL bacteria are South and South-East Asia, Africa and Latin America.

Diarrhoea is the most common health complaint for people who travel to poor regions of the world. Those contracting diarrhoea have an increased risk of ESBL acquisition, and if they choose to they treat it with antibiotics, the risk becomes multiplied. A Finnish study led by Professor Anu Kantele and published two years ago showed that among people travelling to high-risk areas, those contracting diarrhoea and taking antibiotics, up to 80% brought ESBL super bacteria home with them.

A follow-up study led by Professor Kantele has now established that antibiotics taken while abroad not only render the tourist susceptible to an ESBL infection, but also lead to the most resistant strains of these bacteria being selected.

"ESBL bacteria are resistant to penicillins and cephalosporins, which is why infections caused by them are treated with antibiotics from other groups, such as fluoroquinolones (e.g. ciprofloxacin). When we analysed the patients with ESBL more closely, we found that among those who had not resorted to using antibiotics, 37% had an ESBL strain resistant to fluoroquinolone. As for the travellers who had taken fluoroquinolone, 95% had a strain of ESBL resistant to fluoroquinolone and, indeed, a variety of other antibiotics. Antibiotic

use thus implies selecting ESBL strains with the broadest spectrum of resistance," Kantele explains.

"The finding makes sense. When we take an antibiotic, the bacteria that survive in our digestive system are those resistant to the treatment."

Antibiotic resistance can be transferred between bacteria through a package containing a variety of resistance genes, meaning that one package may contain resistance to several types of antibiotics. Indeed, most fluoroquinolone-resistant ESBL strains were also found resistant to certain other types of antibiotics the resistance to which is known to be transferred in the same gene packages that transfer ciprofloxacin resistance.

"In practice this means that travellers pick up the most resistant strains of ESBL, and we are left with dwindling treatment options for ESBL infections," states Kantele.

Antibiotic resistance is a serious threat

An ESBL infection rarely manifests through symptoms. Still, even a symptomless carrier can pass on the bacteria and, with ill luck, it can cause a severe, even life-threatening disease. Kantele emphasises that antibiotic resistance is one of the biggest threats to health care. If antibiotics lose their efficacy, many infectious diseases now treated successfully with antibiotics may become lethal again.

"The spread of resistant strains of bacteria makes the situation worse. Therefore, unnecessary use of antibiotics should be avoided also while travelling. Diarrhoea mostly remains mild or moderate, and no antibiotics are needed in such cases for healthy adults. They should just make sure to keep hydrated. And, if necessary, anti-motility medication can be taken in small amounts to alleviate the symptoms."

The study recently published in *Travel Medicine and Infectious Disease* recruited Finnish travellers visiting the Travel Clinic at Aava Medical Centre as research subjects. The subjects gave a stool sample both before travel and immediately upon return, and answered questionnaire forms. A total of 90 people, all of whom had contracted

an intestinal strain of ESBL bacteria while abroad, were selected to participate in the follow-up study. The susceptibility of the various strains to several different antibiotics was examined, and the results compared to such particulars as destination, age of traveller, travellers' diarrhoea, and antibiotic treatments used.

The study was carried out in cooperation between the University of Helsinki, the Helsinki University Hospital, the Karolinska Institutet and the Travel Clinic at Aava Medical Centre.

<http://bit.ly/2kyKiei>

Primitive plants survive almost two years in outer space
Primitive plants are the latest forms of Earth life to show they can survive in the harshness of space, and for many months.

By Andy Coghlan

Cold-loving algae from the Arctic Circle have joined the space-travelling club, alongside bacteria, lichens and even simple animals called tardigrades.

Preliminary studies of the algae after their return to Earth from the International Space Station lend some weight to the “panspermia” theory, that comets and meteorites could potentially deliver life to otherwise sterile planets. The results also provide insights into the potential for human colonies on distant planets to grow crops brought from Earth.

The algae were of the *Sphaerocystis* species, codenamed CCCryo 101-99, and were returned to Earth in June last year after spending 530 days on a panel outside the ISS. While space-borne, they withstood the vacuum, temperatures ranging from -20 °C at night to 47.2 °C during the day, plus perpetual ultraviolet radiation of a strength that would destroy most life on Earth if not filtered out by the atmosphere.

“I’m sure that plants of many kinds have been on the ISS before, but on the inside, not the outside,” says Thomas Leya of the Fraunhofer Institute for Cell Therapy and Immunology in Potsdam, Germany, who organised the algae experiment. “As far as I know, this is the first report of plants exposed on the surface of the space station.”

Green and orange

It was Leya who discovered CCCryo 101-99 on Norway’s remote Svalbard peninsula. When dormant, these algae develop thick walls and become orange cysts rich in protective carotenoids, the substances that give carrots their colour.

But when seasonal rains arrive, they rapidly resume making chlorophyll and turn green again. “If you give them water, the cysts germinate and revive,” says Leya.

Leya chose CCCryo 101-99 for the space ordeal based on its ability to withstand extreme cold and drying out. To help the algae through, he dried them out beforehand and coaxed them into the dormant, cyst-like state where they simply ticked over, without reproducing, feeding or multiplying.

All samples were open to space but overlaid with a transparent filter to reduce the radiation exposure (pictured, top). All but one sample survived.

Preliminary results the institute released last week showed that within days of their return, all the algae bounced back to normal. “Within just two weeks they become green again,” says Leya.

Team members at the Technical University in Berlin will now explore the extent of damage to the algal DNA, as this could give insights into the capacity of plants to survive and multiply away from Earth.

Leya stresses that if future missions to colonise other planets aim to grow crops, the seeds would need to be carefully protected in transit inside spaceships, unlike the algae just back from the ISS. Likewise, crops grown at the destination would need to be carefully shielded from environmental harms.

“These algae had been desiccated before they went into space, and during their time on the ISS they were kept dormant, with no growth, no development and almost no metabolism,” says René Demets of the European Space Agency. “But the experiment shows that some terrestrial organisms are robust enough to cope with months of exposure to open space conditions without a space suit.”

Leya also sent up photosynthesising microbes called cyanobacteria, specifically a species discovered in Antarctica, and found that it survived.

The work formed part of a bigger experiment called Biomex, led by Jean-Pierre Paul de Vera of the German Aerospace Centre in Berlin. It included mosses from the Alps, black microfungi from the Antarctic, desert lichens, and various bacteria.

<http://bbc.in/2l34nwI>

'Dogs mirror owners' personalities'

The idea that a dog takes on the personality of its owner has received scientific support.

By Helen Briggs BBC News

Researchers in Austria say dogs can mirror the anxiety and negativity of owners. And dogs that are relaxed and friendly can pass this on to humans, perhaps helping their owners cope with stress.



Dogs can recognise human emotions Thinkstock

More than 100 dogs and their owners underwent various tests, including measurement of heart rate and their response to threat.

Saliva samples were also taken to measure cortisol levels, a marker for stress. The owners were then assessed for the big five hallmarks of personality: neuroticism, extraversion, openness to experience, agreeableness and conscientiousness.

The personality of dogs was also assessed with a questionnaire.

Dr Iris Schoberl, of the University of Vienna, said both owners and dogs influenced each other's coping mechanisms, with the human partner being more influential than the dog.

"Our results nicely fit to experience from practice: owners and dogs are social dyads [a group of two], and they influence each other's stress coping," she told BBC News. She said dogs are sensitive to their owners' emotional states and may mirror their emotions.

Dogs have lived alongside humans for more than 30,000 years.

Evidence shows they can pick up emotional information from people and adjust their behaviour accordingly.

The research is published in the journal, [PLOS ONE](https://doi.org/10.1371/journal.pone.0171111).

<http://bit.ly/2lEr1Jy>

NASA wants to put a lander on Europa's surface to look for life

The search for life on Europa is inching closer to reality.

By Matt Reynolds

NASA has released a report outlining an initial set of objectives for a proposed mission to the surface of Jupiter's icy moon.

The primary objective of this mission, the report says, is to search directly for evidence of life. Europa has been a prime target in the search for extraterrestrial life since the mid-1990s when the Galileo orbiter indicated that a huge saltwater ocean may exist beneath its icy crust.

Europa is thought to be one of only two places beyond Earth (the other is Saturn's moon Enceladus) where an ocean is in contact with a rocky seafloor, making it one of the most promising prospects in the search for life in our solar system.

Other mission objectives include analysing samples from Europa's surface to assess its habitability and characterising its surface to help support future robotic exploration there.

"This mission would significantly advance our understanding of Europa as an ocean world, even in the absence of any definitive signs of life," the report says.

The team also recommended a number of life-detecting instruments, such as a mass spectrometer to sift through particles from Europa's surface, a microscope to search for microbial cells and a vibrational spectrometer to analyse the molecular composition of samples.

Take to the sky crane

To get the lander to the surface of Europa, the report proposes using an automated 'sky crane' system similar to the one used to land the

Mars Curiosity rover in 2012. The Europa lander would be suspended beneath the sky crane – a descent craft fitted with thrusters – and steered to a gentle touchdown on the surface, changing course if necessary to avoid dangerous landing areas. Its job done, the sky crane would then jet off to a safe distance and sacrifice itself by crash landing.

If the mission goes ahead, it will be the first NASA mission since the Mars Viking landers in the late 1970s to conduct an in situ search for life beyond our planet.

The lander mission outlined in this report is separate from the Europa flyby mission confirmed for launch in the early 2020s. That spacecraft will perform a series of 45 close flybys of Europa, mapping its composition and studying the characteristics of its ocean and ice shell. NASA routinely conducts these reports – called Science Definition Team reports – to weigh up the challenges and value in a proposed mission. Now scientists will discuss the report and provide their feedback to NASA in two upcoming town hall meetings to take place over the next couple of months in Texas and Arizona.

<http://bit.ly/2l7JUXm>

Brazilian peppertree packs power to knock out antibiotic-resistant bacteria

Amazon traditional healers have used the plant for centuries to treat infections

The red berries of the Brazilian peppertree - a weedy, invasive species common in Florida - contain an extract with the power to disarm dangerous antibiotic-resistant staph bacteria, scientists at Emory University have discovered.

This is a specimen of Brazilian peppertree (Schinus terebinthifolia) from the Emory University Herbarium. Emory University



The journal Scientific Reports is publishing the finding, made in the lab of Cassandra Quave, an assistant professor in Emory's Center for the Study of Human Health and in the School of Medicine's Department of Dermatology.

"Traditional healers in the Amazon have used the Brazilian peppertree for hundreds of years to treat infections of the skin and soft tissues," Quave says. "We pulled apart the chemical ingredients of the berries and systematically tested them against disease-causing bacteria to uncover a medicinal mechanism of this plant."

The researchers showed that a refined, flavone-rich composition extracted from the berries inhibits formation of skin lesions in mice infected with methicillin-resistant *Staphylococcus aureus* (MRSA). The compound works not by killing the MRSA bacteria, but by repressing a gene that allows the bacteria cells to communicate with one another. Blocking that communication prevents the cells from taking collective action, a mechanism known as quorum quenching.

"It essentially disarms the MRSA bacteria, preventing it from excreting the toxins it uses as weapons to damage tissues," Quave says. "The body's normal immune system then stands a better chance of healing a wound."

The discovery may hold potential for new ways to treat and prevent antibiotic-resistant infections, a growing international problem. Antibiotic-resistant infections annually cause at least two million illnesses and 23,000 deaths in the United States, according to the Centers for Disease Control and Prevention. The United Nations last year called antibiotic-resistant infections a "fundamental threat" to global health and safety, citing estimates that they cause at least 700,000 deaths each year worldwide, with the potential to grow to 10 million deaths annually by 2050.

Blasting deadly bacteria with drugs designed to kill them is helping to fuel the problem of antibiotic resistance. Some of the stronger bacteria may survive these drug onslaughts and proliferate, passing on their genes to offspring and leading to the evolution of deadly "super bugs."

In contrast, the Brazilian peppertree extract works by simply disrupting the signaling of MRSA bacteria without killing it. The researchers also found that the extract does not harm the skin tissues of mice, or the normal, healthy bacteria found on skin.

"In some cases, you need to go in heavily with antibiotics to treat a patient," Quave says. "But instead of always setting a bomb off to kill an infection, there are situations where using an anti-virulence method may be just as effective, while also helping to restore balance to the health of a patient. More research is needed to better understand how we can best leverage anti-virulence therapeutics to improve patient outcomes."

Quave, a leader in the field of medical ethnobotany and a member of the Emory Antibiotic Resistance Center, studies how indigenous people incorporate plants in healing practices to uncover promising candidates for new drugs.

The Brazilian peppertree (*Schinus terebinthifolia*) is native to South America but thrives in subtropical climates. It is abundant in much of Florida, and has also crept into southern areas of Alabama, Georgia, Texas and California. Sometimes called the Florida holly or broad leaf peppertree, the woody plant forms dense thickets that crowd out native species.

"The Brazilian peppertree is not some exotic and rare plant found only on a remote mountaintop somewhere," Quave says. "It's a weed, and the bane of many a landowner in Florida."

From an ecological standpoint, it makes sense that weeds would have interesting chemistry, Quave adds. "Persistent, weedy plants tend to have a chemical advantage in their ecosystems, which help may protect them from diseases so they can more easily spread in a new environment."

The studies co-authors include Amelia Muhs and James Lyles (Emory Center for the Study of Human Health); Kate Nelson (Emory School of Medicine); and Corey Parlet, Jeffery Kavanaugh and Alexander Horswill (University of Iowa). The laboratory experiments were

conducted in collaboration between the Quave and Horswill labs with funding from the National Center for Complementary and Integrative Health, National Institutes of Health.

The Quave lab is now doing additional research to confirm the safest and most effective means of using the Brazilian peppertree extract. The next step would be pre-clinical trials to test its medicinal benefits. "If the pre-clinical trials are successful, we will apply for an application to pursue clinical trials, under the Food and Drug Administration's botanical drug pathway," Quave says.

The Brazilian peppertree finding follows another discovery made by the Quave lab in 2015: The leaves of the European chestnut tree also contain ingredients with the power to disarm staph bacteria without increasing its drug resistance. While both the Brazilian peppertree and chestnut tree extracts disrupted the signaling needed for quorum quenching, the two extracts are made up of different chemical compounds.

<http://bit.ly/2lxTC6z>

Ancient signals from the early universe

For the first time, theoretical physicists from the University of Basel have calculated the signal of specific gravitational wave sources that emerged fractions of a second after the Big Bang.

The source of the signal is a long-lost cosmological phenomenon called "oscillon". The journal Physical Review Letters has published the results.

Although Albert Einstein had already predicted the existence of gravitational waves, their existence was not actually proven until fall 2015, when highly sensitive detectors received the waves formed during the merging of two black holes. Gravitational waves are different from all other known waves. As they travel through the universe, they shrink and stretch the space-time continuum; in other words, they distort the geometry of space itself. Although all accelerating masses emit gravitational waves, these can only be

measured when the mass is extremely large, as is the case with black holes or supernovas.

Gravitational waves transport information from the Big Bang. However, gravitational waves not only provide information on major astrophysical events of this kind but also offer an insight into the formation of the universe itself. In order to learn more about this stage of the universe, Prof. Stefan Antusch and his team from the Department of Physics at the University of Basel are conducting research into what is known as the stochastic background of gravitational waves. This background consists of gravitational waves from a large number of sources that overlap with one another, together yielding a broad spectrum of frequencies. The Basel-based physicists calculate predicted frequency ranges and intensities for the waves, which can then be tested in experiments.

A highly compressed universe

Shortly after the Big Bang, the universe we see today was still very small, dense, and hot. "Picture something about the size of a football," Antusch explains. The whole universe was compressed into this very small space, and it was extremely turbulent. Modern cosmology assumes that at that time the universe was dominated by a particle known as the inflaton and its associated field.

Oscillons generate a powerful signal

The inflaton underwent intensive fluctuations, which had special properties. They formed clumps, for example, causing them to oscillate in localized regions of space. These regions are referred to as oscillons and can be imagined as standing waves. "Although the oscillons have long since ceased to exist, the gravitational waves they emitted are omnipresent - and we can use them to look further into the past than ever before," says Antusch.

Using numerical simulations, the theoretical physicist and his team were able to calculate the shape of the oscillon's signal, which was emitted just fractions of a second after the Big Bang. It appears as a pronounced peak in the otherwise rather broad spectrum of

gravitational waves. "We would not have thought before our calculations that oscillons could produce such a strong signal at a specific frequency," Antusch explains. Now, in a second step, experimental physicists must actually prove the signal's existence using detectors.

<http://bit.ly/2kquL6Q>

Gut bacteria may play a role in Alzheimer's disease
New research from Lund University in Sweden has shown that intestinal bacteria can accelerate the development of Alzheimer's disease.

According to the researchers behind the study, the results open up the door to new opportunities for preventing and treating the disease. Because our gut bacteria have a major impact on how we feel through the interaction between the immune system, the intestinal mucosa and our diet, the composition of the gut microbiota is of great interest to research on diseases such as Alzheimer's. Exactly how our gut microbiota composition is composed depends on which bacteria we receive at birth, our genes and our diet.

By studying both healthy and diseased mice, the researchers found that mice suffering from Alzheimer's have a different composition of gut bacteria compared to mice that are healthy. The researchers also studied Alzheimer's disease in mice that completely lacked bacteria to further test the relationship between intestinal bacteria and the disease. Mice without bacteria had a significantly smaller amount of beta-amyloid plaque in the brain. Beta-amyloid plaques are the lumps that form at the nerve fibres in cases of Alzheimer's disease.

To clarify the link between intestinal flora and the occurrence of the disease, the researchers transferred intestinal bacteria from diseased mice to germ-free mice, and discovered that the mice developed more beta-amyloid plaques in the brain compared to if they had received bacteria from healthy mice.

"Our study is unique as it shows a direct causal link between gut bacteria and Alzheimer's disease. It was striking that the mice which

completely lacked bacteria developed much less plaque in the brain", says researcher Frida Fåk Hållenius, at the Food for Health Science Centre.

"The results mean that we can now begin researching ways to prevent the disease and delay the onset. We consider this to be a major breakthrough as we used to only be able to give symptom-relieving antiretroviral drugs."

The research is a result of an international collaboration between Associate Professor Frida Fåk Hållenius and doctoral student Nittaya Marungruang, both at the Food for Health Science Centre in Lund, and a research group at the Ecole Polytechnique Federale de Lausanne in Switzerland. The collaboration has now expanded to include researchers from Germany and Belgium in connection with receiving a SEK 50 million EU grant.

The researchers will continue to study the role of bacteria in the development of Alzheimer's disease, and test entirely new types of preventive and therapeutic strategies based on the modulation of the gut microbiota through diet and new types of probiotics.

<http://bit.ly/2l3uEey>

Four decades of evidence finds no link between immigration and increased crime

Immigration actually appears to be linked to reductions in some types of crimes

BUFFALO, N.Y. - Political discussions about immigrants often include the claim that there is a relationship between immigration patterns and increased crime. However, results of a University at Buffalo-led study find no links between the two. In fact, immigration actually appears to be linked to reductions in some types of crimes, according to the findings.

"Our research shows strong and stable evidence that, on average, across U.S. metropolitan areas crime and immigration are not linked," said Robert Adelman, an associate professor of sociology at UB and the paper's lead author. "The results show that immigration does not increase assaults and, in fact, robberies, burglaries, larceny, and murder are lower in places where immigration levels are higher.

"The results are very clear."

Adelman's study with Lesley Williams Reid, University of Alabama; Gail Markle, Kennesaw State University; Charles Jaret, Georgia State

University; and Saskia Weiss, an independent scholar, is published in the latest issue of the Journal of Ethnicity in Criminal Justice.

"Facts are critical in the current political environment," said Adelman.

"The empirical evidence in this study and other related research shows little support for the notion that more immigrants lead to more crime."

Previous research, based on arrest and offense data, has shown that, overall, foreign-born individuals are less likely to commit crimes than native-born Americans, according to Adelman.

For the current study, the authors stepped back from the study of individual immigrants and instead explored whether larger scale immigration patterns in communities could be tied to increases in crime due to changes in cities, such as fewer economic opportunities or the claim that immigrants displace domestic workers from jobs.

The authors drew a sample of 200 metropolitan areas as defined by the U.S. Census Bureau and used census data and uniform crime reporting data from the Federal Bureau of Investigation for a 40-year period from 1970 to 2010.

"This is a study across time and across place and the evidence is clear," said Adelman. "We are not claiming that immigrants are never involved in crime. What we are explaining is that communities experiencing demographic change driven by immigration patterns do not experience significant increases in any of the kinds of crime we examined. And in many cases, crime was either stable or actually declined in communities that incorporated many immigrants."

Adelman says the relationship between immigration and crime is complex and more research needs to be done, but this research supports other scholarly conclusions that immigrants, on the whole, have a positive effect on American social and economic life.

"It's important to base our public policies on facts and evidence rather than ideologies and baseless claims that demonize particular segments of the U.S. population without any facts to back them up," said Adelman.

<http://bit.ly/2l7TiKL>

Why Exercise Is Not Enough to Prevent Weight Gain

Exercise on its own - without also following a healthy diet - isn't enough to help people lose or even just maintain their weight, a recent study suggests.

By Agata Blaszczak-Boxe, Contributing Writer | February 10, 2017

The new results run counter to the idea that the obesity epidemic in the U.S. is caused by a lack of physical activity, said lead study author Lara Dugas, an assistant professor of public health sciences at Loyola University Chicago Stritch School of Medicine.

When it comes to figuring out the causes of obesity, "what we really need to look at is what people are eating," Dugas told Live Science. Previous research, for example, has linked a greater risk of obesity with the consumption of high-calorie food and sweetened beverages, she said.

In the new study, the researchers found that the amount of time people spent exercising per week didn't seem to play a role in how well those people controlled their weight. In fact, some of the people who exercised more than others in the study actually gained weight over the two-year study period, while some of those who exercised less than others lost weight over the same period, according to the study, which was published in January in the journal PeerJ.

The findings suggest that "physical activity was not enough to prevent weight gain," Dugas said.

The new study examined more than 1,900 people in the U.S., Ghana, South Africa, Jamaica and the Seychelles (an island nation in the Indian Ocean). At the beginning of the study, the researchers asked all of the study participants to wear tracking devices for one week to measure how much time they spent exercising.

The researchers used the data to see whether the people in the study met the U.S. Surgeon General's physical activity guidelines, which recommend that people exercise at a moderate pace for at least 2 and a half hours per week. The researchers also measured each participant's

weight, height and body fat three times: at the start of the study, one year later and two years later.

When the study began, the participants in Ghana weighed the least, on average, and those from the U.S. weighed the most, according to the study. The average weight of both the men and women in Ghana was 139 lbs. (63 kilograms), while the average weight of American men was 206 lbs. (93 kg) and of American women, 202 lbs. (92 kg).

At the end of the two-year study period, the researchers found that some of the people who met the physical activity guidelines at the beginning of the study were more likely to gain weight than those who did not meet the guidelines.

For example, men in the U.S. who met the guidelines gained a half pound per year, on average, whereas those who did not meet the guidelines actually lost about the same amount per year. (This is not typical, as most people usually gain weight over time.)

But the pattern of exercisers either not losing weight or actually gaining weight over time wasn't only true for the Americans in the study — the researchers observed the same pattern in people in each of the five countries. Because of this, these results likely apply to other populations as well, Dugas said.

It's not entirely clear why exercise may not help people lose weight, or may sometimes even be linked to weight gain. One possible explanation is that because exercise tends to increase appetite, it may simply cause people to eat more than they otherwise would, Dugas said.

Still, the results of the study certainly don't mean that people should stop exercising, Dugas said. Exercise has a lot of other health benefits, she said. For example, previous research has shown that people who exercise regularly have a reduced risk of heart disease, diabetes and cancer, compared with people who don't exercise, the researchers said. Moreover, exercise has been linked with a better mood and mental health. And other research shows that people who exercise tend to live longer than those who don't, according to the study.

<http://bit.ly/2kH04Xd>

Stinky armpits? Bacteria from a less smelly person can fix them

Got BO? Blame the bacteria living in your armpits.

By Jessica Hamzelou

In some people, bacteria cause body odour that no deodorant can disguise. But replacing them with underarm bacteria from a less smelly person can solve the problem, for a month or two at least.

Our bodies are crawling with bacteria that have evolved with us and can affect our health. Disrupting the bacteria in our gut, for example has been linked to all kinds of intestinal, immune and brain disorders.

The skin has its own microbiome too, and it varies by region – there can even be a difference between the bacterial ecosystem of your left and right armpits. The bacteria that live there probably have a role in producing the volatile compounds that give sweat its smell, says Chris Callewaert at the University of California, San Diego.

A few years ago, Callewaert met a pair of identical twins – one of whom had particularly bad body odour. Callewaert suspected that the collection of bacteria living in the twins' armpits might be responsible for their different personal scents. To find out, he swapped out the stinky twin's armpit bacteria with that taken from his twin brother.

Twin transplant

Callewaert first asked the twin that didn't smell to refrain from washing for four days. This is because the bacteria in our armpits live deep in the skin, so it takes a few days for them to be shed to the surface with dead skin.

Meanwhile, the stinky twin scrubbed his pits with antibacterial soap every day, for four days. The idea was to remove as much of his armpit bacteria as possible, creating a clean state for his brother's microbes.

When Callewaert collected the nicer-smelling twin's dead skin – which was loaded with his bacteria – and swabbed it in the armpits of the smellier twin, the man's body odour problem rapidly disappeared.

“The effects have persisted for over a year now,” says Callewaert. “We're very happy with that.

Callewaert and his colleagues have since repeated this procedure with 17 other pairs. In each case, one person in the pair had a body odour problem, and the other person was a close relative who was willing to donate bacteria from their armpit microbiome.

Before and after the bacterial transplants, the offensiveness of the previously smelly people was judged by a “trained odour panel” of eight people, says Callewaert.

Bacterial brew

Out of the 18 pairs, 16 saw improvements in body odour within a month. Half of the group had long-term improvements that lasted three months or more. Callewaert presented the results at the Karolinska Dermatology Symposium in Stockholm, Sweden, last month.

“It's very cool, and the idea is sound,” says Emma Allen-Vercoe at the University of Guelph in Ontario, Canada. “Some people suffer with body odour that's really overwhelming,” she says. “Maybe the answer is to replace their microbes with ones that aren't producing such volatile compounds.” She hopes that a similar approach might be useful in treating some skin conditions, like eczema and psoriasis.

Callewaert and his colleagues are now formulating a more general brew of bacteria that could be used in place of a relative's armpit scratchings. “It's still very experimental, but I'm sure it can work,” he says.

Until this is available, there are other ways you can improve your body odour bacteria. Microbes that feed on lipids – compounds that include fats and oils – are especially bad for body odour. You can try limiting the amount of lipids in your skin by keeping a healthy weight and avoiding fatty foods, says Callewaert. “People that eat fast food and meat smell worse, while those that eat vegetables smell better,” he says.

Shaving can also help, as can wearing the right clothing. When we wear clothes, we transfer bacteria to them, and some fabrics encourage the growth of “bad” bacteria associated with offensive smells. Washing your clothes doesn’t solve the problem, either – it merely helps spread the bacteria among the contents of your washing machine. Polyester seems to be particularly bad, and is one to avoid, says Callewaert.

How to have nice-smelling bacteria

If you want better smelling armpits, here a few things you could try.

Eat less fast food

Eat more vegetables and less meat

Maintain a healthy weight

Avoid polyester clothing

Shave your armpits

<http://nyti.ms/2kqC3HL>

Microbes, a Love Story

This Valentine’s Day, as you bask in the beauty of your beloved, don’t just thank his or her genes and your good fortune; thank microbes.

Moises Velasquez-Manoff FEB. 10, 2017

Research on the microbes that inhabit our bodies has progressed rapidly in recent years. Scientists think that these communities, most of which live in the gut, shape our health in myriad ways, affecting our vulnerability to allergic diseases like hay fever, how much weight we put on, our susceptibility to infection and maybe even our moods.

They can also, it seems, make us sexy.

Susan Erdman, a microbiologist at M.I.T., calls it the “glow of health.” The microbes you harbor, she argues, can make your skin smooth and your hair shiny; they may even put a spring in your step.

She stumbled on the possibility some years ago when, after feeding mice a probiotic microbe originally isolated from human breast milk, a technician in her lab noticed that the animals grew unusually lustrous fur.

Further observation of males revealed thick skin bristling with active follicles, elevated testosterone levels and oversize testicles, which the animals liked showing off.

Microbes had transformed these animals into rodent heartthrobs.

When given to females, the probiotic also prompted deeper changes. Levels of a protein called interleukin 10, which helps to prevent inflammatory disease and ensure successful pregnancy, went up, as did an important hormone called oxytocin.

Oxytocin, often called the love hormone, helps mammals bond with one another. Our bodies may release it when we kiss (and mean it), when women breast-feed, even when people hang out with good friends. And the elevated oxytocin Dr. Erdman saw had important effects during motherhood.

Some of the mice in her studies were eating a high-fat, high-sugar diet — junk-foody fare that’s known to shift the microbiome into an unhealthy state.

Not surprisingly perhaps, mothers that didn’t imbibe the probiotics were less caring and tended to neglect their pups. But mothers that had high oxytocin thanks to the probiotic were nurturing and reared their pups more successfully.

What Dr. Erdman’s research suggests is that the microbes we carry, the same ones that make us attractive to potential mates, also directly influence our reproductive success. So when mammals choose mates based on the glow of health, they’re choosing not just an attractive set of genes, but also perhaps a microbial community that might facilitate reproduction.

Another way to look at it: By making their hosts sexy, and by increasing hormones that bring mammals together, microbes help to ensure their own continued existence — the creation of another host. “Everyone wins,” Dr. Erdman told me.

Evolutionary biologists have long included microbes and parasites in how they think about sexual reproduction. But the focus has historically been on the deadly kinds.

Take sexual reproduction itself. The reason we may even have two sexes, as opposed to just one gender that self-duplicates, is that constantly shuffling our genomes helps us stay ahead of the many parasites and pathogens eager to suck us dry.

Sex guarantees the genetic diversity necessary to persevere in a never-ending war, meaning that you can thank disease-causing microbes and parasites for the opportunity to fall in love at all.

And when you kiss your beloved, well, you may have unfriendly microbes to thank there as well. Kissing is nearly ubiquitous in human cultures (although in some it's more like sniffing).

The practice puzzles infectious disease types, because swapping saliva clearly increases the risk of contagion. But maybe that's the point. Humans carry various chronic viral infections. Acquiring these viruses during pregnancy can harm the fetus.

So romantic kissing, some scientists speculate, may allow women to acquire potentially dangerous infections from their babies' fathers before pregnancy, increasing the odds of healthy gestation. Making out may be a crude form of self-vaccination.

Then there's the mystery of body odor. Back in the days before deodorant, one's stench probably conveyed important information. And it still apparently does. In one classic Swiss study, women were asked to sniff T-shirts previously worn by men and rate their pleasantness.

The women tended to prefer shirts from men whose immune-system genes were most different from their own, and with whom they'd most likely produce the fittest offspring. Their noses led them, unawares, to the best genetic matches.

Here's the mystery, though. Human sweat doesn't actually smell. The odor results from microbes feeding on sweat. Armpits are really fermentation crocks emitting what scientists call "volatile organic compounds" and lay people call B.O.

So those women may not have been sensing the men directly, but rather the aroma of whatever microbial mix they carried.

Whether they're really smelling and choosing the human genes directly or the microbes, or both, is anyone's guess.

What about the more brotherly or sisterly type of love — the yearning to be near others of our kind, to not be alone? That, too, may have a microbial component.

Animals that congregate in groups, like us, invariably share parasites and other infections. But they may also spread health-promoting microbes.

In fact, some surmise that the need to share probiotic microbes could have partly driven the emergence of sociality in animals.

Certain salamanders nest in groups to share microbes that protect their eggs against pathogenic fungi, for instance.

Some bumble bee colonies share symbiotic microbes that ward off parasites.

"People tend to think of diseases, like the flu virus, spreading through social networks," Elizabeth Archie, a biologist at Notre Dame, told me.

"But a lot of the microbes you have are potentially useful. So maybe good things as well as bad things are spreading through the same modes."

The idea remains unproven in mammals, although people who live together do end up with similar microbiomes, as do baboons that groom one another.

What is clear, however, is that moms often deliberately transmit healthful microbes to their infants.

Young elephants eat their mothers' feces to acquire the microbes needed to digest food.

Naked mole rat pups plead for anal excretions from their parents - imparting microbes that also help them thrive.

And humans inherit our first large dollop of microbes from our mothers as we pass through the birth canal.

Then comes breast milk, which contains special sugars we can't digest, but which selectively feed certain microbes in our gut.

So motherly love and care involves lots of deliberate slathering with a particular microbial culture.

Dr. Erdman doesn't think any of this is accidental.

She suspects, in fact, that the mammalian innovations of birthing live young and feeding them milk secreted from what was, millions of years ago, a sweat gland (the proto breast) helped us gain tighter control over the microbes we pass from one generation to the next — to our benefit.

And because oxytocin, the “love” hormone unique to mammals, underlies so much of this behavior, and because microbes affect oxytocin levels, Dr. Erdman likes to say that “microbes invented mammals.”

So love, desire, the cheesy rom-coms, the sappy ballads, the Shakespearean sonnets — all of them may depend on that teeming ecosystem of microbes within.

Moises Velasquez-Manoff, the author of “An Epidemic of Absence: A New Way of Understanding Allergies and Autoimmune Disease,” is a contributing opinion writer.

<http://bit.ly/2l6np5E>

Some China cities close poultry markets amid bird flu fears

Several Chinese cities have shut down their poultry markets in the wake of a bird flu outbreak that has killed at least two dozen people this year across China.

Live poultry sales have now been suspended in Changsha, the capital of central China's Hunan province, as well as markets across the eastern province of Zhejiang, the official Xinhua News Agency reported Sunday, as authorities deal with dozens of new cases of H7N9 bird flu.

Nearly 300 markets and slaughterhouses were shut down in the southwestern Chinese city of Suining, where authorities are also cracking down on unauthorized poultry businesses.

Xinhua reported that 21 people in Jiangsu province died in January after contracting H7N9. Hunan authorities have reported at least five

deaths this year, and an infant girl has died in southwestern Yunnan province.

A major H7N9 bird flu outbreak in humans first struck China in March 2013, killing more than 40 people and devastating the poultry industry. H7N9 is considered less virulent than the H5N1 strain, blamed by the World Health Organization for hundreds of deaths worldwide over the last decade.

Most people infected with H7N9 are believed to contract it by touching infected poultry or entering contaminated areas, according to a WHO alert published last month. Experts do not believe the virus can be spread widely between humans, the WHO said.

In Guangzhou, China's third-largest city, more than 30 percent of the live poultry markets were found to be contaminated with H7N9, state media reported Saturday. Authorities in Guangzhou have announced temporary three-day suspensions of the poultry trade to try to contain the virus.

<http://bit.ly/2kiPcQo>

What Geology Has to Say About Building a 1,000-Mile Border Wall

Compared to erecting a marble palace or high-steepled church, a wall may seem relatively straightforward—it isn't

By [Maya Wei-Haas](#) smithsonian.com February 7, 2017

Last month, President Donald Trump took steps to make good on a campaign promise to turn the United States' existing border fence into a "[big, beautiful](#)" wall. On January 25, the White House issued an [Executive Order](#) announcing the creation of a “secure, contiguous, and impassable physical barrier ... to prevent illegal immigration, drug and human trafficking, and acts of terrorism.” Now the [U.S. Customs and Border Protection](#)—the office tasked with enforcing border regulations—is scrambling to make that order a concrete reality.

Today's fence consists of roughly [650 miles of disparate segments](#), made out of a combination of steel posts and rails, metal sheeting, chain link, [concrete vehicle barriers](#) and wire mesh. To replace that

fence with what has been described as a [20- to 50-foot concrete structure](#) that will traverse 1,000 of the some 2,000 miles of the U.S.'s border with Mexico will be no easy feat. Besides dealing with a [proposed Mexican lawsuit](#) and navigating the [private ownership](#) of much of Texas' lands, there is another concern few have addressed in detail: geology.

Compared to building a marble palace or high-steepled church, erecting a wall may seem relatively straightforward. It isn't. (Just ask the Chinese, whose Great Wall [took 2,000 years to build](#) and [failed to keep out invaders](#).) Though most wall designs are fairly simple, builders must adapt to a wide range of terrains, explains [Gary Clendenin](#), a senior hydrogeologist at ICF. The southern U.S. [border alone contains](#) desert, wetlands, grasslands, rivers, mountains and forests—all of which create vastly different problems for builders.

"The length of this thing presents challenges that just aren't typically undertaken in a construction project," says Clendenin.

Can these hurdles be overcome?

Smithsonian.com asked two scientists, a geophysicist and a hydrogeologist, which geologic factors the wall's builders should take into account first if they are to execute this ambitious project.



Some 650 miles of disparate segments of fence stand along the almost 2,000-mile border between the U.S. and Mexico. Many segments, like the one pictured above, still allow some communication across the border. (Brian Auer / Alamy Stock Photo)

Surveying the Situation

The Tower of Pisa was never meant to lean. Built between [1173 and 1370](#), the off-kilter structure was [positioned atop](#) roughly 30 feet of fine river sediments underlain by a layer of ancient marine clay. But as builders assembled the tons of marble, the river sediments didn't compact evenly. So by 1178, when they had finished [work on the third story](#), the tower had already acquired its characteristic tilt.

The Italian government has since spent [millions of dollars](#) to make sure this beloved landmark [doesn't topple over](#). Such structural failures serve as a reminder that, while our ancestors did manage to successfully erect many impressive feats, "they don't necessarily stay upright," in the words of field geophysicist [Mika McKinnon](#). To circumvent such problems today, modern builders have added a crucial step to the construction process: surveying. Though time-consuming, this step is critical to ensure that the resulting structure can remain standing on *terra firma* for years to come.

Before a single brick is laid, teams of scientists assemble on scene to investigate a litany of details, from bedrock depth to soil chemistry. In the case of the border wall, they would have to traverse the entire length of the proposed path, working in segments to evaluate the region, collect data, develop plans. (This necessity makes the process of erecting walls—especially ones spanning thousands of miles—more challenging than building, say, a [95-story skyscraper](#).)

"Quite frankly, that would take years to do," says Clendenin, who specializes in linear projects like railways and roads. McKinnon agrees. One project she worked on, a three-mile stretch of pipeline, is now on year five of field surveys.

Yet Trump's order appears to allow a mere six months for all surveying and planning efforts. Within its long list of required steps, his executive order states:

"Produce a comprehensive study of the security of the southern border, to be completed within 180 days of this order, that shall include the current state of southern border security, all geophysical and topographical aspects of the southern border, the availability of Federal and State resources necessary to achieve complete operational control of the southern border, and a strategy to obtain and maintain complete operational control of the southern border."

When contacted by Smithsonian.com, the [Customs and Border Protection](#) agency declined to comment on the current timeline for the wall, saying in an email that "it would be speculative to address the

questions that you're asking at this point.” But according to scientists Smithsonian.com spoke to, it isn't going up anytime soon.

Getting to Bedrock

The prehistoric [city of Petra](#) stands as a prime example of ancient geologic foresight. [Around the 4th century BC](#), Petra's inhabitants carved the basis for this once-bustling trading city directly into the rugged pink and tan sandstone cliffs between the Red Sea and the Dead sea. Though winds and rain threatened to erode the structure top down, its firm rooting in bedrock—the solid rock that lies beneath the earth's loose layers—has kept this structure standing tall for thousands of years.

Such grounding in bedrock is a key feature when building a megastructure, says McKinnon. For something as extensive as a 1,000-mile wall that stands upwards of 20 feet tall, builders will need to anchor the whole thing beneath the surface to the underlying rock if they want it to stay upright.

The problem is, getting to bedrock can be a doozy. Great swaths of the border feature a hefty layer of [loose sediments](#)—dirt, soils, sand—laying atop the bedrock. In some regions the bedrock is [hundreds if not thousands](#) of feet down. “Some places the bedrock will be too deep—you'll never be able to reach the bedrock in an affordable fashion,” says McKinnon.

“That's okay if you want to [build] a tiny house because you just have it floating on its foundation,” she adds. But if you're building a megastructure, “you have a problem,” she says.

That's not to say that building on sand is impossible. But to safely erect such structures, geophysicists today conduct extensive seismic surveys to image what lies beneath. To create these pictures, they install rows of spike-like [geophones](#), which are 3D microphones that detect minute vibrations of the ground, converting them into an electric signal. Then they make a large noise, often by triggering an explosion or using a heavy weight to thump the ground. The geophones record the scattering and reflection of vibrations to

image underground structures, and tease out problems that may lay under the surface.

McKinnon experienced one of these problems firsthand, during the construction of a hydroelectric dam that was meant to be built across a valley that spanned about a mile. The team did all the proper surveys of the region, and discovered that beneath their riverbed lay a second channel buried in dirt.



The border fence that runs through the Algodones Sand Dunes in California is of special construction to accommodate the ever-changing dune environment. The narrow, 15-foot-tall posts "float" above the sand and can be moved vertically as the dunes shift. (United States Border Patrol, Department of Homeland Security)

“If we hadn't found it and we tried to build our dam across, then the water would have just eroded that old channel underneath and we would have had a river under our dam,” she says.

There are two options for overcoming such problems with sediment: compact the sediment and add a deeper foundation. For a wall roughly 20 feet tall, the foundation should extend six to eight feet beneath the surface, Clendenin says. All of these steps are expensive and time-consuming. But skimp on any of them, and “you get your Leaning-Tower-of-Pisa situation,” says McKinnon.

Of course, many modern regions don't have the economic resources to do such surveys and construction of deep foundations. The cities of Campania, Italy, are built atop loose sediments that are prone to sliding—a situation worsened by local clearcutting of the vegetation and unregulated construction that commonly lacks adequate foundations. These factors leave them vulnerable to the whims of their

region's geology: In 1998, when a mudslide rippled through the city, the houses crumpled under the weight and movement of the sludge, leaving [at least 95 dead](#).

Dirt Drama

“**Something** there is that doesn't love a wall / That sends the frozen-ground-swell under it,” begins Robert Frost's poem "[Mending Wall](#)." Frost may not have been a geological surveyor, but he got one thing right: When it comes to building walls, soil swelling is a major headache. That's why, after surveyors finish assessing the kind of rock and earth they'll be building over, they start studying the dirt.

Sediments, particularly in [clay-rich materials](#), can take on water, swelling like a sponge in a bowl of water. The resulting cycles of swelling and shrinking during wet and dry periods can crack the very foundation of structures. And these types of soils are common in many states where the border wall will be built, including [Texas and parts of New Mexico](#). In fact, about half of American homes are built on soils that expand significantly, and nearly half of those suffer damage yearly because of the soil, [according to the American Society of Civil Engineers](#).

Dirt can also eat up the wall's support system. Soils that are naturally acidic or have high chloride levels can rapidly [degrade iron-rich metals](#), says McKinnon. These soils could “corrode any, say, nice big metal rebar that you're putting in there to stabilize your foundation,” she says. Other soils have a high amount of sulfates, a compound found in the common mineral gypsum that breaks down both metals and concrete. Sulfate-rich soils are common in what's known as the Trans-Pecos soils along the border in the [southwestern arm of Texas](#).

“You're going to encounter hundreds, if not thousands, of different types of soils along [such a lengthy] linear pathway,” says Clendenin. (In fact, there are over [1,300 kinds](#) of soil in Texas alone.) And many of those soils aren't going to be the right type to build on top of. At that point, would-be wall-builders have two options: Spend more time

and money excavating the existing soils and replacing them with better dirt—or avoid the region altogether.

One thing they can't always avoid, though, are regions at risk of earthquakes and floods. Rivers run along a sizeable portion of the U.S.-Mexico border, which can create a very real danger of flood. Building adjacent to rivers can also present unexpected legal issues: A 1970 treaty necessitates that the fence be [set back from](#) the Rio Grande river, which delineates the Texas-Mexico border. Because of this, the current fence [crosscuts Texas landowner's property](#) and has gaps to allow landowners to pass.

Earthquakes are also relatively common in the western U.S. Depending on the build, some of these tremblors could cause cracks or breaks in the wall, says McKinnon. One example is the magnitude 7.2 quake that struck in 2010 near the California-Mexico Border, according to [Austin Elliott](#), a postdoctoral student at the University of Oxford whose research is focused on the history of earthquakes. “If there had been a wall at El Centinela [a mountain in northern Mexico] it would have been offset,” Elliott [writes on Twitter](#).

Even if all the proper surveys are completed and the boxes checked, success isn't guaranteed. “There are just so many things that have to be done before you even shovel out the first scoop of dirt,” says Clendenin.

Despite all of our modern surveying tools and careful planning, the earth will still surprise you, adds McKinnon. “This part that you thought was boring and simple and easy to predict is actually totally complicated,” she says. “Look at any major excavation for a subway system, any major bridge construction, any large tower complex; all of them had intense surveys beforehand, extensive design phases, and still had to modify while building.”

After the announcement of Trump's Executive Order, McKinnon took to Twitter to leave a foreboding reminder of the consequences of underestimating the Earth. “Earth doesn't forgive sloppy,” she [wrote](#). She added in an interview: “Ignore geology at your peril.”