

<http://bit.ly/3mqhiVm>

## Black 'sand-like' asteroid dust found in box from Japan probe

*Black sandy dust found in a capsule brought to Earth by a Japanese space probe is from the distant asteroid Ryugu, scientists confirmed after opening it on Monday.*

by Katie Forster

The discovery comes a week after the Hayabusa-2 [probe](#) dropped off its capsule, which entered the atmosphere in a streak of light before landing in the Australian desert and then being transported to Japan.

The Japanese space agency (JAXA) released a picture of a small deposit of sooty material inside the metal box—a first glimpse at the results of an unprecedented six-year mission for the unmanned probe.



*This photograph released by the Japan Aerospace Exploration Agency (JAXA) shows black sandy grains (R) collected from the asteroid Ryugu*

The dust was found in the capsule's [outer shell](#), agency officials said, with more substantial samples expected to be found when they open the inner container, a delicate task.

"JAXA has confirmed that samples derived from the asteroid Ryugu are inside the [sample](#) container," the agency said. "We were able to confirm black, sand-like particles which are believed to be derived from the asteroid Ryugu." Hayabusa-2 travelled about 300 million kilometres (200 million miles) from Earth to collect the samples, which scientists hope could help shed light on the origin of life and the formation of the universe.

The probe collected both surface [dust](#) and pristine material from below the surface that was stirred up by firing an "impactor" into the asteroid.

"We will continue our work to open the sample-catcher within the sample container. Extraction of the sample and analysis of it will be carried out," JAXA said.

Half of Hayabusa-2's samples will be shared between JAXA, US space agency NASA and other international organisations, and the rest kept for future study as advances are made in analytic technology. But work is not over for the probe, which will now begin an extended mission targeting two new asteroids.

<http://bit.ly/2Woeb5B>

## Chance played a major role in keeping Earth fit for life

*New perspective on why our planet has managed to stay habitable for billions of years*

A study by the University of Southampton gives a new perspective on why our planet has managed to stay habitable for billions of years - concluding it is almost certainly due, at least in part, to luck. The research suggests this may lengthen the odds of finding life on so-called 'twin-Earths' in the Universe.

The research, published in the Nature journal *Communications Earth & Environment*, involved conducting the first ever simulation of climate evolution on thousands of randomly generated planets.

Geological data demonstrate that Earth's climate has remained continuously habitable for more than three billion years. However, it has been precariously balanced, with the potential to rapidly deteriorate to deep-frozen or intolerably hot conditions causing planet-wide sterility.

Professor Toby Tyrrell, a specialist in Earth System Science at the University of Southampton, explains: "A continuously stable and habitable climate on Earth is quite puzzling. Our neighbours, Mars and Venus, do not have habitable temperatures, even though Mars once did. Earth not only has a habitable temperature today, but has kept this at all times across three to four billion years - an extraordinary span of geological time."

Many events can threaten the continuous stability of a planet - asteroid impacts, solar flares and major geological events, such as eruptions of supervolcanoes. Indeed, an asteroid which hit the Earth 66 million years ago caused the extinction of more than 75 per cent of all species, killing off the dinosaurs along with many other species.

Previous computer modelling work on Earth habitability has involved modelling a single planet: Earth. But, inspired by discoveries of exoplanets (those outside of our solar system) that reveal that there are billions of Earth-like planets in our galaxy alone, a Southampton scientist took a novel approach to investigating a big question: what has led Earth to remain life-sustaining for so long?

To explore this, Professor Tyrrell tapped into the power of the University of Southampton's Iridis supercomputing facility to run simulations looking at how 100,000 randomly different planets responded to random climate-altering events spread out across three billion years, until they reached a point where they lost their habitability. Each planet was simulated 100 times, with different random events each time.

Having accrued a vast set of results, he then looked to see whether habitability persistence was restricted to just a few planets which were always capable of sustaining life for three billion years, or instead was spread around many different planets, each of which only sometimes stayed habitable for this period.

The results of the simulation were very clear. Most of those planets which remained life-sustaining throughout the three billion year period only had a probability, not a certainty, of staying habitable. Many instances were of planets which usually failed in the simulations and only occasionally remained habitable. Out of a total population of 100,000 planets, nine percent (8,700) were successful at least once - of those, nearly all (about 8,000) were successful

fewer than 50 times out of 100 and most (about 4,500) were successful fewer than 10 times out of 100.

The study results suggest chance is a major factor in determining whether planets, such as Earth, can continue to nurture life over billions of years. Professor Tyrrell concludes: "We can now understand that Earth stayed suitable for life for so long due, at least in part, to luck. For instance, if a slightly larger asteroid had hit Earth, or had done so at a different time, then Earth may have lost its habitability altogether.

"To put it another way, if an intelligent observer had been present on the early Earth as life first evolved, and was able to calculate the chances of the planet staying habitable for the next several billion years, the calculation may well have revealed very poor odds."

Given these seemingly poor odds, the study speculates that elsewhere in the Universe there should be Earth-like planets which had similar initial prospects but which, due to chance events, at one point became too hot or too cold and consequently lost the life upon them. As techniques to investigate exoplanets improve, and what seem at first to be 'twin Earths' are discovered and analysed, it seems likely that most will be found to be uninhabitable.

#### *Notes to Editors*

1) The paper *Chance played a role in determining whether Earth stayed habitable* DOI: 10.1038/s43247-020-00057-8 is published in the *Nature journal Communications Earth & Environment*: : <https://www.nature.com/articles/s43247-020-00057-8>

<http://bit.ly/3mqoUXW>

### **Powerhouse plants that bolster the food web**

#### ***Researchers identify key native plants that stabilize feeding relationships essential for our planet's health***

University of Delaware Professor of Entomology Doug Tallamy published a new research study in *Nature* that systematically identifies the most critical plants needed to sustain food webs across the United States. Alongside co-authors Kimberley Shropshire and former graduate student Desiree Narango, now a

postdoctoral researcher at the University of Massachusetts Amherst, the study drills down to the top plants in each county and bioregion, illuminating a plan for how to restore ecosystems anywhere in the country.

Why care about food webs? Well, these complex, highly interconnected systems of feeding relationships are essential for our planet's health. The Earth and its many species depend on them, including humans.

To get the feast started, who has the first seat at the dining room table? The system all starts with plants, which get great publicity for their ability to convert carbon dioxide and into breathable air. But plants also have another, lesser known talent; they capture energy from the sun and turn it into food. Animals eat plants. Some eat plants directly; others obtain this energy by eating an animal who eats plants. And what animals are the best at converting this energy? Think small.

Punching way above their weight class, insects are the best creatures on Earth at this energy transfer. And the world champions are caterpillars of the Lepidoptera species, the lifeblood of the food web whose protein-rich bodies are ideal for hungry birds.

But caterpillars and other insects can't simply thrive among any plants; they must be surrounded by native plants, meaning those that have evolved alongside insects over millions of years. For example, caterpillars in Delaware like the promethea silkmoth don't jive with popular exotic trees like crepe myrtle, a popular choice by homeowners.

And not just any native plant will do. The new research finds that only a few powerhouse plants support the majority of Lepidoptera. Ninety percent of what caterpillars eat is created by only 14 percent of native plant species with only five percent of the powerhouse plants taking credit for 75 percent of food. This pattern is consistent wherever you go in the U.S.

"Most people talk about a food chain as if it's linear. In a diagram, these connections look like a web rather than a simple chain," said Tallamy, a conservationist and bestselling author. "Take a keystone native plant like an oak tree. More than 500 types of caterpillars can eat that oak tree. That allows for a more complex and, thus, more stable food web."

It's known that native plants are much better for an ecosystem than non-native plants, but this new study takes the knowledge an important further step.

"There are certain native plants, and there are actually not that many of them, that are doing the bulk of the work," said Tallamy.

"So, if you build landscapes without these powerhouse plants that support caterpillars, the food web is doomed."

The mid-Atlantic region boasts more than 2,000 plant genera; Tallamy and Narango categorized 38 as powerhouses. Native oaks, willows, birches and wild cherry trees made the trees' list; the most powerful herbaceous plants included goldenrod, asters and perennial sunflowers.

Tallamy, a veteran of conservation research, was surprised by just how significant the difference was between powerhouse plants and other native species.

"The magnitude of the differences surprised us. It's not just a steady continuum where you have all of your native plants lined up and, from one plant to the next, there's a gradual decrease in productivity," said Tallamy. "It is extremely skewed toward these powerhouse plants."

The Lepidoptera order of insects includes butterflies and moths. While butterflies are more admired for their beauty, the tastier moth caterpillars do most of the work of transferring energy to predators.

"You hear a lot about butterfly gardens. We need to think more about Lepidoptera gardens that include moths, who are the biggest driver of the food web," said Tallamy.

Today, because of human expansion, pesticides and species isolation, insect populations around the world are in a precipitous decline, referred to as Insect Armageddon. Flying insects like moths have seen a 78% reduction over the past 40 years. Whether you love insects or run in fear of these six-legged invertebrates, their demise will affect you.

"Insects pollinate 90% of our flowering plants. Without insects, we'd lose these plants, which collapses the food web," said Tallamy. "We'd lose amphibians, reptiles, birds, mammals and even some freshwater fish."

On top of their energy transfer abilities, insects are also crucial to soil decomposition, unlocking dead plant and animal material and returning nutrients to the soil. Sure, fungi and bacteria also have this talent, but they are significantly slower than insects. Tallamy puts it bluntly.

"If insect populations continue to decline, the Earth will rot. Humans will not survive such a drastic change," said Tallamy. "Insects are essential not just to our well-being, but to our continued existence on Earth."

So, what can you do to help? As Tallamy details in his New York Times bestseller *Nature's Best Hope: A New Approach to Conservation that Starts in Your Yard*, homeowners can turn their yards into conservation corridors that provide wildlife habitats. They just need to choose plants native to their region.

"We need to change the cultural norms of what our yards should look like. Homeowners can shrink the size of their lawns," said Tallamy. "But you can't simply replace the grass with any old plants; choose key native plants that support local insect populations. If you're in the mid-Atlantic, pick from the 38 genera that we identified. Start with oaks. Some others on the list aren't the most beautiful, but we need to learn to accept that. Maybe you plant a black cherry in the backyard instead of out front."

The same goes for public and non-profit efforts to restore ecosystems. Without powerhouse plants, restoration efforts will fall short.

"Think of a baseball team. What if you constructed a lineup of only pitchers and zero position players? They all pitch, but are lousy hitters, so you're going to lose the game," said Tallamy. "Take these national and international ventures [focused on forest restoration]. It's important to plant trees, but we need to have the right lineup of powerhouse plants native to each region."

<https://bit.ly/2KcYls6>

## **Too many donor kidneys are discarded in U.S. before transplantation**

*Kidneys discarded as low-quality in U.S are similar to kidneys transplanted with acceptable outcomes in France, study finds*

Philadelphia - When kidneys are removed from deceased organ donors in the United States, they are often subjected to "procurement biopsies" and are discarded if certain abnormalities are seen in the kidney tissue -- a practice that worsens the already-severe shortage of transplant-eligible kidneys in the country. However, a large portion of the discarded kidneys would function acceptably if transplanted, according to a new study from a team led by researchers in the Perelman School of Medicine at the University of Pennsylvania and the Paris Translational Research Center for Organ Transplantation.

In the study, published today in the *Journal of the American Society of Nephrology*, the researchers analyzed biopsy data on a series of 1,103 kidneys discarded in the U.S. between 2015 and 2016. They found that 493 of these kidneys could be matched, in terms of biopsy-evaluated quality and other donor characteristics, to 493 kidneys that were actually transplanted in France, where transplant practice is less restrictive.

The researchers then examined the performance of these 493 kidneys transplanted in France, and found that their survival rates were acceptable -- 93 percent at one year, 81 percent at five years, and 69 percent at 10 years -- indicating that many donor kidneys in the U.S. are being discarded unnecessarily.

Analyzing a larger set of kidney transplants in France for which biopsy data were available, the researchers concluded that the biopsy data added no value in terms of making predictions of transplant failure more accurate.

"These results highlight a lost transplant opportunity in the U.S., and provide a strong rationale for organ procurement organizations to reduce the practice of obtaining biopsies of deceased donor kidneys," said study lead author Peter Reese, MD, MSCE, an associate professor of Renal-Electrolyte & Hypertension and Epidemiology in the Perelman School of Medicine at the University of Pennsylvania and a kidney transplant physician at the Penn Transplant Center.

The study was a collaboration involving several medical centers in the U.S., France, and Belgium, co-led by Olivier Aubert, MD, PhD and corresponding author Alexandre Loupy, MD, PhD, of the Paris Translational Research Center for Organ Transplantation.

The shortage of kidneys for transplantation continues to be a public health crisis in the U.S. More than 90,000 patients are waiting for kidney transplants, yet only about 20,000 transplants are performed each year. Annually, nearly 5,000 people on the transplant waiting list die without getting a transplant.

Deceased donors provide roughly two-thirds of transplanted kidneys, but thousands of deceased-donor kidneys are discarded annually in the U.S., due to abnormalities seen in procurement biopsies. Studies suggest that most discards are due to a finding of substantial glomerulosclerosis, a condition that can be caused by age or diabetes, for example, and involves the scarring of small

blood vessels in the kidney. However, research also suggests that the reproducibility of procurement biopsy findings is poor.

Moreover, kidney transplants in several European countries are usually done without procurement biopsies and are therefore less likely to be discarded. A study published last year by the same research team found that French transplant centers are much more likely than U.S. centers to accept kidneys from older deceased donors. In fact, the average age of French deceased donors is more than 15 years older than deceased kidney donors in the U.S.

The findings from this new study underscore the notion that pre-transplant biopsies don't seem to add value to the kidney transplant process, and in fact tend to make things worse by reducing the supply of kidneys that could benefit recipients.

"Transplant center staff should understand that procurement biopsy results only contribute limited meaningful information about kidney quality," Reese said. "In some cases, those biopsies may add bad information. And unfortunately, those biopsies come at a cost -- in terms of delays, dollars and occasionally, complications."

*Other co-authors on the study were Maarten Naesens, Edmund Huang, Vishnu Potluri, Dirk Kuypers, Antoine Bouquegneau, Gillian Divard, Marc Raynaud, Yassine Bouatou, Ashley Vo, Denis Glotz, Christophe Legendre, Carmen Lefaucheur, Stanley Jordan, Jean-Philippe Empana, and Xavier Jouven.*

*Funding was provided by INSERM, Fondation Bettencourt-Schueller, the National Kidney Foundation, and the U.S. Department of Health and Human Services (234-2005-37011C).*

<http://bit.ly/3h2ZfmX>

## **UK Scientists Urge Caution Over Claims of a Particularly Contagious SARS-CoV-2 Strain**

*A new [coronavirus](#) strain may be fuelling an uptick in spread across the southern UK, according to Health Secretary Matt Hancock.*

**Aylin Woodward**

"Over the last few days, thanks to our world-class genomic capability in the UK, we have identified a new variant of



coronavirus, which may be associated with the faster spread in the South of England," Hancock said Monday, speaking in the House of Commons. He pointed to "very sharp exponential rises in the virus across London, Kent, parts of Essex, and Hertfordshire."

Hancock added that there's no evidence to suggest this new strain is more deadly or resistant to vaccines. But it could be more transmissible, he said: "Initial analysis suggests this variant is growing faster than the existing variants."

Hancock said that at least 60 different local authorities had seen infections from the variant, the [World Health Organisation](#) had been notified, and UK scientists were doing detailed studies, [according to the BBC](#). He did not publicly provide any further data about the variant, however.

London and large parts of Southern England will be placed into "tier 3," the strictest level of lockdown, from midnight on Tuesday, Hancock said. That means roughly 34 million British people are now in tier 3 areas, in which pubs and restaurants are closed.

However, scientists are urging calm until more is known about the coronavirus variant Hancock mentioned. "It is incredibly frustrating to have such a statement made without any associated evidence,"

Lucy van Dorp, a geneticist studying the coronavirus' genome, told Business Insider, adding that it's unlikely that [one mutation](#) would play a big role in changing disease severity for a virus.

### 'It's too early to be worried' by this new variant

Like all [viruses](#), the coronavirus mutates over time. So scientists have been regularly collecting samples of the coronavirus since the beginning of the [pandemic](#) and genetically sequencing them to track how it changes. "That's normal. That's how viruses work," Emma Hodcroft, a geneticist studying the coronavirus' genome in Basel Switzerland, [previously told Business Insider](#).

According to Alan McNally, a professor of genomics at the University of Birmingham, testing labs across the UK "picked up"

the new variant in the last few weeks. "It is important to keep a calm and rational perspective on the strain as this is normal virus evolution and we expect new variants to come and go and emerge over time," [he said in a statement to UK's Science Media Centre](#).

"It's too early to be worried or not by this new variant, but I am in awe of the surveillance efforts in the UK that allowed this to be picked up so fast."

The variant includes a mutation in the virus' spike protein, called N501Y. That spike is what the coronavirus uses to invade our cells, so it's possible a tweak there could make it easier for the virus to infect our bodies. "Efforts are under way to confirm whether or not any of these mutations are contributing to increased transmission," the [COVID-19 Genomics UK Consortium](#), the group that identified the variant, [said in a statement](#).

"There is currently no evidence that this variant (or any other studied to date) has any impact on disease severity, or that it will render vaccines less effective," it added.

### Mutations don't necessarily impact a virus' behaviour

Other scientists are similarly hesitant to make conclusions based on the news of this new variant.

"There is no evidence that the newly reported variant results in a more severe disease," Wendy Barclay, head of the Department of Infectious Disease at Imperial College London, said in a Science Media Centre statement on Monday.

Hodcroft said that most mutations her team has seen so far are harmless, and the coronavirus is [mutating slowly](#). There is one variant, [called 614G](#), that might be more transmissible than the original virus, she added, but that question is not settled.

Jonathan Ball, a molecular virologist at the University of Nottingham, struck a cautious tone in his own statement to the Science Media Centre. "The genetic information in many viruses can change very rapidly and sometimes these changes can benefit

the virus - by allowing it to transmit more efficiently or to escape from vaccines or treatments - but many changes have no effect at all," he said.

Ball added: "Even though a new genetic variant of the virus has emerged and is spreading in many parts of the UK and across the world, this can happen purely by chance. Therefore, it is important that we study any genetic changes as they occur, to work out if they are affecting how the virus behaves."

<https://bit.ly/2IYj5TT>

## Cretaceous Dinosaur Had Impressive Mane and Shoulder Ribbons

*A maned theropod dinosaur with elaborate filamentous structures has been identified by a research team led by University of Portsmouth paleontologists.*

The newly-discovered dinosaur species lived about 110 million years ago (Aptian stage of the Cretaceous period) in what is now Brazil.

Named *Ubirajara jubatus*, the ancient animal was chicken-sized with a mane of long fur down its back. It also had long, flat, stiff shoulder ribbons of keratin, each with a small sharp ridge running along the middle. Its arms were covered in fur-like filaments down to the hands.



*Life restoration of Ubirajara jubatus. Image credit: Bob Nicholls, paleocreations.com.*

"What is especially unusual about the beast is the presence of two very long, probably stiff ribbons on either side of its shoulders that were probably used for display, for mate attraction, inter-male rivalry or to frighten off foe," said co-author Professor David

Martill, a paleontologist in the School of the Environment, Geography and Geosciences at the University of Portsmouth.

"We cannot prove that the specimen is a male, but given the disparity between male and female birds, it appears likely the specimen was a male, and young, too, which is surprising given most complex display abilities are reserved for mature adult males." "Given its flamboyance, we can imagine that the dinosaur may have indulged in elaborate dancing to show off its display structures."

*Ubirajara jubatus*' mane is thought to have been controlled by muscles allowing it to be raised, in a similar way a dog raises its hackles or a porcupine raises its spines when threatened.

"Any creature with movable hair or feathers as a body coverage has a great advantage in streamlining the body contour for faster hunts or escapes but also to capture or release heat," Professor Martill said. "The elaborate plumage of *Ubirajara jubatus* might have improved its chances of survival," added lead author Robert Smyth, also from the School of the Environment, Geography and Geosciences at the University of Portsmouth.

"*Ubirajara jubatus* is the first non-avian dinosaur to be described from Brazil's Crato Formation, a shallow inland sea laid down about 110 million years ago," the paleontologists said.

"It is also the first non-avian dinosaur found on the ancient supercontinent of Gondwana with preserved skin."

"*Ubirajara jubatus* is not only important because of the integumentary structures present for the first time in a non-avian dinosaur, completely changing the way of seeing the behavior of certain dinosaurs," said co-author Dr. Hector Rivera Sylva, a paleontologist at the Museo del Desierto, Mexico.

"Rather, the scientific value transcends, forming a watershed, since it is the first evidence for this group in Latin America, as well as one of the few reported for the subcontinent of Gondwana, expanding the knowledge about non-avian feathered dinosaurs for

America, whose evidence is very scarce." The discovery is reported in a [paper](#) in the journal *Cretaceous Research*.

*Robert S.H. Smyth et al. A maned theropod dinosaur from Gondwana with elaborate integumentary structures. Cretaceous Research, published online December 13, 2002; doi: 10.1016/j.cretres.2020.104686*

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

## **Ice-rich flow features in Martian southern hemisphere reveal effects of recent climate cycles**

*A large, previously unrecognized reservoir of water ice on Mars is well preserved and formed within the past few million years*

by Alan Fischer

A large, previously unrecognized reservoir of water ice on Mars is well preserved and formed within the past few million years, says a paper led by Planetary Science Institute Senior Scientist Daniel C. Berman.

"Our radar analysis shows that at least one of these features is about 500 meters thick and nearly 100 percent ice, with a debris covering at most ten meters thick," said Berman, lead author of "Ice-rich landforms of the southern mid-latitudes of Mars: A case study in Nereidum Montes" published online in *Icarus*. PSI scientists Frank C. Chuang, Isaac B. Smith and David A. Crown are co-authors on the paper.

Global mapping of Viscous Flow Features (VFFs), a general grouping of ice-rich flow features in the southern hemisphere of Mars shows a dense concentration in Nereidum Montes, along the northern rim of Argyre basin. Located within a northwestern subregion of Nereidum Montes is a large number of well-preserved VFFs and ice-rich mantling deposits, the paper says, potentially the largest concentrations of any non-[polar region](#) in the southern hemisphere.

Processed data from the Shallow Radar (SHARAD) instrument aboard NASA's Mars Reconnaissance Orbiter spacecraft were used

to search for basal reflections across VFFs within the [region](#). For one in particular, these observations and analysis indicate that it is composed of nearly pure water ice. Model ages obtained from crater counts and their associated size-frequency distributions (SFDs) on both ice-rich mantling deposits and small lobate VFFs suggest that the deposits stabilized several to tens of millions of years ago in the Late Amazonian Epoch, and that small lobate VFFs likely formed due to the mobilization of mantling deposits.

"Our results show that VFFs have more complete and diverse preservation states in Nereidum Montes than similar features in other regions on Mars. This region contains uniquely well-preserved mantling deposits associated with the VFFs. This key observation suggests that lobate VFFs are formed by the glacial flow of the mantling deposits on hillslopes," Berman said.

"This region would be an interesting landing site due to the large amounts of ice, which could be used as a source for water," Berman said. "Unfortunately, it is very mountainous terrain and it would likely be very difficult to land there."

Portions of this work were supported through a NASA Mars Data Analysis program grant NNX10AO21G awarded to PSI's David A. Crown.

*More information: Daniel C. Berman et al. Ice-rich landforms of the southern mid-latitudes of Mars: A case study in Nereidum Montes, Icarus (2020). DOI: [10.1016/j.icarus.2020.114170](https://doi.org/10.1016/j.icarus.2020.114170)*

<http://bit.ly/34mErlh>

## **World's first gas sample from deep space confirmed** *Gas from the sample container inside Hayabusa2 is a gas sample originating from asteroid Ryugu*

The Japan Aerospace Exploration Agency (JAXA) has confirmed that the gas collected from the sample container inside the re-entry capsule of the asteroid explorer, Hayabusa2, is a gas sample originating from asteroid Ryugu.



The result of the mass spectrometry of the collected gas within the sample container performed at the QLF (Quick Look Facility) established at the Woomera Local Headquarters in Australia on December 7, 2020, suggested that the gas differed from the atmospheric composition of the Earth. For additional confirmation, a similar analysis was performed on December 10-11 at the Extraterrestrial Sample Curation Center on the JAXA Sagamihara Campus. This has led to the conclusion that the gas in the sample container is derived from asteroid Ryugu. The grounds for making this decision are due to the following three points.

- *Gas analysis at the Extraterrestrial Sample Curation Center and at the Woomera Local Headquarters in Australia gave the same result.*
- *The sample container is sealed with an aluminum metal seal and the condition of the container is as designed, such that the inclusion of the Earth's atmosphere was kept well below the permissible level during the mission.*
- *Since it was confirmed on the Sagamihara campus that gas of the same composition had been generated even after the removal of the container gas in Australia, it is considered that the collected gas must be due to the degassing from the sample.*

This is the world's first sample return of a material in the gas state from [deep space](#).

The initial analysis team will continue with opening the [sample container](#) and performing a detailed [analysis](#) of the molecular and isotopic composition of the collected gas.

<http://bit.ly/3r85dHZ>

## **Climate change caused the demise of Central Asia's river civilizations, not Genghis Khan**

*A new study challenges the long-held view that the destruction of Central Asia's medieval river civilizations was a direct result of the Mongol invasion in the early 13th century CE.*

A new study challenges the long-held view that the destruction of Central Asia's medieval river civilizations was a direct result of the Mongol invasion in the early 13th century CE.

The Aral Sea basin in Central Asia and the major rivers flowing through the region were once home to advanced river civilizations which used floodwater irrigation to farm.

The region's decline is often attributed to the devastating Mongol invasion of the early 13th century, but new research of long-term river dynamics and ancient irrigation networks shows the changing climate and dryer conditions may have been the real cause.

Research led by the University of Lincoln, UK, reconstructed the effects of climate change on floodwater farming in the region and found that decreasing river flow was equally, if not more, important for the abandonment of these previously flourishing city states.

Mark Macklin, author and Distinguished Professor of River Systems and Global Change, and Director of the Lincoln Centre for Water and Planetary Health at the University of Lincoln said: "Our research shows that it was climate change, not Genghis Khan, that was the ultimate cause for the demise of Central Asia's forgotten river civilizations.

"We found that Central Asia recovered quickly following Arab invasions in the 7th and 8th centuries CE because of favourable wet conditions. But prolonged drought during and following the later Mongol destruction reduced the resilience of local population and prevented the re-establishment of large-scale irrigation-based agriculture."

The research focused on the archaeological sites and irrigation canals of the Otrar oasis, a UNESCO World Heritage site that was once a Silk Road trade hub located at the meeting point of the Syr Darya and Arys rivers in present southern Kazakhstan. The researchers investigated the region to determine when the irrigation canals were abandoned and studied the past dynamics of the Arys

river, whose waters fed the canals. The abandonment of irrigation systems matches a phase of riverbed erosion between the 10th and 14th century CE, that coincided with a dry period with low river flows, rather than corresponding with the Mongol invasion.

*The research was led by the University of Lincoln in collaboration with VU University Amsterdam, University College London, the University of Oxford and JSC Institute of Geography and Water Safety, Almaty, Republic of Kazakhstan. It is published in Proceedings of the National Academy of Sciences of the United States of America and highlights the critical role that rivers can have in shaping world history.*

<https://bit.ly/34rju8Q>

## **Incidence of esophageal adenocarcinoma is increasing in younger adults**

*Analysis shows that patients under age 50 are more likely to be diagnosed at advanced stages*

Bottom Line: Esophageal adenocarcinoma is occurring more frequently in adults under age 50, and these younger adults are more likely to be diagnosed at advanced stages.

Journal in Which the Study was Published: Cancer Epidemiology, Biomarkers & Prevention, a journal of the American Association for Cancer Research

Author: Prasad G. Iyer, MD, MSc, professor of medicine in the Barrett's Esophagus Unit, Division of Gastroenterology and Hepatology; and Don C. Codipilly, MD, a gastroenterology fellow, both at the Mayo Clinic in Rochester, Minnesota.

Background: Esophageal cancer is a relatively rare cancer, with 18,440 cases expected to be diagnosed in the United States this year, according to the Surveillance, Epidemiology, and End Results (SEER) database. While those cases account for only about 1 percent of U.S. cancer diagnoses, esophageal cancer has poor survival outcomes, with a five-year survival rate of only 19.9 percent.

"Patients who present with late-stage esophageal cancer typically have poorer outcomes than those with early-stage disease. As such,

it is important to understand the epidemiology of esophageal cancer to target our screening strategies," Iyer said. Esophageal adenocarcinoma (EAC) is one of the most common types of esophageal cancer.

How the Study was Conducted: In this study, Iyer and colleagues sought to assess trends in incidence, stage, and survival outcomes in patients diagnosed with EAC before age 50 compared with those diagnosed at later ages.

The researchers used the Surveillance, Epidemiology, and End Results database to identify 34,443 cases of EAC diagnosed between 1975 and 2015. They calculated age-standardized incidence across three age groups: under 50; 50-69; and 70 and over. Results: Incidence of EAC increased across all age groups, with the rate of incidence for patients under age 50 increasing an average of 2.9 percent per year between 1975 and 2015. Younger patients were more likely to be diagnosed at advanced stages of the disease, with 84.9 percent of those under 50 diagnosed at regional or distant stages, compared with 67.3 percent of those 50 or older.

As a result, the younger age group also had poorer survival outcomes: In the most recent time period, 2000-2011, those under 50 had a five-year EAC-free survival rate of 22.9 percent, compared with 29.6 percent for both the 50-69 and the 70-and-over age groups.

Author's Comments: The authors cautioned that while EAC remains a rare cancer, especially in those under 50, clinicians and patients should be aware of the increasing incidence and the poor survival outcomes in younger patients. "The magnitude of late-stage disease and poor cancer-related survival in this age group were surprising findings for us," Iyer said. "We are also concerned by the trend of increase over the past four decades."

The authors pointed out that the rising incidence of EAC in younger adults mirrors the trend in colon cancer. In both cases, physicians

may attribute symptoms to other causes, delaying diagnosis and potentially leading to worse outcomes, said Codipilly.

The authors added that patients should be aware of risk factors and symptoms of esophageal cancer. Symptoms typically include difficulty swallowing, chest discomfort, or unintended weight loss. They added that certain high-risk groups, such as those with long-term reflux and those with a family history of esophageal cancer, should discuss screening with their health care providers.

"Physicians must keep in mind that EAC is not a disease of the elderly, and that outcomes for young people with EAC are dismal," Codipilly said. "Our findings suggest that physicians should have a low threshold of suspicion for patients who present with dysphagia (difficulty swallowing). While younger patients would typically not be at high risk for EAC, they may benefit from an upper endoscopy." This procedure, in which doctors examine the upper lining of the digestive tract, could rule out EAC or could help diagnose the disease at an earlier stage, when it is easier to treat, the authors said.

**Study Limitations:** The authors noted that a limitation of the study is that researchers could not examine individual-level data. Also, comorbidity information was not available in the SEER database.

*Funding & Disclosures:* This study was funded by the National Cancer Institute and the National Center for Advancing Translational Sciences. The authors declare no conflicts of interest.

<http://bit.ly/2LFC8b9>

## **Kangaroos can intentionally communicate with humans, research reveals**

*Challenges the notion that this behavior is usually restricted to domesticated animals*

Animals that have never been domesticated, such as kangaroos, can intentionally communicate with humans, challenging the notion that this behavior is usually restricted to domesticated animals like dogs,

horses or goats, according to a first-of-its-kind study from the University of Roehampton and the University of Sydney.

The research, which involved undomesticated kangaroos at three locations across Australia, revealed that kangaroos gaze at a human when trying to access food inside a closed box. The kangaroos used gazes to communicate with the human instead of attempting to open the box themselves, a behavior that is usually expected for domesticated animals.

Ten out of 11 kangaroos actively looked at the person who had put the food in a box (this type of experiment is known as "the unsolvable problem task"). Nine of the 11 kangaroos additionally showed gaze alternations between the box and the person present, a heightened form of communication.

The research builds on previous work in the field which has looked at the communication of domesticated animals, such as dogs and goats, and whether intentional communication in animals is a result of domestication. Lead author Dr. Alan McElligott, University of Roehampton (now based at City University of Hong Kong), previously [led a study](#) that found goats can understand human cues, including pointing, to gather information about their environment. Like dogs and goats, kangaroos are [social animals](#), and Dr. McElligott's new research suggests they may be able to adapt their usual social behaviors for interacting with humans.

Dr. Alan McElligott said, "Through this study, we were able to see that communication between animals can be learned and that the behavior of gazing at humans to access food is not related to domestication. Indeed, kangaroos showed a very similar pattern of behavior we have seen in dogs, horses and even goats when put to the same test. Our research shows that the potential for referential intentional [communication](#) toward humans by [animals](#) has been underestimated, which signals an exciting development in this area. Kangaroos are the first marsupials to be studied in this manner and

the positive results should lead to more cognitive research beyond the usual domestic species."

Dr. Alexandra Green, School of Life and Environmental Sciences at the University of Sydney, said, "Kangaroos are iconic Australian endemic fauna, adored by many worldwide but also considered a pest. We hope that this research draws attention to the cognitive abilities of kangaroos and helps foster more positive attitudes towards them."

*More information:* Alan G. McElligott et al. Kangaroos display gazing and gaze alternations during an unsolvable problem task, *Biology Letters* (2020). [DOI: 10.1098/rsbl.2020.0607](https://doi.org/10.1098/rsbl.2020.0607)

<https://go.nature.com/3myiXs>

### Stopping sperm at the source

*The development of male contraceptives has slowed in the past decade, but some preliminary studies are showing promise.*

[Michael Eisenstein](#)

When the University of California, Davis, announced in June that it was recruiting heterosexual couples as part of an international clinical study to test a male contraceptive gel, the researchers were quickly overwhelmed. "Phones were ringing off the hook with people wanting to take part," says Richard Anderson, a reproductive-health specialist at the University of Edinburgh, UK, who is one of the study's principal investigators.

The need for effective male contraception is real. A global survey from the New York City-based Guttmacher Institute found<sup>1</sup> that 48% of pregnancies from 2015 to 2019 were unplanned, even though there is already a range of contraception options. Diana Blithe, chief of the Contraceptive Development Program at the US National Institute of Child Health and Human Development (NICHD) in Bethesda, Maryland, thinks that many men would like to try alternatives to condoms and vasectomy. "Surveys have found that about 60% of men say they're interested," she says.

The gel in the current trial, which combines the hormones testosterone and segesterone acetate (marketed as Nestorone), is the first male contraceptive to enter efficacy testing in more than five years — and offers a rare glimmer of hope after decades of setbacks. "One of the cynical jokes in the field is that a male contraceptive has been 5 years away for the last 40 years," says John Amory, an endocrinologist at the University of Washington in Seattle. And although several other promising options are now in development, they will have to clear a high bar in terms of matching the efficacy of female contraception, while producing minimal side effects, if they are to make a meaningful difference to family planning.

### Valuable lessons

Hormonal contraceptives that prevent ovulation have transformed women's reproductive health and freedom. In a similar way, much of the effort regarding male contraceptives is targeted at blocking sperm production. In the 1980s and 1990s, the World Health Organization (WHO) oversaw trials of testosterone as a contraceptive. Although known as a driver of male sexual development, testosterone can suppress the release of the pituitary hormones that stimulate the production of sperm. In 1996, WHO researchers reported that 98% of a cohort of 399 men injected with testosterone achieved a meaningful reduction in sperm count<sup>2</sup>, and 70% had no detectable sperm at all. In this latter group, no pregnancies were reported, and only four occurred among those with reduced sperm counts.

The study was intended only as a proof of concept because high doses of testosterone can produce unwanted side effects linked to mood, weight gain and levels of cholesterol. Subsequent studies have therefore paired testosterone with hormones related to the female sex hormone progesterone. Such 'progestogen' compounds inhibit the release of the pituitary hormones, but they also shut



down the production of testosterone — so extra testosterone must be added to maintain a normal hormonal balance.

Researchers at the WHO tested<sup>3</sup> this combination of hormones in 320 men between 2008 and 2012. They combined testosterone undecanoate — a testosterone variant that lasts for longer than normal in the bloodstream — with the progestogen norethisterone enanthate. The study found that nearly 96% of men reached the target for sperm-count reduction. “Those men and their partners had very few pregnancies — that was a big deal,” says Christina Wang, an endocrinologist at the Harbor-UCLA Medical Center in Torrance, California, who was a consultant for the WHO.

Unfortunately, the trial was terminated early because of concern over some adverse events, mainly related to mood swings and injection-related pain. Wang laments the termination, pointing out that the problems resulted mostly from inconsistent reporting of side effects at different sites. “Over 90% of these complaints come from one site,” she says, adding that the facility in question saw a change of leadership part way through. But the WHO was sufficiently concerned to call a halt. “This was really very controversial,” recalls Wang. “They stopped the study without consulting the main investigators, or the people managing it, or the independent data and safety board.”

This trial and others did not result in any clinical approvals, but they did provide some valuable lessons. For example, it became clear that completely stopping spermatogenesis is not practical, so researchers need to identify a cut-off level that leads to effective sterility. In fertile men, ejaculate typically contains more than 15 million sperm per millilitre, and early trials suggested that reducing this to one million per millilitre would be sufficient. “The idea was that one million and below would give you an overall contraceptive efficacy comparable to the female pill,” explains Anderson. But researchers have found that some people take much longer to reach

this threshold than others. “Some men get there in two to four weeks,” says Blithe. “Other men take 16 to 20.”

### **Building excitement**

Research into the combination of testosterone undecanoate and norethisterone enanthate was supported by Berlin-based pharmaceutical company Schering AG until it was acquired by Bayer, based in Leverkusen, Germany, at which point the investment stopped. This left the field with no clear success stories, no established regulatory pathway to market approval, and the difficult task of developing a drug that is safe enough to be used by millions of healthy men. Understandably, pharmaceutical companies have been reluctant to try. “There really aren’t any major companies that I’m aware of with active R&D programmes in male contraception,” says Amory.

This dismal history helps to explain the excitement about an ongoing phase II trial of a combination of testosterone and Nestorone, which is being backed by the NICHD and the non-profit Population Council in New York City. Neither compound can be taken orally, but both are available as topical gels that can be absorbed through the skin. Anderson says that Nestorone is a particularly potent progestogen and remains active in the circulation for twice as long as testosterone, which must be replaced daily. “So there’s a built-in safety mechanism if you miss a dose,” he adds.

An initial trial<sup>4</sup> showed that 84% of men receiving this combination saw their sperm count fall below the threshold of one million sperm per millilitre within 28 days, with no serious adverse events. The gel might also prove more popular than the intramuscular injections used in earlier trials, which were among reasons cited for men dropping out.

The current trial is expected to involve 400 heterosexual couples from the United States, Europe, South America and Africa. Recruitment was paused by the COVID-19 pandemic but is now

half-completed, and the first data are rolling in. “Our first couples have actually finished the trial, and we’ve got a lot who are just finishing their year of contraceptive use,” says Anderson, adding that the efficacy data so far have been encouraging.

According to Amory, who works at the trial’s Seattle site, a small percentage of men are failing to respond to treatment — a similar figure to that in previous hormone trials. These failures are frustrating because there is no clear indicator of who will, or will not, benefit.

But when it works, users are enthusiastic. “I’ve been doing exit interviews with some of these guys, and they love it,” Amory says. With 200 couples left to recruit, and the study lasting roughly 18 months for each couple, proof of effectiveness will be a long time coming. But the process could clarify how the US Food and Drug Administration and other regulators approach approval decisions for male contraceptives.

### **Beyond hormones**

Many researchers favour contraceptives that use hormones because the systems involved are well defined. “We know them, and we know their side effects,” says Wang. But hormones are not the only game in town.

Non-hormonal contraceptives that target the production, function or release of sperm offer a more direct and fast-acting alternative to hormones but bring new risks. In the 1980s, the plant-derived compound gossypol was found to prevent pregnancy in clinical trials in China. Its sterilizing effects proved irreversible in roughly 20% of men, however, and a few experienced episodes of muscular paralysis.

Despite the problems, some promising non-hormonal options are emerging. For example, there is interest in targeting retinoic acid, a compound manufactured from vitamin A that helps to drive spermatogenesis. “It’s been known for a very long time that if you

put mice on a vitamin A-deficient diet they become infertile,” says Gunda Georg, a medicinal chemist at the University of Minnesota in Minneapolis, who has been developing inhibitors of retinoic acid synthesis.

Amory points out that early attempts to suppress the synthesis of retinoic acid blocked an enzyme responsible for alcohol metabolism, such that drinking led to severe sickness. His team has since designed some drug candidates that could suppress the production of retinoic acid without causing such off-target effects.

Several start-up companies are now investing in non-hormonal strategies. Georg has spoken to several companies about her work on compounds that reduce sperm motility. “You could envision it for male contraception, but also for female contraception — for example, you could do a vaginal gel,” she says.

The Male Contraceptive Initiative, based in Durham, North Carolina, has also been funding research on non-hormonal drugs. “We support basic science and discovery as well as preclinical studies and established development programmes that are working towards human trials,” says Logan Nickels, the organization’s research director.

The body is now backing several promising commercial programmes. For example, Revolution Contraceptives, based in San Francisco, California, and Contraline, based in Charlottesville, Virginia, have developed products that physically block the flow of sperm through the vas deferens. In principle, this obstruction can be reversed non-invasively. “They both have promising animal data,” says Nickels, although he notes that data are still lacking in terms of demonstrating full reversibility in live animals or humans. He is also enthusiastic about work from Eppin Pharma, based in Durham, North Carolina, which has developed a pill that reversibly inhibits sperm motility in a non-human primate model.

Any breakthrough could reawaken the interest of big pharma, and Nickels doesn't see the current race as a zero-sum game. Much as women opt for pills, diaphragms or intra-uterine devices, "all of these things are going to be important to establish a mix of methods that fit a lot of different men's lifestyles".

Progress in male contraceptives might seem slow, but Anderson thinks that many men and women are keen to find a good alternative to condoms. "We've just had such a dearth of opportunities for so long that it's become marginalized," he says, "But I think that's more changeable than people recognize."

*Nature* 588, S170-S171 (2020) doi: <https://doi.org/10.1038/d41586-020-03534-4>

This article is part of [Nature Outlook: Reproductive health](#), an editorially independent supplement produced with the financial support of third parties. [About this content](#).

#### References

1 Bearak, J. et al. *Lancet Glob. Health* 8, e1152–e1161 (2020). [PubMed Article Google Scholar](#)

2 World Health Organization Task Force on Methods for the Regulation of Male Fertility. *Fertil. Steril.* 65, 821–829 (1996). [PubMed Article Google Scholar](#)

3 Behre, H. M. et al. *J. Clin. Endocrinol. Metab.* 101, 4779–4788 (2016). [PubMed Article Google Scholar](#)

4 Anawalt, B. D. et al. *Andrology* 7, 878–887 (2019). [PubMed Article Google Scholar](#)

<http://bit.ly/34uNxwx>

## Missing 5,000-year-old piece of Great Pyramid puzzle discovered in cigar box in Aberdeen

*One of only three objects ever recovered from inside the Wonder of the Ancient World*

by Joanne Milne, [University of Aberdeen](#)

A chance discovery at the University of Aberdeen could shed new light on the Great Pyramid with museum staff uncovering a lost artifact—one of only three objects ever recovered from inside the Wonder of the Ancient World.



Credit: University of Aberdeen

In 1872 the engineer Waynman Dixon discovered a trio of items inside the pyramid's Queens Chamber, which became known as the Dixon relics. Two of them—a ball and hook—are now housed in the British Museum however the third, a fragment of wood, has been missing for more than 70 years.

The lost piece of cedar has generated many theories about its purpose and date and holds particular significance because of the potential for radiocarbon dating. Some have speculated that it was part of a measuring rule which could reveal clues regarding the pyramid's construction.

In 2001 a record was identified which indicated the wood fragment may have been donated to the University of Aberdeen's [museum collections](#) as a result of a connection between Dixon and James Grant, who was born in Methlick in 1840.

Grant studied medicine at the University and in the mid-1860s went to Egypt to help with an outbreak of cholera where he befriended Dixon and went on to assist him with the exploration of the Great Pyramid, where together they discovered the relics.

The finding was widely reported at the time, with British newspaper, "The Graphic," carrying a story on the important discovery in December 1872 which stated: "Although they possess remarkable interest, not alone on account of their vast antiquity, but from the evidence they are likely to afford as to the correctness of the many theories formed by Sir Isaac Newton and others as to the weights and measures in use by the builders of the [pyramids](#). The position in which they were left shows that they must have been left there whilst the work was going on, and at an early period of its construction."

Following Grant's death in 1895, his collections were bequeathed to the University, while the 'five inch piece of cedar' was donated by his daughter in 1946. However, it was never classified and despite an extensive search, could not be located.

Then at the end of last year, curatorial assistant Abeer Eladany was conducting a review of items housed in the University's Asia collection.

Abeer, who is originally from Egypt and spent 10 years working in the Egyptian Museum in Cairo, was immediately intrigued and, noting that the item had the country's former flag on the top and did not seem to belong in the Asian collection, cross referenced it with other records. It was then that she realized just what she was holding.

"Once I looked into the numbers in our Egypt records, I instantly knew what it was, and that it had effectively been hidden in plain sight in the wrong collection," she said.

"I'm an archaeologist and have worked on digs in Egypt but I never imagined it would be here in north-east Scotland that I'd find something so important to the heritage of my own country.



**Credit: University of Aberdeen**

"It may be just a small fragment of wood, which is now in several pieces, but it is hugely significant given that it is one of only three items ever to be recovered from inside the Great Pyramid.

"The University's collections are vast—running to hundreds of thousands of items—so looking for it has been like finding a needle in a haystack. I couldn't believe it when I realized what was inside this innocuous-looking cigar tin."

COVID restrictions delayed the dating of the 'lost' cedar fragment which originally belonged to a much larger piece of wood, which was most recently seen in a 1993 exploration of the interior of the pyramid by a robotic camera in hidden and now unreachable voids.

Results have recently been returned and show that the wood can be dated to somewhere in the period 3341-3094BC—some 500 years earlier than historical records which date the Great Pyramid to the reign of the Pharaoh Khufu in 2580-2560BC.

This supports the idea that—whatever their use—the Dixon Relics were original to the construction of the Great Pyramid and not later artifacts left behind by those exploring the chambers.

Neil Curtis, Head of Museums and Special Collections at the University of Aberdeen, said: "Finding the missing Dixon Relic was a surprise but the carbon dating has also been quite a revelation. "It is even older than we had imagined. This may be because the date relates to the age of the wood, maybe from the center of a long-lived tree. Alternatively, it could be because of the rarity of trees in ancient Egypt, which meant that wood was scarce, treasured and recycled or cared for over many years.

"It will now be for scholars to debate its use and whether it was deliberately deposited, as happened later during the New Kingdom, when pharaohs tried to emphasize continuity with the past by having antiquities buried with them.

"This discovery will certainly reignite interest in the Dixon Relics and how they can shed light on the Great Pyramid."

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## **Astronomers detect possible radio emission from exoplanet**

*The signal could be the first radio emission collected from a planet beyond our solar system*

by Blaine Friedlander, [Cornell University](#)

By monitoring the cosmos with a radio telescope array, a Cornell University-led international team of scientists has detected radio bursts emanating from the constellation Boötes. The signal could be the first radio emission collected from a planet beyond our solar system.



The team, led by Cornell postdoctoral researcher Jake D. Turner, Philippe Zarka of the Observatoire de Paris—Paris Sciences et Lettres University and Jean-Mathias Griessmeier of the Université d'Orléans published their findings in the forthcoming research section of the journal *Astronomy & Astrophysics*, on Dec. 16.

"We present one of the first hints of detecting an exoplanet in the radio realm," Turner said. "The signal is from the Tau Boötes system, which contains a [binary star](#) and an exoplanet. We make the case for an emission by the planet itself. From the strength and polarization of the radio signal and the planet's magnetic field, it is compatible with theoretical predictions."

Among the co-authors is Turner's postdoctoral advisor Ray Jayawardhana, the Harold Tanner Dean of the College of Arts and Sciences at Cornell, and a professor of astronomy.

"If confirmed through follow-up observations," Jayawardhana said, "this radio detection opens up a new window on exoplanets, giving us a novel way to examine alien worlds that are tens of light-years away."

Using the Low Frequency Array (LOFAR), a radio telescope in the Netherlands, Turner and his colleagues uncovered emission bursts from a star-system hosting a so-called hot Jupiter, a gaseous giant planet that is very close to its own sun. The group also observed other potential exoplanetary radio-emission candidates in the 55 Cancri (in the constellation Cancer) and Upsilon Andromedae systems. Only the Tau Boötes exoplanet system—about 51 light-years away—exhibited a significant radio signature, a unique potential window on the planet's magnetic field.

Observing an exoplanet's magnetic field helps astronomers decipher a planet's interior and atmospheric properties, as well as the physics of star-planet interactions, said Turner, a member of Cornell's Carl Sagan Institute.

Earth's magnetic field protects it from solar wind dangers, keeping the planet habitable. "The magnetic field of Earth-like exoplanets may contribute to their possible habitability," Turner said, "by shielding their own atmospheres from solar wind and cosmic rays, and protecting the planet from atmospheric loss."

Two years ago, Turner and his colleagues examined the radio emission signature of Jupiter and scaled those emissions to mimic the possible signatures from a distant Jupiter-like [exoplanet](#). Those results became the template for searching radio emission from exoplanets 40 to 100 light-years away.

After poring over nearly 100-hours of radio observations, the researchers were able to find the expected hot Jupiter signature in Tau Boötes. "We learned from our own Jupiter what this kind of detection looks like. We went searching for it and we found it," Turner said.

The signature, though, is weak. "There remains some uncertainty that the detected radio signal is from the planet. The need for follow-up observations is critical," he said.

Turner and his team have already begun a campaign using multiple [radio telescopes](#) to follow up on the signal from Tau Boötes.

*More information:* J.D. Turner et al, *The search for radio emission from the exoplanetary systems 55 Cancri, epsilon Andromedae, and tau Boötis using LOFAR beam-formed observations*, *Astronomy & Astrophysics* (2020). [DOI: 10.1051/0004-6361/201937201](https://doi.org/10.1051/0004-6361/201937201)

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

## **The DNA regions in our brain that contribute to make us human**

### *Pinpointing adaptive human-specific changes in the way genes are regulated in the brain*

With only 1% difference, the human and chimpanzee protein-coding genomes are remarkably similar. Understanding the biological features that make us human is part of a fascinating and intensely debated line of research. Researchers at the SIB Swiss

Institute of Bioinformatics and the University of Lausanne have developed a new approach to pinpoint, for the first time, adaptive human-specific changes in the way genes are regulated in the brain. These results open new perspectives in the study of human evolution, developmental biology and neurosciences. The paper is published in *Science Advances*.

### **Gene expression, not gene sequence**

To explain what sets human apart from their ape relatives, researchers have long hypothesized that it is not so much the DNA sequence, but rather the regulation of the genes (i.e. when, where and how strongly the gene is expressed), that plays the key role. However, precisely pinpointing the regulatory elements which act as 'gene dimmers' and are positively selected is a challenging task that has thus far defeated researchers (see box).

Marc Robinson-Rechavi, Group Leader at SIB and study co-author says: "To be able to answer such tantalizing questions, one has to be able identify the parts in the genome that have been under so called 'positive' selection [see box]. The answer is of great interest in addressing evolutionary questions, but also, ultimately, could help biomedical research as it offers a mechanistic view of how genes function."

### **A high proportion of the regulatory elements in the human brain have been positively selected**

Researchers at SIB and the University of Lausanne have developed a new method which has enabled them to identify a large set of gene regulatory regions in the brain, selected throughout human evolution. Jialin Liu, Postdoctoral researcher and lead author of the study explains: "We show for the first time that the human brain has experienced a particularly high level of positive selection, as compared to the stomach or heart for instance. This is exciting, because we now have a way to identify genomic regions that might have contributed to the evolution of our cognitive abilities!"

To reach their conclusions, the two researchers combined machine learning models with experimental data on how strongly proteins involved in gene regulation bind to their regulatory sequences in different tissues, and then performed evolutionary comparisons between human, chimpanzee and gorilla. "We now know which are the positively selected regions controlling gene expression in the human brain. And the more we learn about the genes they are controlling, the more complete our understanding of cognition and evolution, and the more scope there will be to act on that understanding," concludes Marc Robinson-Rechavi.

### **Positive selection: a hint of the functional relevance of a mutation**

Most random genetic mutations neither benefit nor harm an organism: they accumulate at a steady rate that reflects the amount of time that has passed since two living species had a common ancestor. In contrast, an acceleration in that rate in a particular part of the genome can reflect a positive selection for a mutation that helps an organism to survive and reproduce, which makes the mutation more likely to be passed on to future generations. Gene regulatory elements are often only a few nucleotides long, which makes estimating their acceleration rate particularly difficult from a statistical point of view.

*REFERENCE* Jialin Liu and Marc Robinson-Rechavi, *Robust inference of positive selection on regulatory sequences in the human brain*, *Science Advances*, 2020. DOI: 0.1126/sciadv.abc9863

<http://bit.ly/3pcIBE6>

### **New recipe for antibiotic could prevent deafness**

*A new method of purifying gentamicin, a widely used antibiotic, reduces the risk that it will cause deafness, according to a Stanford Medicine-led study.*

Gentamicin is used in U.S. hospitals to treat a variety of bacterial infections, including infections in newborns and in other susceptible patients, such as those with cystic fibrosis. It's a popular drug in developing countries because it is highly effective and inexpensive. Yet researchers estimate that up to 20% of patients

who are treated with it experience some degree of irreversible hearing loss.

Now, researchers have found a relatively inexpensive way to reformulate the drug, which belongs to a class of antibiotics called aminoglycosides, to be safer. Their findings were published Dec. 7 in the *Proceedings of the National Academy of Sciences*.

"When a drug causes hearing loss, it is devastating, and it's especially disturbing when it happens to a young child, as they rely on hearing to acquire speech," said Alan Cheng, MD, a professor of otolaryngology at the Stanford School of Medicine. He shares senior authorship of the study with Anthony Ricci, PhD, also a professor of otolaryngology at Stanford and the Edward C. and Amy H. Sewall Professor II in the School of Medicine. Cheng is the Edward C. and Amy H. Sewall Professor IV in the School of Medicine. Postdoctoral scholar Mary O'Sullivan, PhD, is the lead author.

"We've developed a simple method of reformulating the drug that should be put to use as soon as possible," Ricci said. The researchers will be writing to the Food and Drug Administration to recommend changes to the organization's requirements for how drug companies make gentamicin.

"Currently, the FDA's instructions for how to make aminoglycosides are making people go deaf," Ricci said.

### **A dangerous recipe**

Aminoglycosides have been in use since the 1950s. The drugs don't need to be refrigerated, which keeps the costs of storing them low. Despite new antibiotics, their use remains commonplace as they are cheap and potent.

"These drugs are used because they save a lot of lives," Ricci said.

"We've stopped paying attention to their toxic side effects because living with hearing loss is better than dying."

The gentamicin used in hospitals today is a mixture of five different subtypes of the antibiotic grown together in the same mixture. The mixture also includes as much as 10% impurities. Using methods such as high-performance liquid chromatography and nuclear magnetic resonance imaging, the researchers tried to figure out how to chemically separate each of the subtypes so they could be tested separately. Once the researchers established methods of separating the different parts of the mixture, they tested these various subtypes of gentamicin individually on inner-ear tissues from animals. They identified the least toxic subtype as C2b, and the most toxic as sisomicin. Both C2b and sisomicin showed the same highly effective antimicrobial properties comparable to the mixture as a whole. The researchers also found that by removing impurities from the mixture, toxicity to the ear tissue was reduced.

"What this study shows is that the formulation that is currently in a hospital bottle of gentamicin is not optimized," Ricci said. The ingredients are required by both federal and international law; one of those is sisomicin, the subtype found to be most toxic to the ear tissue.

"If we just use the subtype that's less toxic or change the formulation of this bottle, we can make the drug much less ototoxic," Ricci said, referring to harm to the ear. Given that the subtypes are all approved by the Food and Drug Administration, new formulations don't necessarily need to be retested in humans and could get to patients fast.

The researchers are also working on plans to create a new aminoglycoside that could further reduce the risk of hearing loss, Ricci said. They've discovered that the inner-ear toxicity of the various subtypes highly correlates with the way they bind to the ion channels that open to the inner ear.

"This discovery lays the groundwork for the discovery of safer antibiotic alternatives and future drug development," he said.

Other Stanford co-authors are medical residents Yohan Song, MD, and Adela Perez, MD; chemist and adjunct lecturer Robert Greenhouse, PhD; research assistant Randy Lin; and research scientist Patrick Atkinson, PhD.

Other institutions that contributed to the study were NANOSYN Inc. in Santa Clara, California, Thermo Fisher Scientific in San Jose and the University of Bern in Switzerland. This work was supported by a grant from the National Institutes of Health (RO1DC014720).

<http://bit.ly/2WA0YGM>

## Deadly 'Brain-Eating' Amoeba Slowly But Surely Expanding Its Footprint in The US

Cases have been appearing farther north in recent years, likely because of [climate change](#)  
Rachael Rettner, Live Science

Deadly "[brain-eating amoeba](#)" infections have historically occurred in the Southern United States. But cases have been appearing farther north in recent years, likely because of [climate change](#), a new study finds.

The study researchers, from the Centers for Disease Control and Prevention (CDC), examined cases of this brain-eating amoeba, known as *Naegleria fowleri*, over a four-decade period in the US.

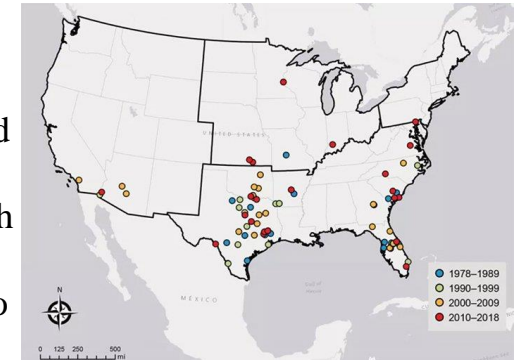
They found that, although the number of cases that occur each year has remained about the same, the geographic range of these cases has been shifting northward, with more cases popping up in Midwestern states than before.

*N. fowleri* is a single-celled organism that's naturally found in warm freshwater, such as lakes and rivers, according to the [CDC](#). It causes a devastating brain infection known as primary amebic meningoencephalitis (PAM), which is almost universally fatal.

Infections occur when contaminated water goes up a person's nose, allowing the organism to enter the brain through the olfactory nerves (responsible for your sense of smell) and destroy brain tissue. Swallowing contaminated water will not cause an infection, the CDC says.

Because *N. fowleri* thrives in warm waters, up to 113 degrees Fahrenheit (45 degrees Celsius), it's possible that warming global temperatures may affect the organisms' geographic range, the authors said.

In the new study, published Wednesday (Dec. 16) in the journal [Emerging Infectious Diseases](#), the researchers analyzed US cases of *N. fowleri* linked to recreational water exposure – such as swimming in lakes, ponds, rivers or reservoirs – from 1978 to 2018.



*Above: Cases of N. fowleri infections tied to recreational water, from 1978 to 2018. (CDC, Emerging Infectious Diseases, 2021)*

They identified a total of 85 cases of *N. fowleri* that met their criteria for the study (i.e. cases that were tied to recreational water exposure and included location data). During this time, the number of yearly reported cases was fairly constant, ranging from zero to six per year.

The vast majority of cases, 74, occurred in southern states; but six were reported in the Midwest, including Minnesota, Kansas and Indiana. Of these six cases, five occurred after 2010, the report said. What's more, when the team used a model to examine trends in the maximum latitude of cases per year, they found that the maximum latitude had shifted about 8.2 miles (13.3 kilometers) northward per year during the study period. Finally, the researchers analyzed weather data from around the date each case occurred, and found that on average, daily temperatures in the two weeks leading up to each case were higher than the historical average for each location.

"It is possible that [rising temperatures](#) and consequent increases in recreational water use, such as swimming and water sports, could



contribute to the changing epidemiology of PAM," the authors wrote.

Efforts to characterize PAM cases, such as knowing when and where these cases occur, and being aware of changes in their geographic range, could help predict when it's riskiest to visit natural swimming holes, the authors said. Since there is no rapid test for *N. fowleri* in water, the only sure way to prevent these infections is to avoid swimming in warm freshwater, the CDC says. If you choose to go swimming in warm freshwater, you can try to avoid having water go up your nose by holding your nose closed, using nose clips or keeping your head above water.

<http://bit.ly/3h7FoTQ>

## The Subaru Telescope photographs the next target asteroid for Hayabusa2

*Hayabusa2 is supposed to approach and observe its next target, the small asteroid 1998 KY26*

On December 10, 2020 (Hawai'i Standard Time), the Subaru Telescope imaged the small asteroid 1998 KY26, the target of Hayabusa2's extended mission. The positional data for 1998 KY26 collected during the observations will be used to more accurately determine the orbital elements of this object.

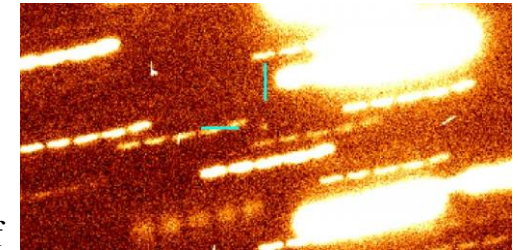
Operated by the Japan Aerospace Exploration Agency (JAXA), the asteroid explorer Hayabusa2 delivered a reentry capsule to Earth containing samples from the asteroid (162173) Ryugu on December 6 (Japan Standard Time). After this drop-off, Hayabusa2 set out again, this time for the extended mission utilizing its remaining fuel. In this extended mission, Hayabusa2 is supposed to approach and observe its next target, the small asteroid 1998 KY26.

This asteroid is predicted to approach to within 0.47 AU of Earth in mid to late December 2020, giving us a rare opportunity that comes only once every three and a half years. However, the diameter of 1998 KY26 is estimated to be no more than 30 meters, and thus its

brightness is so dim that ground-based observations of the asteroid are difficult without a very large telescope.

The observations with the Subaru Telescope were conducted upon the request of the Institute for Space and Astronautical Science (ISAS), JAXA. And as a result, 1998 KY26 was photographed in the direction of the constellation Gemini as a 25.4-magnitude point of light with a measurement uncertainty of 0.7 mag. The positional data collected during these observations will be used to improve the accuracy of the orbital elements of the asteroid. Similar observations were conducted with the Very Large Telescope (VLT) of the European Southern Observatory (ESO).

"We successfully photographed the next target asteroid for Hayabusa2. We hope that these data will facilitate Hayabusa2's new mission," says Dr. Michitoshi Yoshida, Director of Subaru Telescope.



*The asteroid 1998 KY26 (the point of light located at where the two lines would cross) captured by Hyper Suprime-Cam mounted on the Subaru Telescope. The blurring of the background stars is due to the motion of the telescope tracking the asteroid. Five shots, each with a 2-minute exposure time, taken during 2:04-2:16 on December 10, 2020 (Hawai'i Standard Time) were stacked to create this image. The field of view is 30 x 15 arcseconds. NAOJ*

"After returning its reentry capsule to Earth, Hayabusa2 departed for a new target object, a small asteroid known as 1998 KY26. This will be the first mission to this small of an asteroid, so it is very meaningful both in terms of planetary science and planetary defense (protecting Earth from collisions with stellar objects). These Subaru Telescope observations will not only become very important data for Hayabusa2's extended mission, they will also give a boost to future missions. We are grateful to everyone at Subaru Telescope."

says Dr. Makoto Yoshikawa, the Hayabusa2 Mission Manager at ISAS, JAXA.

*These results appeared on December 15, 2020, in the Minor Planet Electronic Circular issued by the IAU Minor Planet Center (MPEC 2020-X181 : 1998 KY26).*

<http://bit.ly/3h2kNAh>

## Don't try this at home: *George's Marvelous Medicine* is quite toxic

*Roald Dahl's classic children's story proved "remarkably accurate" about toxic effects.*

[Jennifer Ouellette](#)

Famed children's author [Roald Dahl](#) greatly admired doctors who pioneered new medicines and even dedicated his 1981 book [George's Marvelous Medicine](#)—in which a young boy cooks up a potion using various ingredients around his family farm—to "doctors everywhere."



*The concoction featured in Road Dahl's 1981 children's book, *George's Marvelous Medicine*, could be harmful—even fatal—to grandmas, new BMJ study finds.*

Copies of the book contain a disclaimer to readers, warning them not to try to make George's concoction at home, as it could be dangerous. And now [a recent paper](#) published in the annual Christmas issue of the British Medical Journal (BMJ) has determined just how toxic the concoction could be if ingested.

The BMJ's Christmas issue is typically more light-hearted in nature, although [the journal maintains](#) that the papers published therein still "adhere to the same high standards of novelty, methodological rigour, reporting transparency, and readability as apply in the regular issue." [Past years](#) have included papers on such topics as why 27 is not a dangerous age for musicians, and the side effects of

sword swallowing, among others. The most widely read was 1999's infamous "[Magnetic resonance imaging of male and female genitals during coitus and female sexual arousal](#)." (We [wrote about the paper](#) last year to mark the 20th anniversary of its publication.)

(Spoilers for the 1981 children's book below.)

In Dahl's book, eight-year-old George Kranky is home alone with his bossy, bullying grandmother, and he decides to concoct his own magic potion to replace her usual medicine as a way of getting even. Among the ingredients he collects from around the family farm: deodorant, shampoo, floor polish, horseradish sauce, gin, engine oil, antifreeze, brown paint, sheep dip, and "purple pills for hoarse horses." When his grandmother drinks it, she grows as tall as a house; so do the family chickens when George gives them a taste of the medicine. When his parents find out, George's father comes up with a scheme to raise giant animals to get rich and end world hunger.

But George can't quite replicate his original recipe, and the fourth version has the opposite effect, causing those who drink it to shrink. George's grandmother mistakes it for tea and drinks the whole thing, shrinking out of existence. In typical Dahl fashion, the family shrugs off the granny's disappearance, and the book ends with George pondering the potential of this new magical world he has discovered. (You can watch/listen to an audio reading of the book on YouTube courtesy of Storyvision Studios UK: [Part 1](#), [Part 2](#), and [Part 3](#).)

Graham Johnson and Patrick Davies of the University of Nottingham's School of Medicine decided to analyze the therapeutic effects and toxicity of the marvelous medicine, using ToxBase, a national database of poisons in the UK. And while they clearly had fun with the project, there is a more serious underlying objective: more than 28,000 children receive treatment for poisoning in the UK each year, according to the authors, and more

than 3,000 children die each year across the European Union. Most unintentional poisonings occur in the home. And with so many young children being home-schooled during the pandemic, there is an increased risk of accidental poisoning via common household items like those George used in his marvelous medicine.



*George serves his marvelous medicine to*

*his grandmother.* YouTube/Storyvision Studios UK

Currently home educators themselves, Johnson and Davies thought it would be fun to concoct a similar mixture to George's, "but without using unsuspecting recipients such as cranky grandmas." With their five young "helpers," the pair conducted the study between March and April of this year. (There are actually three different versions of the paper corresponding to the different ages and reading levels of the helpers.)

Everyone read the book and noted down the ingredients mentioned on paper. Those ingredients were then cross-referenced with ToxBASE. In at least one case (the purple pills for hoarse horses) there was no exact matching ingredient, so the authors matched it to pale purple tablets of an anti-inflammatory, non-steroidal drug called phenylbutazone, often used to treat an equine disease known as "[the strangles](#)" (basically an upper respiratory infection).

The team identified 34 different ingredients from the bathroom (10), the bedroom (4), the laundry room (5), the kitchen (6), the shed (6), and the garage (3). The most common symptoms associated with those ingredients were vomiting, depression of the central nervous system, diarrhea, and myocarditis or arrhythmia. "Our findings suggest that far from being marvelous, George's medicine is in fact incredibly toxic," the authors wrote.

Dahl's descriptions of the likely initial effects proved remarkably accurate. For example, Grandma complains that her stomach is on fire at one point, which could have been caused by the sheep dip, shoe polish, and floor polish. Then Grandma begins to swell, before being punctured and deflating. The authors note that four of the ingredients could cause foaming and gastrointestinal bloating, although "puncture" is not a medically recognized treatment for either. When Grandma's body twists and jerks, that could be a reaction to the sheep dip, antifreeze, engine oil, or grease. As for her impressive growth spurt, "from this point the account of the effects of the medicine diverges from reality," the authors concede.

A more realistic description of the effects of George's medicine would include vigorous vomiting with severe esophageal burns, followed by rapid drowsiness and coma, eventually leading to aspiration pneumonitis and possibly even complete airway obstruction and suffocation. If Grandma survived that stage, she could then develop seizures, myocarditis or arrhythmia, and organ failure, among other lethal symptoms.

In short, "Far from experiencing major growth and invigoration, grandmas and other equally unfortunate recipients would be at high risk of death," the authors concluded. While they are in favor of encouraging scientific exploration and experimentation in children, "It would be wise for parents of budding pharmacists to remain vigilant, particularly during lockdown."

Johnson and Davies also [devised an amusing interactive tool](#) to accompany their paper, enabling readers to create their own unique mixture by choosing different combinations of George's many ingredients and then seeing the likely effects of their custom concoction on the human body. That's a much better virtual outlet for bored kids to explore their chemical creativity.

DOI: BMJ, 2020. [10.1136/bmj.m4467](https://doi.org/10.1136/bmj.m4467) ([About DOIs](#)).



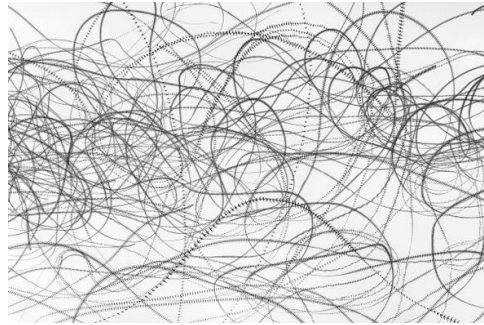
<http://bit.ly/2KJYsLr>

## This Super Speedy Bird Barely Stops to Sleep

*Common swifts zoom around at almost 70mph, may sleep while in flight*

By [Andrea Thompson](#)

What look like tangled lines of abstract art are actually the result of time-lapse photography of the dizzying flight patterns of the common swift (*Apus apus*) taken in Barcelona, Spain, in June 2019.



*These lines are the flight patterns of common swifts (Apus apus), in the city of Barcelona, June 2019. Credit: [Xavi Bou](#)*

“Every morning and afternoon they join in groups to fly in circles or chase each other. They have many different flight behaviors; that's why it's one of my favorites birds to work with,” says photographer Xavi Bou, who took the shot as part of a long-term project called [Ornithographies](#). The aim of the project is to make these otherwise invisible flight paths visible to humans. From their breeding grounds across Europe and Asia to their wintering grounds in Southern Africa, the dark brown birds capture food and material for their nests while airborne. In fact, a 2016 study in *Current Biology* that attached small sensors that measured movement to several swifts in Sweden showed that they [stayed aloft for 99 percent](#) of their 10-month nonbreeding season. The finding raises the possibility that common swifts sleep while airborne, as some other bird species have been shown to do. Swifts can also live up to their name: a 2010 study in the *Journal of Avian Biology* [clocked one bird flying at 69.3 mph](#), the fastest on record for any bird during level flight. The species seems to turn on its turbo drive during “screaming parties,” a social display where they swoop and circle and make high-pitched calls to each other.

<http://bit.ly/2J6zshf>

## Another coronavirus mutation was discovered – and this one might be more dangerous

*Causing more severe illness in younger patients who do not suffer from other medical conditions but can still be defeated with the current vaccines*

By [Chris Smith @chris\\_writes](#)

Like any other pathogen, the novel coronavirus is constantly evolving in response to the hosts it infects. It's a mutation that allowed the virus to jump species between animals and ultimately reach humans. At least, that's what researchers think happened with the original strain that infected the first people. The upcoming WHO investigation in China might uncover more answers about the early days of the Wuhan outbreak.

SARS-CoV-2 continued to mutate after that, with scientists tracking those genetic changes closely. This is crucial because mutations can make a virus more infectious or dangerous and can hinder drug and vaccine research. Several notable novel coronavirus strains have been found so far. The D614G mutation is believed to be responsible for the current status of the pandemic. This mutation doesn't make the virus more dangerous, but it did become more infectious. [D614G left China and infected most of the world](#), returning to Asia a few months later. Since then, other strains have been discovered, including a couple of new coronavirus versions that are spreading rapidly in the UK and South Africa. Now, it appears as though the latter might be more dangerous of the two.

The [Cluster 5 mutation](#) in Danish mink sent the world into a short frenzy a few weeks ago. The local government warned the mutation might evade neutralizing antibodies that can block the virus's spike protein. Those proteins are formed when someone beats the virus after infection or via a vaccine. Mink mutation worries have died



down since the early scare, however, and it appears as though current vaccines may still work against this new strain.

A few days ago, UK health officials announced that another new coronavirus mutation was spreading rapidly in the south of the country. The strain featured 17 distinct genetic changes, most of them impacting the spike protein. [One of them is called N501Y](#), affecting the receptor-binding motif of the spike protein, according to the UK COVID-19 Genomics Consortium. The mutation did not appear to cause more severe illness, according to public health officials.

Now, a few days later, South African authorities have reported another SARS-CoV-2 mutation that's apparently driving the second wave in the country. South Africa is nearing 1 million infections, with more than 24,000 people having died of COVID-19 complications. The second wave started in mid-November, with the country registering more than 10,000 cases in a single day a few days ago. This appears to be the second wave's local peak, but the case count might continue to climb.

South Africa's Health Minister Zweli Mkhize announced the 501.V2 mutation of the virus, [reports The East African](#). Unlike the UK strain, this one might cause more severe illness. The official said on Twitter that local clinicians had found anecdotal evidence of the clinic presentation of patients. They said that a larger proportion of younger people are developing critical illness without suffering from other comorbidities.

"The evidence that has been collated, therefore, strongly suggests that that the second wave we are experiencing is being driven by this new variant," Mkhize said during a virtual briefing on Friday.

The second wave also seems to be spreading faster than the previous one, according to local officials. The Network for Genomics Surveillance in South Africa (NGS-SA) discovered the mutation in several provinces, noting between 10-20 mutations that

were not seen in other strains since September. It's unclear whether the new version came from.

Health officials "remain convinced" that current vaccines will work against the new strain, says *The East African*.

<http://bit.ly/37A2Ky2>

### **Study resolves the position of fleas on the tree of life** *Reordering fleas' placement in the tree of life and pinpointing who their closest relatives are*

A study of more than 1,400 protein-coding genes of fleas has resolved one of the longest standing mysteries in the evolution of insects, reordering their placement in the tree of life and pinpointing who their closest relatives are.



*Genomic study of fleas finds them to be related to scorpionflies* Shutterstock  
The University of Bristol study, published in the journal *Palaeoentomology*, drew on the largest insect molecular dataset available. The dataset was analysed using new statistical methods, including more sophisticated algorithms, to test all historically proposed hypotheses about the placement of fleas on the insect tree of life and search for new potential relationships.

The findings overturn previously held theories about fleas, the unusual anatomy of which has meant that they eluded classification in evolutionary terms. According to the authors of the study, contrary to popular belief, fleas are technically scorpionflies, which evolved when they started feeding on the blood of vertebrates sometime between the Permian and Jurassic, between 290 and 165 million years ago.

The closest living relatives of fleas are the members of the scorpionfly family Nannochoristidae, a rare group with only seven species native to the southern hemisphere. Unlike the blood-thirsty

fleas, adult nannochoristid scorpionflies lead a peaceful existence feeding on nectar.

"Of all the parasites in the animal kingdom, fleas hold a pre-eminent position. The Black Death, caused by a flea-transmitted bacterium, was the deadliest pandemic in the recorded history of mankind; it claimed the lives of possibly up to 200 million people in the 14th century," says lead author and undergraduate student Erik Tihelka from the School of Earth Sciences.

"Yet despite their medical significance, the placement of fleas on the tree of life represents one of the most persistent enigmas in the evolution of insects."

It used to be thought that all blood-feeding parasitic insects began life as either predators or by living alongside vertebrate hosts in their nests. In actual fact, blood feeding can evolve in groups that originally fed on nectar and other plant secretions.



*Scorpion Fly (Panorpa communis)* *Panorpa* is a genus of scorpionflies that is widely dispersed in the Northern hemisphere. [Richard Bartz](#), Munich aka [Makro Freak](#) [Image:MFB.jpg](#) - Own work

"It seems that the elongate mouthparts that are specialized for nectar feeding from flowers can become co-opted during the course of evolution to enable sucking blood," says Mattia Giacomelli, a PhD student at the University of Bristol who participated in the study.

Previous studies had suggested a connection between fleas and anatomically unusual groups of scorpionflies, but their exact relationships remained unresolved. The mystery was prolonged by the fact that flea genomes underwent rapid evolution, which makes reconstructing ancient evolutionary relationships challenging. Moreover, the nannochoristids are a quite rare and little-studied group that only occurs in New Zealand, southeastern Australia, Tasmania, and Chile, so they are easy to overlook.

"The new results suggest that we may need to revise our entomology textbooks. Fleas no longer deserve the status of a separate insect order, but should actually be classified within the scorpionflies," says Chenyang Cai, associate professor at the Nanjing Institute of Geology and Palaeontology (NIGP) and a research fellow at the University of Bristol specialising on Mesozoic insects.

"We have exceptionally preserved fossil fleas from the Jurassic and Cretaceous. In particular, some Jurassic fleas from China, about 165 million years old, are truly giant and measure up to two centimetres. They may have fed on dinosaurs, but that is exceedingly difficult to tell. What is more interesting is that these ancient fleas share important characters with modern scorpionflies."

<http://bit.ly/38py5Tu>

### **Difference in blood pressure between arms linked to greater death risk**

***Robust evidence from a large international study confirms that a difference in blood pressure readings between arms is linked to greater risk of heart attack, stroke and death.***

Led by the University of Exeter, the global INTERPRESS-IPD Collaboration conducted a meta-analysis of all the available research, then merged data from 24 global studies to create a database of nearly 54,000 people. The data spanned adults from Europe, the US, Africa and Asia for whom blood pressure readings for both arms were available.

Funded by the National Institute for Health Research (NIHR) and published today in *Hypertension*, the study is the first to conclude that the greater the inter-arm blood pressure difference, the greater the patient's additional health risk.

Currently, international blood pressure guidelines advise health professionals to measure blood pressure in both arms when assessing cardiovascular risk,- yet this is widely ignored. The new

study provides a new upper limit of 'normal' for an inter-arm difference in blood pressure, which is significantly lower than the current guidance. The research could lead to a change in international hypertension guidelines, meaning more at-risk patients could be identified and receive potentially life-saving treatment.

In a methodology that put patients at its heart, working with a patient advisory group at every step of the research, the team analysed data on inter-arm blood pressure difference, and tracked the number of deaths, heart attacks and strokes that occurred in the cohort over 10 years.

Lead author and GP Dr Chris Clark, of the University of Exeter Medical School, said: "Checking one arm then the other with a routinely used blood pressure monitor is cheap and can be carried out in any healthcare setting, without the need for additional or expensive equipment. Whilst international guidelines currently recommend that this is done, it only happens around half of the time at best, usually due to time constraints. Our research shows that the little extra time it takes to measure both arms could ultimately save lives".

"We've long known that a difference in blood pressure between the two arms is linked to poorer health outcomes. The large numbers involved in the INTERPRESS-IPD study help us to understand this in more detail. It tells us that the higher the difference in blood pressure between arms, the greater the cardiovascular risk, so it really is critical to measure both arms to establish which patients may be at significantly increased risk. Patients who require a blood pressure check should now expect that it's checked in both arms, at least once."

Blood pressure rises and falls in a cycle with each pulse. It is measured in units of millimetres of mercury (mmHg), and the reading is always given as two numbers: the upper (systolic) reading represents the maximum blood pressure and the lower

(diastolic) value is the minimum blood pressure. A high systolic blood pressure indicates hypertension. This affects one third of the adult population and is the single leading cause globally of preventable heart attacks, strokes and deaths. A significant difference between the systolic blood pressure measurements in the two arms could be indicative of a narrowing, or a stiffening, of the arteries, which can affect blood flow. These arterial changes are recognised as a further risk marker for subsequent heart attack, stroke or early death, and should be investigated for treatment.

The researchers concluded that each mmHg difference found between the two arms, elevated predicted 10-year risk of one of the following occurring by one percent; new angina, a heart attack or stroke.

At the moment, both UK and European guidelines recognise a systolic difference of 15 mmHg or more between the two arms as the threshold indicative of additional cardiovascular risk. This new study found that a lower threshold of 10 mmHg was clearly indicative of additional risk, which would mean that far more people should be considered for treatment if such a difference between arms is present. To this end, the research team has created a tool that is easy for clinicians to use, to establish who should be considered for treatment based on their risk, incorporating the blood pressure reading in both arms.

Research co-author Professor Victor Aboyans, head of the department of cardiology at the Dupuytren University Hospital in Limoges, France, said "We believe that a 10 mmHg difference can now reasonably be regarded as an upper limit of normal for systolic inter-arm blood pressure, when both arms are measured in sequence during routine clinical appointments. This information should be incorporated into future guidelines and clinical practice in assessing cardiovascular risk. It would mean many more people were

considered for treatment that could reduce their risk of heart attack, stroke and death."

An interarm difference of greater than 10 mmHg occurs in 11 per cent of people with high blood pressure (hypertension) - itself a known health risk - and in four per cent of the general population.

*The INTERPRESS-IPD collaboration includes Oxford and Glasgow Universities, the Université de Limoges in France and the Université du Québec à Trois-Rivières in Canada, working with colleagues in Spain, Taiwan, the USA, Denmark, Sweden, Germany, China, the Netherlands, Wales and Scotland.*