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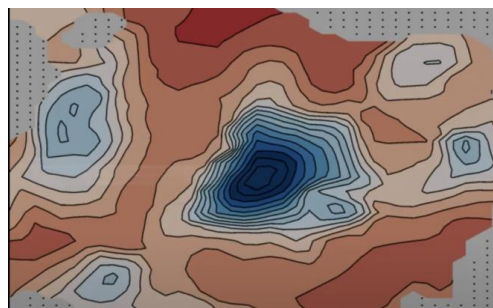
## Another look at possible under-ice lakes on Mars: They're still there

*It can be tough to spot water under an ice cap from orbit.*

[John Timmer](#)

In recent decades, we've become aware of lots of water on Earth that's deep under ice. In some cases, we've watched this water nervously, as it's deep underneath ice sheets, where it could lubricate the sheets' slide into the sea. But we've also discovered lakes that have been trapped under ice near the poles, possibly for millions of years, raising the prospect that they could harbor ancient ecosystems.

Now, researchers are applying some of the same techniques that we've used to find those under-ice lakes to data from Mars. And the results support an earlier claim that there are bodies of water [trapped under the polar ice](#) of the red planet.



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### Spotting liquids from orbit

Mars clearly has extensive water locked away in the form of ice, and some of it cycles through the atmosphere as orbital cycles make one pole or the other a bit warmer. But there's not going to be pure liquid water on Mars—the temperatures just aren't high enough for very long, and the atmospheric pressures are far too low to keep any liquid water from boiling off into the atmosphere.

Calculations suggest, however, that liquid water *is* possible on Mars—just not on the surface. With enough dissolved salts, a water-rich brine could remain liquid at the temperatures prevalent on Mars—even in the polar areas. And if it's trapped under the Martian surface, there might be enough pressure to keep it liquid

despite the thin atmosphere. That surface could be Martian soil, and people are [thinking about that possibility](#). But the surface could also be one of the ice sheets we've spotted on Mars.

That possibility helped motivate the design of the MARSIS (Mars Advanced Radar for Subsurface and Ionosphere Sounding) on the [Mars Express orbiter](#). MARSIS is a radar device that uses wavelengths that water ice is transparent to. As a result, most of the photons that come back to the instrument are reflected by the interface between ice and something else: the atmosphere, the underlying bedrock, and potentially any interface between the ice and a liquid brine underneath it.

And that's what the original results, published in 2018, seemed to indicate. In an area called Ultimi Scopuli near Mars' south pole. The researchers saw a bright reflection, distinct from the one caused by the underlying bedrock, at some specific locations under the ice. And they interpreted this as indicating a boundary between ice and some liquid brines.

### Now with more data

Two things have changed since those earlier results were done. One is that Mars Express has continued to pass over Mars' polar regions, generating even more data for analysis. The second is that studies of ice-covered lakes on Earth have also advanced, with new ones identified from orbit using similar data. So some of the team behind the original work decided it was time to revisit the ice sheets at Ultimi Scopuli.

The analysis involves looking at details of the photons reflected back to the MARSIS instrument from a 250 x 300 square kilometer area. One aspect of that is the basic reflectivity of the different layers that can be discerned from the data. Other aspects of the signal can tell us about how smooth the surface of the reflective boundaries are and whether the nature of the boundary changes suddenly.

For example, the transition from an ice-bedrock boundary to an ice-brine one would cause a sudden shift from a relatively weak, uneven signal to a brighter and smoother one.

The researchers generated separate maps of the intensity and the smoothness of the signal and found that the maps largely overlapped, giving them confidence that they were identifying real transitions in the surfaces. A separate measure of the material (called permittivity) showed that it was high in the same location.

Overall, the researchers found that the largest area that's likely to have water under the ice as about 20 by 30 kilometers. And it's separated by bedrock features from a number of similar but smaller bodies. Calling these bodies "lakes" is speculative, given that we have no idea how deep they are. But the data certainly is consistent with some sort of under-ice feature—even if we use the standards of detection that have been used for under-ice lakes on Earth.

### **How did that get there?**

The obvious question following the assumption that these bodies are filled with a watery brine is how that much liquid ended up there. We know that these salty solutions can stay liquid at temperatures far below the freezing point. But the conditions on Mars are such that most of minimum temperatures for water to remain liquid are right at the edge of the possible conditions at the site of the polar ice sheets. So some people have suggested geological activity as a possible source of heat to keep things liquid. That's not necessarily as unlikely as it may sound. Some groups have proposed that some features indicate that there was magma on the surface of Mars as recently as 2 million years ago. But the researchers here argue that if things are on the edge of working under current climate conditions, there's no need to resort to anything exceptional.

Instead, they suggest that the sorts of salts we already know are present on Mars can absorb water vapor out of the thin Martian

atmosphere. Once formed, these can remain liquid down to 150 Kelvin, when the local temperatures at Ultimi Scopuli are likely to be in the area of 160 Kelvin and increase with depth.

And if that's true, there could be liquid in many more locations at Mars' poles. Not all of them are as amenable to orbital imaging as Ultimi Scopuli, but it's a safe bet that this team will try to find additional ones.

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<https://bit.ly/33neq5e>

## **Deadly Spread of Some Cancers May Be Driven by a Common Mouth Microbe**

*An ordinary bacterium can trigger changes in some primary tumors that lead to dangerous metastasis*

By [Claudia Wallis](#)

When people hear that they might have cancer, perhaps the only thing more frightening than the C word is the M word. Metastatic disease—in which the malignancy has traveled beyond its primary site to other spots in the body—is responsible for nine out of every 10 cancer deaths.

Recently an unexpected player in this process has emerged: a common bacterium. *Fusobacterium nucleatum*, which normally lives harmlessly in the gums, appears to have a role in the spread of some cancers of the colon, esophagus, pancreas and—possibly—breast. Laboratory studies and evidence in patients indicate that the microbe can travel through the blood and infect tumor cells by attaching to a sugar molecule on their surface. There it provokes a range of signals and immune responses known to cause tumor cells to migrate. If further confirmed, the work with *F. nucleatum* could add to a growing understanding of how the microbiome influences cancer progression and may even point the way to fresh approaches to treatment.

In a healthy human mouth, *F. nucleatum* is a law-abiding member

of the microbial community. With poor dental hygiene, uncontrolled diabetes and other conditions, however, it can go rogue and cause periodontitis, tonsillitis, appendicitis and even preterm labor. A connection to colorectal cancer was first hinted at about nine years ago, when two research groups discovered that the bacterium's DNA was overrepresented in colon tumor tissue compared with normal tissue. Dozens of studies have since found that the infection in tumor cells is a sign of trouble: it is linked to a poorer prognosis in patients with pancreatic, esophageal or colorectal cancer; resistance to chemotherapy in the latter two groups; and metastasis in colorectal cancer, which is the [world's third most common and second most deadly malignancy](#).

Still, the question remained: Is this bug merely a warning sign, or is it an active participant in cancer progression? This year at least three studies of colon cancer, by separate teams, pointed to an active role. “We reached the same conclusion through different pathways,” says biochemist Daniel Slade of Virginia Tech. [Slade and his colleagues](#) found that when cultured human colon tumor cells were invaded by the bacterium, they produced two inflammatory proteins called cytokines—specifically, interleukin-8 and CXCL1—that have been shown to promote the migration of malignant cells, a step in metastasis. [A second paper reported](#) that the bacterium induces changes in gene regulation that boost metastasis to the lungs in mice. [A third study determined](#) that the abundance of *F. nucleatum* in human colon cancer tissue correlates with the amount of metastases and, in mice, identified additional signals by which the microbe may “orchestrate” metastasis. Slade and others have also demonstrated that the bacterium incites a kind of cytokine storm that is aimed at controlling the infection but that ultimately exacerbates the cancer. “It's like throwing gas on an already lit fire,” Slade says.

Something similar may be going on in some breast tumors. In [June](#)

a team led by microbiologist Gilad Bachrach of Hebrew University reported finding *F. nucleatum* DNA in 30 percent of the human breast cancer tissue examined; the bacterium was most common in cancer cells that expressed a lot of the surface sugar molecule Gal/GalNAc. Researchers also showed that the infection promotes growth of both primary tumors and metastases in mouse models of breast cancer. “The data imply that fusobacterium is not a cause of cancer, but it can accelerate progression,” Bachrach says.

How much this is happening in humans is, of course, a critical question. “The findings are intriguing, and it makes sense,” says Joan Massagué of Memorial Sloan Kettering Cancer Center, who is a leading investigator of metastasis. Inflammation is invariably part of the metastatic process, he says, so an infection that incites a dramatic inflammatory reaction in a tumor will have a consequence: “it helps cancer cells engage in mobile, invasive behavior.”

The discoveries about fusobacterium are part of a fast-moving field that is illuminating the way the microbiome both promotes and battles cancer. Many modern immunotherapy drugs, for instance, work best in the presence of beneficent microbes—as do some older chemotherapies. Some scientists envision that fusobacterium eventually could be turned into a cancer fighter. Given the microbe's attraction to a sugar on tumor cells, they suggest, perhaps it could be deployed as a Trojan horse, bound to cancer drugs and carrying them straight to a malignant target.

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## About 80% of Asymptomatic People With COVID-19 Develop Symptoms

*Most asymptomatic patients should be considered presymptomatic.*

**Damian McNamara**

Approximately 20% of asymptomatic people who test positive for COVID-19 will remain symptom-free over time, according to two studies published September 22 in different journals. The

researchers propose, therefore, that most asymptomatic patients should be considered presymptomatic.

"Only a minority of people with SARS-CoV-2 have a truly asymptomatic infection. Most patients with SARS-CoV-2 who are asymptomatic at the time of testing will go on to develop symptoms," study author Nicola Low, MD, head of the Research Group at the Institute of Social and Preventive Medicine at the University of Bern in Switzerland, told *Medscape Medical News*.

The result also suggests expanded testing for SARS-CoV-2 infection is warranted, especially among those at higher risk, and supports use of control measures including masks, physical distancing, and isolation.

"People with asymptomatic infection are infectious. All should be isolated and contact tracing should be started," Low added.

Low and colleagues performed a [living systemic review and meta-analysis](#) evaluating the occurrence and transmission of asymptomatic and presymptomatic patients. They published their findings in *PLOS Medicine*.

Sung-Han Kim, MD, PhD, and co-investigators conducted a [study comparing levels of SARS-CoV-2](#) in the nose and throat of asymptomatic vs symptomatic individuals published in the journal *Thorax*.

The research teams out of Switzerland and South Korea point to a need for more clarity on which patients with COVID-19 are asymptomatic vs presymptomatic. Most previous researchers tested people for SARS-CoV-2 infection at a single time, preventing identification of the percentage who subsequently developed symptoms.

The previous work also has been heterogeneous. "Researchers have investigated the proportion with asymptomatic infection in a wide range of settings, including hospitals, as part of outbreaks, through contact tracing, and through screening," Low said. The variability

between estimates was "very high," from 3% to 83% in individual studies, she added.

### **Main Meta-Analysis Findings**

Low and colleagues searched PubMed, Embase, bioRxiv and MedRxiv for relevant studies. The "living" meta-analysis reflects ongoing updates in March, April, and June of this year. They used reverse transcriptase polymerase chain reaction (RT-PCR) testing for SARS-CoV-2. The data included a statistical modeling study of all 634 passengers from the [Diamond Princess cruise ship](#) with RT-PCR positive test results.

Overall, in 79 studies conducted in a range of different settings, 20% of people with SARS-CoV-2 infection remained asymptomatic during follow-up. When confined to seven studies that screened defined populations with follow-up, a higher proportion (31%) remained asymptomatic over time.

The researchers caution their asymptomatic estimate was limited by biases in study designs. Furthermore, they found it difficult to identify the proportion of asymptomatic and presymptomatic patients who contribute to the overall transmission of SARS-CoV-2. A subset of five studies include detailed contact tracing. From this data, the investigators calculated the risk of asymptomatic people transmitting SARS-CoV-2 was lower (summary risk ratio, 0.35, compared with symptomatic people at 0.63). More trials are needed to confirm these findings, they note.

"The findings from systematic reviews, including ours, do not support the claim that a large majority of SARS-CoV-2 infections are asymptomatic," they add. Furthermore, because SARS-CoV-2 can be transmitted a few days before an infected person develops symptoms, "presymptomatic transmission likely contributes substantially to overall SARS-CoV-2 epidemics."

### **Similar Viral Loads Found in South Korea**

Kim and colleagues found almost the same proportion, 19% of 213

patients, without severe symptoms of COVID-19 remained asymptomatic through potential exposure, lab confirmation, and hospital admission. The upper respiratory tract viral load did not differ significantly between asymptomatic and symptomatic individuals in upper respiratory tract samples in South Korea.

"Our data adds to the recent growing body of evidence that asymptomatic individuals with SARS-CoV-2 infection are indeed contributing to the ongoing community spread of COVID-19, senior study author Kim told *Medscape Medical News*.

The mean cycle threshold (Ct) values of SARS-CoV-2 genes, which reflect the viral load, "were highly similar between asymptomatic individuals and symptomatic patients," added Kim, professor of infectious diseases and chief of the Office of Infection Control at Asan Medical Center in Seoul, South Korea.

The findings suggest that asymptomatic individuals have "a comparable potential for spreading the virus as much as symptomatic patients," he said. "To prevent the transmission from asymptomatic individuals with SARS-CoV-2 infection, the use of face masks by the general public — regardless of the presence of symptoms — is highly recommended."

The study was feasible because of a unique situation — a COVID-19 outbreak in Daegu City was traced to a single religious group. The 3000 close contacts identified reported symptoms from none to severe, and the asymptomatic people were isolated and monitored in dedicated facilities.

"We were able to assess many asymptomatic individuals who were otherwise unlikely to be identified as cases of COVID-19," the investigators note.

A subset of 183 patients, including 39 asymptomatic people and 144 who were symptomatic, underwent follow-up RT-PCR testing. Swab samples from the nasopharynx and oropharynx were combined in a single assay. As most asymptomatic people with

COVID-19 continue to live in a community setting, the researchers note, "such individuals may act as an essential driving force for the community spread of COVID-19 and the ongoing pandemic state."

A limitation of the study was a population largely composed of individuals in their 20s and 30s, so the generalizability to other age groups is unknown.

### **Uncertainty Remains**

"These studies represent valuable contributions, but also underline how much uncertainty remains. Neither says much about asymptomatic transmission," Jonathan Dushoff, PhD, professor, Department of Biology, McMaster University, Hamilton, Canada, told *Medscape Medical News* when asked to comment on the research.

"They don't seem to me to change the consensus that people without symptoms, whether asymptomatic or presymptomatic, should be seen as potential spreaders, even though there is weak evidence that they are less contagious than people with symptoms," added Dushoff, who [coauthored a study](#) on the timing of asymptomatic SARS-CoV-2 transmission published in June in the journal *Epidemics*.

### **Not an Easy Task**

"It would be actually difficult and challenging to provide a real estimate of the asymptomatic transmission rates," Lei Huang, MD, told *Medscape Medical News* when asked to comment. People without symptoms may be unaware that they were exposed to someone else during the virus incubation period, Huang added.

Studying a randomly selected population, one that is representative and generalizable to settings where disease transmission is known to occur, would be a more ideal approach, Huang said.

The current research "suggests that in places where transmission has occurred, it would always be helpful to pay special attention to self-protection, even when facing someone who appears to be

perfectly healthy," said Huang, lead author of a [prospective, contact-tracing study](#) that revealed rapid transmission of COVID-19 in asymptomatic people aged 16 to 23 years.

"While the chance of transmission from asymptomatic cases may be lower than from symptomatic ones, the importance of asymptomatic transmission should never be ignored considering the uncertainty of the real proportion of asymptomatic cases," said Huang, who is affiliated with the Department of General Surgery, the First Affiliated Hospital of Anhui Medical University, Anhui Province, China.

*Low is a member of the PLOS Medicine editorial board. Kim, Dushoff, and Huang have disclosed no relevant financial relationships.*

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*PLOS Med. Published online September 22, 2020. [Full text](#)*

*Thorax. Published online September 22, 2020. [Full text](#)*

<https://bit.ly/33nMFJV>

## **A Once-in-a-Century Climate 'Anomaly' Might Have Made World War I Even Deadlier**

***Abnormally bad season of weather may have had a significant impact on the death toll from both World War I and the [1918](#)***

***[Spanish flu pandemic](#)***

***[David Nield](#)***

An abnormally bad season of weather may have had a significant impact on the death toll from both World War I and the [1918 Spanish flu pandemic](#), according to new research, with many more lives being lost due to torrential rain and plummeting temperatures. Through a detailed analysis of an ice core extracted from the Swiss-Italian Alps, scientists were able to get a close look at the climate patterns across Europe between 1914 and 1919, linking them to the

war and the [pandemic](#) for the first time.

The unusually wet and cold conditions could well have contributed to more lives being lost out on the battlefield, as well as interfering with bird migration behaviour – potentially pushing birds and people closer together than they would otherwise have been.

"Atmospheric circulation changed and there was much more rain, much colder weather all over Europe for six years," [says climate scientist Alexander More](#) from Harvard University. "In this particular case, it was a once in a 100-year anomaly."

"I'm not saying that this was 'the' cause of the pandemic, but it was certainly a potentiator, an added exacerbating factor to an already explosive situation."

Of course, accounts of atrocious conditions in the trenches of the First World War are not new – the rain and mud has been well documented. What this new research does is link those conditions with the once-in-a-century environmental patterns.

Traces of sea salt trapped in the ice core revealed extremely unusual influxes of Atlantic ocean air and associated rainfall in the winters of 1915, 1916, and 1918 – coinciding with peaks in mortality rates on the European battlefield.

Close to 10 million military personnel are thought to have died in the First World War in total. Problems such as trench foot and frostbite would have been exacerbated by the constantly damp conditions, while the quagmires created on the battlefield meant it was much harder to recover and rescue wounded soldiers. Drowning, exposure, and [pneumonia](#) claimed more lives.

"We found the association between increased wetter and colder conditions and increased mortality to be especially strong from mid-1917 to mid-1918, spanning the period from the third [battle of Ypres](#) to the first wave of Spanish flu," [says archaeologist Christopher Loveluck](#) from the University of Nottingham in the UK.

Besides making bad conditions worse for soldiers, the researchers

suggest this climate anomaly may have played a big role in creating the perfect environment for the [H1N1 influenza strain](#) to trigger a deadlier second wave of the Spanish flu, which picked up as the war ended.

This part of the research is more speculative, but the study points to the bad weather as a reason for mallard ducks – a primary reservoir of H1N1 – to stay put in western Europe, rather than migrating to Russia as normal. This would have kept them closer to military and civilian populations already struggling with unhygienic conditions.

More water would've meant a faster spread of the [virus](#) as it mixed with bird droppings, the researchers suggest, and perhaps the transmission of a more virulent strain of the flu that went on to kill 2.64 million people in Europe. With the world once again facing a pandemic and climate anomalies today, there might be important lessons to learn here.

The research has been published in [GeoHealth](#).  
<https://bit.ly/33pHo4C>

## Scientists Say They've Determined The Total Amount of Matter in The Universe

*The stuff that makes up our Universe is tricky to measure, to put it mildly.*

[Michelle Starr](#)

We know that most of the Universe's matter-energy density consists of [dark energy](#), the mysterious unknown force that's driving the Universe's expansion. And we know that the rest is matter, both normal and dark.

Accurately figuring out the proportions of these three is a challenge, but researchers now say they've performed one of the most precise measurements yet to determine the proportion of matter.

According to their calculations, normal matter and [dark matter](#) combined make up 31.5 percent of the matter-energy density of the Universe. The remaining 68.5 percent is dark energy.

"To put that amount of matter in context, if all the matter in the Universe were spread out evenly across space, it would correspond to an average mass density equal to only about six hydrogen atoms per cubic meter," [said astronomer Mohamed Abdullah](#) of the University of California, Riverside and the National Research Institute of Astronomy and Geophysics in Egypt.

"However, since we know 80 percent of matter is actually dark matter, in reality, most of this matter consists not of hydrogen atoms but rather of a type of matter which cosmologists don't yet understand."

Understanding dark energy is actually crucial to our understanding of the Universe. We don't know what it is, exactly - the 'dark' in the name refers to that mystery - but it appears to be the force that drives the expansion of the Universe, the velocity of which has [proven incredibly difficult to narrow down past a certain point](#).

Once we have a better understanding of the expansion rate, that will improve our grasp of the evolution of the Universe as a whole. Hence, constraining the properties of dark energy is a pretty important undertaking for cosmology in general, and there are a number of ways to do so.

Abdullah and his team employed a method based on the way things move around in galaxy clusters - groups of up to thousands of galaxies gravitationally bound together. Generally, galaxy clusters are a good tool for measuring matter in the Universe. That's because they're made up of matter that has come together over the lifetime of the Universe, about 13.8 billion years, under gravity.

The number of clusters we can observe in a volume of space is highly sensitive to the amount of matter, so counting them can give a reasonable measurement. But, again, that's not a simple task.

"A higher percentage of matter would result in more clusters," [Abdullah said](#). "The 'Goldilocks' challenge for our team was to measure the number of clusters and then determine which answer

was 'just right'. But it is difficult to measure the mass of any galaxy cluster accurately because most of the matter is dark so we can't see it with telescopes."

The team found a way around this problem with a technique called GalWeight. It uses the orbits of galaxies in and around a cluster to determine which galaxies actually belong to any given cluster, and which do not, with over 98 percent accuracy. This, they said, provides a more accurate census of that cluster, in turn leading to a more accurate mass calculation.

"A huge advantage of using our GalWeight galaxy orbit technique was that our team was able to determine a mass for each cluster individually rather than rely on more indirect, statistical methods," [explained astronomer Anatoly Klypin](#) of New Mexico State University.

The team applied their technique to observations collected by the [Sloan Digital Sky Survey](#), and created a catalogue of galaxy clusters. These clusters were then compared to numerical simulations of galaxies to calculate the total amount of matter in the Universe. The team's result - 31.5 percent matter and 68.5 percent dark energy - is in [close agreement with other measurements](#) of the Universe's matter-energy density. "We have succeeded in making one of the most precise measurements ever made using the galaxy cluster technique," [said astronomer Gillian Wilson](#) of UC Riverside. "Moreover, this is the first use of the galaxy orbit technique which has obtained a value in agreement with those obtained by teams who used noncluster techniques such as [cosmic microwave background](#) anisotropies, baryon acoustic oscillations, Type Ia supernovae, or gravitational lensing."

This result, the team says, demonstrates that GalWeight could prove to be a very useful tool for continuing to probe and constrain the cosmological properties of the Universe.

The research has been published in [The Astrophysical Journal](#).

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## Nature's Splendor Exceeds Our Imagination

*When you're unprepared to find exceptional things, you never will*

By [Avi Loeb](#)

The sincerest expression of love is to learn the characteristics of the object of our affection as they are, without reservations or prejudice. By this definition, the pursuit of scientific knowledge is the ultimate act of loving nature in its full splendor. Scientific inquiry can only enhance the awe we feel when witnessing reality in all of its quantitative detail.

The beauty of nature comes for free. The fact that all phenomena in the physical world obey a small set of strict laws is remarkable, given how difficult it is to enforce societal laws in the human world.

I often imagine how disorganized the universe could have been if it resembled my daughters' rooms each morning.

We tend to feel hubris when we contemplate cutting-edge technological accomplishments, such as [self-driving cars](#). But in fact, a more balanced perspective requires [humility](#), not hubris. Following a recent injury, my body healed from its bruises faster than it took my optometrist to get me a new pair of glasses. Our most advanced technologies are yet to produce a self-healing car that repairs itself after accidents like the human body.

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Nature is not just beautiful; it exceeds the limits of our imagination. Relatively recent examples in astronomy include the unexpected discoveries of [dark matter](#) and [dark energy](#) whose nature are still mysterious; the ubiquity of "[hot Jupiters](#)" that hug their suns in tight orbits, in contrast to the Jupiter in our own planetary system; or the [strange properties](#) of [Oumuamua](#), the first interstellar object discovered in the solar system. This experience is generic to all research fields, making science a learning experience in which we



expand our ability to imagine simply by observing reality.

The scientific process is a dialogue with nature where we propose theoretical ideas and listen to nature's response through our experiments, rather than [a monologue](#) in which we focus on mathematical beauty and simply assume its relevance to reality. Figuring out the subtleties of nature is more challenging than proving theorems in mathematics, because the latter activity involves only the human. But there is only one physical reality out there, out of an infinite number of possibilities that could have existed. The outcome of our scientific inquiry is not up to us: reality is predetermined by nature.

While pursuing research, we could miss important discoveries if we expect the future course of science to resemble its past history. When you are not ready to find exceptional things, you will never discover them. The 1995 discovery of the first “hot Jupiter,” [51 Pegasi b](#), by Michel Mayor and Didier Queloz, for which they won the [2019 Nobel Prize in Physics](#), confirmed [a theoretical proposal by Otto Struve](#) from 1952. The four-decade delay was caused by the refusal of the mainstream to allocate telescope time for a hot Jupiter search based on the argument that it would violate what we “know” about the solar system. A [similar sort of delay](#) predated the 1992 discovery of the first [Kuiper belt](#) object in the outer solar system by David Jewitt and Jane Luu.

These examples illustrate how scientists rely on conventional wisdom to decide what's true rather than having the humility to subject their assumptions to experimental tests. Before [Galileo Galilei](#), it was the conventional wisdom that heavy objects fall faster than light objects under the influence of gravity. But he dared to conduct an experimental test that proved this notion wrong, and established the “[equivalence principle](#),” which in turn became a foundation for Albert Einstein's theory of [general relativity](#). In reaction to his contesting [another false prejudice](#)—that the sun

orbits the Earth—Galileo was kept in house arrest for nine years until his death in 1642. But this did not make the sun revolve around the Earth nine times; it only delayed the natural progression of scientific knowledge.

Reluctance to test new ideas based on the conviction that they are “unreasonable” is not the only repeating pattern since the days of Galileo. There is also the tendency, after data are taken, to ignore anomalies—to downplay the unexplained and declare “business as usual” even in the face of contradicting evidence. Giant arcs of light around the cores of clusters of galaxies appeared in images that were published in the *Astrophysical Journal*, but were ignored until the topic of [gravitational lensing](#) became fashionable in the 1980s. In this case, [Fritz Zwicky](#) predicted such arcs [in 1937](#), more than four decades earlier.

Scientists are not immune to wishful thinking, and a reality check on their convictions is mandatory. This is a particularly important lesson to keep in mind when considering the risk from in-person events before an experimentally tested vaccine for COVID-19 is widely available. Scientific rigor should not be compromised, especially in life-and-death situations.

In a recent exchange with a philosopher who suggested that there is “no loss” inherent in our natural death because we do not own our future, I responded that from the perspective of astronomy, death involves losing the ability to follow the universe [as it evolves](#). The experience of death therefore feels like being in a concert hall, with the usher escorting you out while the orchestra is still playing the symphony. It is a fundamentally lesser experience to listen just to a part of the symphony, whose full meaning and beauty is apparent from the whole. Cutting our stay short represents a loss. He conceded.

The human being as a spectator of nature appears on occasion comical, at other times tragic, but most of the time insignificant

relative to everything else taking place out there. Humanity's lack of imagination should be forgiven as a temporary handicap that scientists are attempting to repair. Education takes time even when the students love the class.

<https://bit.ly/36rcRVW>

### **The ancient Neanderthal hand in severe COVID-19**

*Genetic variants that leave their carrier more susceptible to severe COVID-19 are inherited from Neanderthals, a new study finds.*

Since first appearing in late 2019, the novel virus, SARS-CoV-2, has had a range of impacts on those it infects. Some people become severely ill with COVID-19, the disease caused by the virus, and require hospitalization, whereas others have mild symptoms or are even asymptomatic.

There are several factors that influence a person's susceptibility to having a severe reaction, such as their age and the existence of other medical conditions. But one's genetics also plays a role, and, over the last few months, research by the COVID-19 Host Genetics Initiative has shown that genetic variants in one region on chromosome 3 impose a larger risk that their carriers will develop a severe form of the disease.

Now, a new study, [published in Nature](#), has revealed that this genetic region is almost identical to that of a 50,000-year old Neanderthal from southern Europe. Further analysis has shown that, through interbreeding, the variants came over to the ancestors of modern humans about 60,000 years ago.

"It is striking that the genetic heritage from Neanderthals has such tragic consequences during the current pandemic," said Professor Svante Pääbo, who leads the Human Evolutionary Genomics Unit at the Okinawa Institute of Science and Technology Graduate University (OIST).

### **Is severe COVID-19 written in our genes?**

Chromosomes are tiny structures that are found in the nucleus of

cells and carry an organism's genetic material. They come in pairs with one chromosome in each pair inherited from each parent. Humans have 23 of these pairs. Thus, 46 chromosomes carry the entirety of our DNA -- millions upon millions of base pairs. And although the vast majority are the same between people, mutations do occur, and variations persist, at the DNA level.

The research by the COVID-19 Host Genetics Initiative looked at over 3,000 people including both people who were hospitalized with severe COVID-19 and people who were infected by the virus but weren't hospitalized. It identified a region on chromosome 3 that influences whether a person infected with the virus will become severely ill and needs to be hospitalized.

The identified genetic region is very long, spanning 49.4 thousand base pairs, and the variants that impose a higher risk to severe COVID-19 are strongly linked -- if a person has one of the variants then they're very likely to have all thirteen of them. Variants like these have previously been found to come from Neanderthals or Denisovans so Professor Pääbo, in collaboration with Professor Hugo Zeberg, first author of the paper and a researcher at the Max Planck Institute for Evolutionary Anthropology and Karolinska Institutet, decided to investigate whether this was the case.

They found that a Neanderthal from southern Europe carried an almost identical genetic region whereas two Neanderthals from southern Siberia and a Denisovan did not.

Next, they questioned whether the variants had come over from Neanderthals or had been inherited by both Neanderthals and present-day people through a common ancestor.

If the variants had come from interbreeding between the two groups of people, then this would have occurred as recently as 50,000 years ago. Whereas, if the variants had come from the last common ancestor, they would have been around in modern humans for about 550,000 years. But random genetic mutations, and recombination

between chromosomes, would have also occurred during this time and because the variants between the Neanderthal from southern Europe and present-day people are so similar over such a long stretch of DNA, the researchers showed that it was much more likely that they came from interbreeding.

Professor Pääbo and Professor Zeberg concluded that Neanderthals related to the one from southern Europe contributed this DNA region to present-day people around 60,000 years ago when the two groups met.

### Neanderthal variants pose up to three times the risk

Professor Zeberg explained that those who carry these Neanderthal variants have up to three times the risk of requiring mechanical ventilation. "Obviously, factors such as your age and other diseases you may have also affect how severely you are affected by the virus. But among genetic factors, this is the strongest one."

The researchers also found that there are major differences in how common these variants are in different parts of the world. In South Asia about 50% of the population carry them. However, in East Asia they're almost absent.

It is not yet known why the Neanderthal gene region is associated with increased risk of becoming severely ill. "This is something that we and others are now investigating as quickly as possible," said Professor Pääbo.

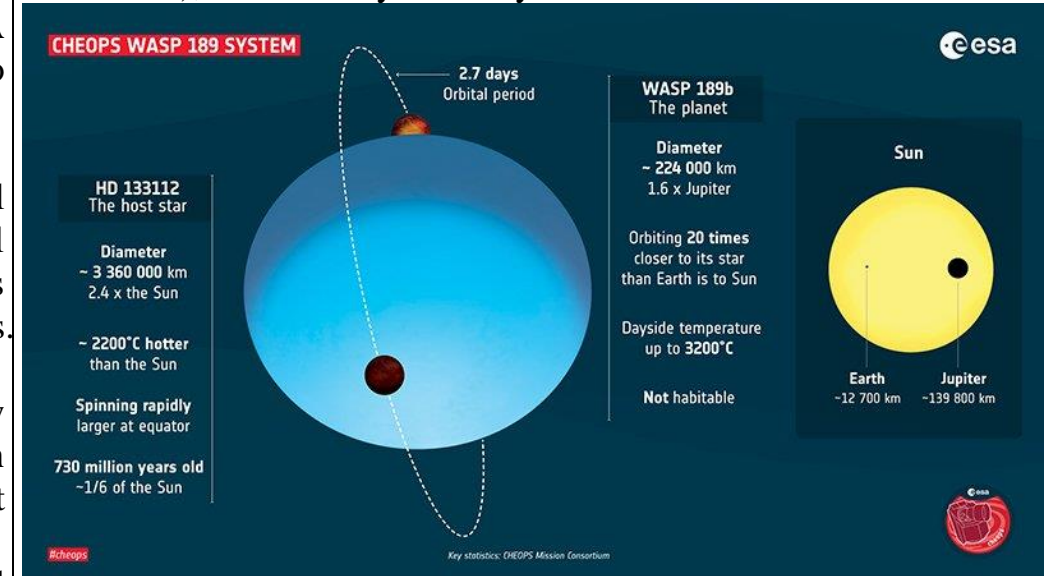
*Journal Reference:* Hugo Zeberg, Svante Pääbo. *The major genetic risk factor for severe COVID-19 is inherited from Neanderthals.* Nature, 2020; DOI: [10.1038/s41586-020-2818-3](https://doi.org/10.1038/s41586-020-2818-3)

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

## Astronomers Just Revealed One of The Most Extreme Planets Ever Discovered

*Astronomers have taken detailed observations of an incredibly extreme exoplanet, detecting brutal surface temperatures in the region of 3,200 degrees Celsius (5,792 degrees Fahrenheit)*

Those temperatures – measured by the European Space Agency's [CHaracterising ExOPlanet Satellite](#) (or CHEOPS) – are enough to melt all rocks and metals, and even turn them into a gaseous form. While the exoplanet, named [WASP-189b](#), is not quite as hot as the surface of our Sun (6,000 degrees Celsius or 10,832 degrees Fahrenheit), it's basically as toasty as some small dwarf stars.



(ESA)

The new findings immediately identify WASP-189b as one of the most extreme planets ever discovered. It has an orbit of just 2.7 days around its star, with one side seeing a permanent 'day' and the other side seeing a permanent 'night'. It's gigantic, too – about 1.6 times the size of Jupiter.

"WASP-189b is especially interesting because it is a gas giant that orbits very close to its host star," [says astrophysicist Monika Lendl](#) from the University of Geneva in Switzerland. "It takes less than three days for it to circle its star, and it is 20 times closer to it than Earth is to the Sun."

HD 133112 is the host star in question, 2,000 degrees Celsius (3,600 degrees Fahrenheit) hotter than our Sun, and one of the

hottest stars known to have a planetary system around it. CHEOPS made an interesting discovery about this celestial body too: it's spinning so fast that it's being pulled outwards at its equator.

WASP-189b is too far away (326 light-years) and too close to HD 133112 to observe directly, but CHEOPS knows some tricks. First, it observed the exoplanet as it passed behind its star: an [occultation](#). Then, it watched as WASP-189b passed in front of its star: a [transit](#). From these readings, researchers were able to figure out the brightness, temperature, size, shape, and orbital characteristics of the exoplanet, as well as some extra information about the star that it's circling around.

As it's on the scale of Jupiter but much closer to its host star, and much hotter, WASP-189b qualifies as a so-called [hot Jupiter](#) planet (you can see where the name came from). Scientists are hoping that the information CHEOPS has gathered about WASP-189b will improve our understanding of hot Jupiters in general.

"Only a handful of planets are known to exist around stars this hot, and this system is by far the brightest," [says Lendl](#). "WASP-189b is also the brightest hot Jupiter that we can observe as it passes in front of or behind its star, making the whole system really intriguing."

One of the questions that the new CHEOPS research has raised is how WASP-189b was formed in the first place – its inclined orbit suggests it formed further out from HD 133112 and was then driven inwards.

Besides the treasure trove of data this new study has provided, it also shows CHEOPS working as intended and working well, measuring brightness across deep space with a mind-boggling level of accuracy.

The satellite has plenty more missions to move on to next, with hundreds of exoplanets in the queue for closer observation. The data that it collects should teach us more about our own Solar

System, as well as the planets outside of it.

"The accuracy achieved with CHEOPS is fantastic," [says planetary scientist Heike Rauer](#) from the DLR Institute of Planetary Research in Germany. "The initial measurements already show that the instrument works better than expected. It is allowing us to learn more about these distant planets."

The research has been published in [Astronomy & Astrophysics](#).  
<https://bit.ly/33nARHz>

### **Kids' Severe COVID-19 Reaction Bears Unique Immune Signature**

*The rare complication known as multisystem inflammatory syndrome in children (MIS-C) differs from both Kawasaki disease and severe adult cases of COVID-19, a study finds.*

[Shawna Williams](#)

For months now during the COVID-19 pandemic, doctors have observed a rare but consistent scenario in a small number of kids: It starts with a SARS-CoV-2 infection, which can be mild, even asymptomatic. But weeks after the children seem to have fully recovered, they suddenly come down with symptoms that may include fever, vomiting, diarrhea, and severe abdominal pain.

"They had the infection, they got through it. And then all of a sudden . . . they can have this collapse in their bodies a few weeks later," says Alvaro Moreira, a neonatologist at the University of Texas Health San Antonio who recently coauthored a [review](#) on the condition, known as multisystem inflammatory syndrome in children (MIS-C).

MIS-C is rare, and not all children who become severely ill or die from COVID-19 develop it. According to the Centers for Disease Control and Prevention (CDC), [fewer than 1,000](#) cases of MIS-C have been reported so far in the US, the country hardest-hit by the COVID-19 pandemic, with 19 deaths. [Early reports](#) of cases of MIS-C pointed to similarities between it and Kawasaki disease, a

rare condition linked to viral infections that involves inflammation in the blood vessels. But there were notable differences observed between the two, such as the fact that Kawasaki mainly affects children under five, while even teenagers have come down with MIS-C. A study published earlier this month in [Cell](#) examines the similarities and differences between MIS-C and Kawasaki, as well as immune responses to COVID-19 in children and adults, to find unique features of the new condition and clues to the immune missteps that bring it about.

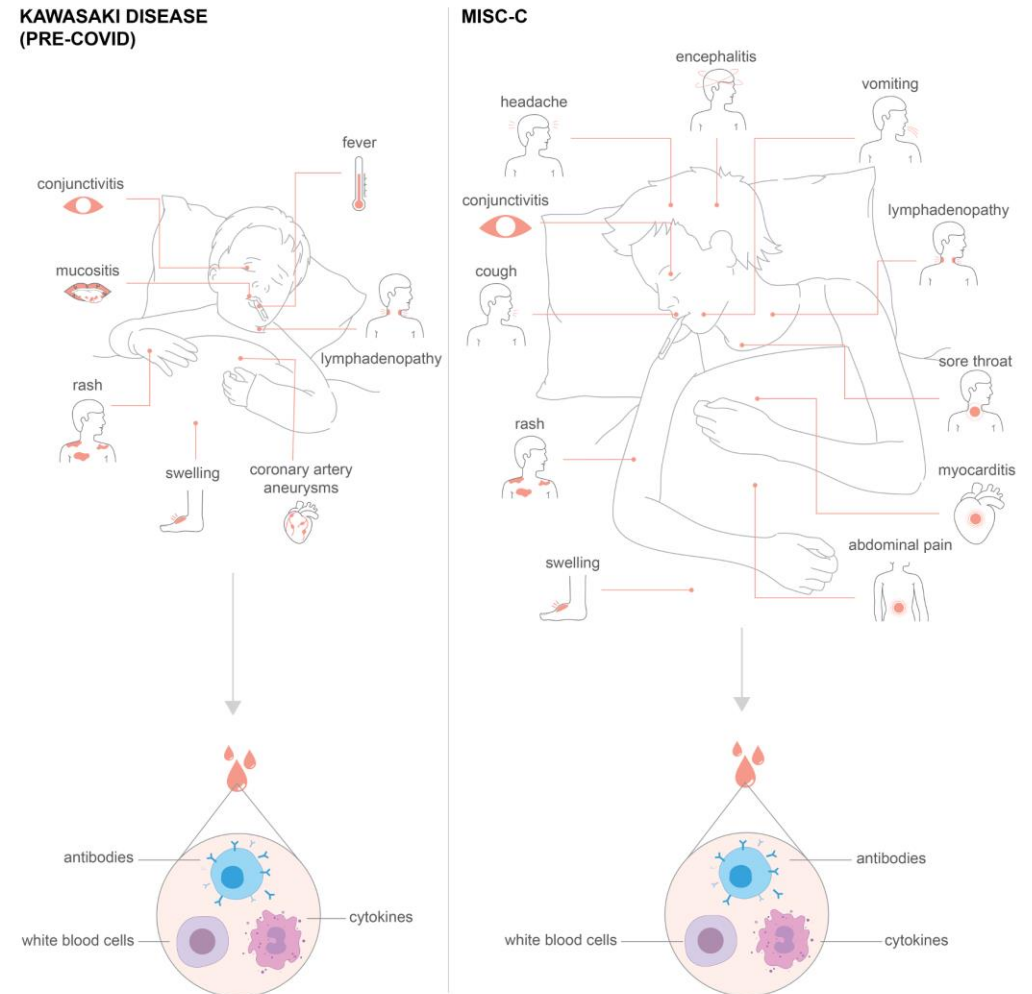
“I think that everyone has been waiting for something like this,” says Moreira of the work, which he was not involved in. “This one is the first study that I’ve really seen that is looking at pathways, signaling mechanisms. . . . It’s still premature, but it will start to tell us a little bit more about what is happening at the molecular level.”

The study team had been investigating Kawasaki disease before the pandemic, and had collected blood samples from 28 children with the condition between 2017 and 2019. They compared levels of white blood cells and proteins in those samples with those of 12 healthy children, 13 with MIS-C, and 41 with COVID-19 who did not develop MIS-C, along with 17 adults with severe COVID-19.

“One of the first things that happened when these kids [with MIS-C] started coming into the hospital was that people said, ‘Well, maybe we should treat them the same way as we treat adults with severe disease,’” says coauthor Petter Brodin, a pediatric immunologist at the Karolinska Institute and the Karolinska University Hospital in Sweden. But the study found that the inflammatory response in MIS-C is “completely different,” he adds, indicating that it should probably be treated differently. Specifically, the severe adult COVID-19 patients and MIS-C cases had much different blood levels of the cytokines used to guide the immune response, particularly interleukin (IL)-8 and IL-7—both of which are associated with, among other things, the number of infection-

fighting immune cells available in the blood. Levels of both of those cytokines were higher in adults with COVID-19 than in either Kawasaki or MIS-C patients.

### *A comparison of the symptoms of Kawasaki disease and MIS-C* Marek



### **Scupinski, Consiglio ET AL./CELL**

Brodin and his coauthors found more overlap in the profiles of MIS-C and Kawasaki disease than they did with MIS-C and severe COVID-19 in adults. MIS-C and Kawasaki both had lower overall

numbers of T cells compared with healthy children. Both conditions also involved the presence of antibodies to some of the body's own proteins, known as autoantibodies, Brodin notes. "Some of them overlapped between MIS-C and Kawasaki, and some were unique to MIS-C, and we didn't see them in any of the other groups," he says, which "suggests that there's a pathological process induced by [SARS-CoV-2] that is unique to this particular virus."

One possible explanation, he says, has to do with a phenomenon other studies [have observed](#): that SARS-CoV-2 tamps down an early, innate immune defense cells mount to viral infections, known as the interferon response. That could lead to a scenario where, in the later adaptive immune response, T cells and antibody-producing B cells "potentially then have a less-focused response and more of a wide response that might cross react and lead to autoimmunity," he says, adding that this has yet to be proven.

Another hypothesis, put forward in a study published yesterday in [PNAS](#), is that a unique part of SARS-CoV-2's spike protein acts as a so-called superantigen that causes an excessive adaptive immune response. Brodin says the idea is "interesting," but adds that in his opinion, "the evidence in the paper are not strong enough to conclude that this is the principal mechanism" in causing MIS-C.

The finding from Brodin's *Cell* study that there are clear differences between the proteins found in the blood of Kawasaki and MIS-C patients jibes with what Betsy Herold, a pediatric infectious disease physician and virologist at Albert Einstein College of Medicine and Montefiore Health System, has seen in the clinic, she says. (Herold was not involved in the *Cell* study.) That finding, she says, "is very important, because I think there's a lot of confusion out there [about], is this Kawasaki? And I think the answer is no, it has some overlap with Kawasaki, but it's not the same thing."

Herold, along with her spouse Kevan Herold, an immunobiologist

at Yale University, recently led their own [study](#) that touched on MIS-C, although its primary aim was to ferret out differences in the immune responses to SARS-CoV-2 between children and adults. In that study, the cytokine responses of infected children who later went on to develop MIS-C matched those of kids who did not, leading Betsy Herold to think that both groups of patients do indeed mount an effective innate response initially. "We postulate that [the MIS-C patients] made a good innate response and that they protected their lungs from disease, and then . . . a few weeks later, when their antibody responses start kicking in, there's something else that's perhaps a little bit dysregulated," she says. But, notes Kevan Herold, "I think we still don't have a completely clear answer" on what it is that causes some children to develop MIS-C after a SARS-CoV-2 infection, while most don't.

The good news, says Moreira, is that "even though we still don't completely understand a lot of the mechanistic drivers of the disease, [MIS-C patients] are responding to common therapies that we use for Kawasaki disease." These include intravenous immunoglobulin and steroids. "So they work, but I think we would feel more comfortable if we knew how, exactly, they work."

*C.R. Consiglio et al., "The immunology of multisystem inflammatory syndrome in children with COVID-19," [Cell](#), doi:https://doi.org/10.1016/j.cell.2020.09.016, 2020.*

*C.A Pierce et al., "Immune responses to SARS-CoV-2 infection in hospitalized pediatric and adult patients," [Sci Transl Med](#), doi:10.1126/scitranslmed.abd5487, 2020.*

<https://bit.ly/3laogxc>

## Newly Created Mutant Enzyme Hybrid Is Six Times Better at Devouring Plastic

*New super mutant enzyme that efficiently breaks down PET*

[Carly Cassella](#)

Some soil microbes adept at recycling plants have [developed a taste](#) for plastic. A few years ago, while fiddling with one of these highly adapted organisms, scientists [accidentally created](#) a mutant enzyme, capable of devouring 20 percent more plastic than its natural

counterpart.

Just two years later, the same team has once again outdone themselves. Combining a newly discovered enzyme with the old version, they've created a new super mutant enzyme that efficiently breaks down PET.

The huge surge in efficiency could represent a possible avenue for future plastic recycling, although at the moment, avoiding plastic products is still the most effective way to manage our pollution.

Today, human-made plastic waste has virtually invaded [every crevice of our planet](#), and PET (aka polyethylene terephthalate) is the most common thermoplastic of them all, generally used in water bottles and clothing.

In the natural world it takes centuries for this plastic to break down fully, but even in the short time these products have existed on our planet, some microbes have figured out how to munch through them in mere days.

In 2016, the first of these organisms was [discovered](#) at a recycling plant in Japan - *Ideonella sakaiensis*. Over the years, research has shown it secretes a plastic-degrading enzyme called PETase to break down PET water bottles.

Now, we've discovered a second one, and labelled it MHETase. Together, the two enzymes create the perfect plastic-destroying partnership.

While PETase breaks down the surface of plastics, researchers say the new enzyme chops things up even further, until all that's left are the basic building blocks, offering the promise of essentially recycling the plastic in full.

"[I]t seemed natural to see if we could use them together, mimicking what happens in nature," [explains](#) structural biologist John McGeehan, who has been part of the research at the University of Portsmouth from the beginning.

Simply mixing PETase with the new enzyme MHETase was

enough to double the breakdown of PET. But when scientists physically linked them "like two Pac-men joined by a piece of string", they worked even better.

Using the powerful Diamond Light Source synchrotron in the UK as a source of intense X-ray beams, McGeehan and his colleagues revealed the structure of the new enzyme through [X-ray crystallography](#), which then allowed them to painstakingly attach the two, creating an inseparable duo.

"It took a great deal of work on both sides of the Atlantic, but it was worth the effort," [says](#) McGeehan.

"[W]e were delighted to see that our new chimeric enzyme is up to three times faster than the naturally evolved separate enzymes, opening new avenues for further improvements."

In nature, it's not unusual for microbe-secreted enzymes to work alongside one another, breaking down cellulose, chitin, and other tough cell structures.

"Given that natural microbial systems evolved over millions of years to optimally degrade recalcitrant polymers, perhaps it is thus not surprising, in hindsight, that a soil bacterium such as *I. sakaiensis* evolved the ability to utilise [...] a two-enzyme system," the authors [write](#).

When trying to engineer faster and more efficient ways to break down plastic waste, researchers think a cocktail of plastic-demolishing enzymes is likely to be better than simply one individual - and this super mutant destroyer could certainly be a piece in that puzzle.

"Going forward, the design of multienzyme systems for depolymerisation of mixed polymer wastes is a promising and fruitful area for continued investigation," the team concludes in their paper.

The study was published in the [Proceedings of the National Academy of Sciences](#).

<https://bit.ly/3l7vD8F>

## Virtually Blind Mole-Rats Use Their Eyes to 'See' Magnetic Fields, Experiment Shows

*One species always carefully builds its nests in the south-eastern part of its den.*

[Tessa Koumoundouros](#)

In the gloom of subterranean tunnels, chonky little mole-rats build their nests, tucked safely away, deep inside the earth. Strangely, one species always carefully builds these nests in the south-eastern part of their den.

Why they do this remains unclear, but even in total darkness, it seems, these burrowing rodents – animals that can barely see in the best of conditions – can still sense direction.

We've long known animals like birds can [sense magnetic fields](#), and recently [discovered dogs navigate via them too](#). But the biological mechanisms behind this sense – and how it might function in mole-rats – are still very much a mystery. We didn't even know where in the body these magnetic detectors, whatever they prove to be, are located.

A recent theory suggests this sensory ability may somehow occur [via magnetotactic bacteria living within these species](#). But so far clues about mole-rats' magnetoreceptors suggest that their mechanism is [magnetite](#)-based.



*A cuddle pile of mole-rats in the lab. (Kai Robert Caspar)*

This sense of Earth's magnetic field works independent of light, and is affected by strong magnetic pulses but not radio frequencies, [explain researchers](#) from the University of Duisburg-Essen in Germany. They've been studying Ansell's mole-rat (*Fukomys ansellii*) to learn more about how this sensory mystery works.

Ansell's mole-rat is a highly cooperative social species that lives in

colonies of around 10 individuals and builds the [longest known tunnel of any \(non-human\) mammal](#). They may even be friendly with their neighbours, with some colonies linked by joining tunnels. These fuzzy tubes with legs have a stubby little tail at one end, with large teeth jutting out over closed lips at the other end. Their strange lower-jaw incisors [can move independently](#) of each other. As well as their usual tasks, the mole-rats spar with these teeth when play-fighting.

Above their teeth are the organs of interest - miniscule eyes, up to just 2 mm in diameter. These eyes can't see much at all, only really being able to detect the difference between light and dark.

"They do not orient by vision," zoologist and lead author Kai Caspar [told New Scientist](#). "Vision is more or less completely unimportant for them."

A [previous study](#) found disrupting the function of the eyes using anaesthesia destroyed the mole-rats' ability to place their nests in their preferred location, while still allowing them to detect light and shadows. They couldn't rule out that the anaesthesia wasn't entering the bloodstream and impacting other organs though.

So, Caspar and colleagues decided to try a more definitive approach to confirming the location of the animals' magnetoreceptors.

Unfortunately for the laboratory mole-rats, this involved surgically removing the eyes of some of the study subjects (a process called [enucleation](#)).

Tests 1.5 years after the surgical procedure confirmed, however, that these individuals' everyday behaviours were no different from the other captive mole-rats, including digging, grooming each other, and play-fighting.

"All enucleated animals were fully immersed members of their respective family groups and many successfully bred and raised offspring," the team [write in their paper](#).

Once this was established, the researchers created nesting terraria



where they could precisely control the magnetic field.

The team then tested the animal's nest building in four different magnetic field alignments, to rule out responses based on topography.

They found control animals that still had their sight displayed their usual clear preference for building their nests in the magnetic south-eastern part of the arena, whereas those without eyes built them in random locations.

"We conclude that the removal of the eyes led to a permanent impairment of the magnetic sense," the [team write](#). "Our study is the first to identify a magnetoreceptive organ in a mammal."

Caspar and team suggest the eyes be closely examined under electron-microscopy and through spectroscopy to find these elusive mammalian magnetoreceptors.

This research was published in the [Journal of the Royal Society Interface](#).

<https://bit.ly/33rJeSx>

### **Algorithm discovers how six simple molecules could evolve into life's building blocks**

*Starting off with six precursors, program discovers many known and 24 new pathways to prebiotic molecules*

By [Patrick Hughes](#)

An organic synthesis algorithm has mapped out the thousands of reactions that might have converted abiotic compounds into the building blocks of life more than 3.5 billion years ago.

Starting off with six simple precursors, the program discovered many known as well as 24 entirely new pathways to prebiotic molecules, and showed how catalytic and self-replicating systems might emerge.

Despite hundreds of demonstrations that various organic reactions

can take place under the conditions on early Earth, the scientific community still only has a piecemeal understanding of how the building blocks of life emerged. That's because the number of possible combinations of these reactions is so large that the number of molecules generated quickly jumps into the tens of thousands. While synthesising and analysing so many compounds is difficult, it could in principle be sorted using a computer.

Now, researchers have done just that. A team led by [Bartosz Grzybowski](#) and [Sara Szymkuć](#) from the Polish Academy of Sciences encoded all 500 known prebiotic reactions and a feedstock of six precursors – water, hydrogen cyanide, ammonia, hydrogen sulfide, nitrogen and methane – into open-use platform [Allchemy](#). The algorithm then used encoded mechanistic chemistry rules to produce a map of their combinations.

Running the program for seven generations, each time combining the generated molecules with what came before, the researchers ended up with almost 35,000 compounds including 50 biotic ones. The program was able to find many prebiotic syntheses previously described in the literature, for example 10 pathways leading to the [DNA component adenine](#). But it also discovered 24 entirely new pathways to biotic compounds – more than 20 of which the team experimentally validated.

As well as that, more complex systems such as reaction cycles and micelles began to emerge. One molecule generated, [iminodiacetic acid](#), can complex with metals such as manganese to act as a catalyst.

'You can take it through a cycle and it can potentially reproduce two copies of itself for one cycle. In experiment, we showed this auto-amplification. What this teaches us is that this self-replication emerges chemically,' says Grzybowski.

One of the reasons computer programs are better at finding these pathways than humans, explains Szymkuć, is that ‘people aren’t accustomed, when designing something, to incorporate a step, which degrades a molecule, and that’s necessary for the cycle.’

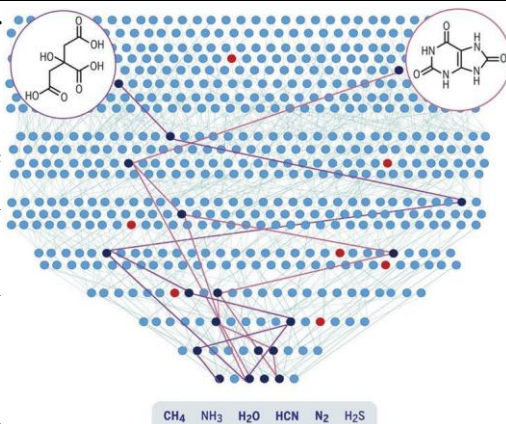
But the vast majority of reaction combinations led to abiotic compounds – molecules that were never incorporated into living systems. Analysis showed that the molecules that became the building blocks of life were more soluble in water and more thermodynamically stable.

*This schematic of the prebiotic chemistry network shows newly discovered routes to citric acid (left) and uric acid (right) starting from six simple building blocks. Light blue nodes are abiotic molecules, red nodes are other biotic molecules and dark blue nodes are molecules along the syntheses to uric/citric acid* Source: © Science/AAAS

‘The chosen ones had a balanced number of hydrogen bond donors and acceptors,’ Grzybowski adds. ‘When you think about it, this makes perfect sense – think about DNA. Nature chose molecules that are more likely to be fitting into a larger architecture, to build these kinds of supramolecular assemblies.’

‘This is an incredible piece of work,’ says [Valentina Erastova](#) who investigates origin of life chemistry with computational methods at the University of Edinburgh, UK. ‘We have a bit of a limitation in that this has to be based upon our discovered reactions. There are still reactions we haven’t been exploring as much that will be related to minerals and surfaces, which could be catalytic. That would be very interesting to look into... we can’t take this map as an absolute map.’

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<https://bit.ly/3n7nXW1>

## New Species of Truffle Found in Congo, Thanks to Mushroom-Munching Bonobos

*Researchers have found that wild bonobos in the rainforests of Congo forage and feed on a previously undescribed species of crystal-encrusted truffle.*

Fungi play a significant role in the diets and nutrition of diverse vertebrates. Many fungi, particularly truffle-like species, have evolved close associations with animals that help to disperse their spores. These animal-fungus associations are frequently overlooked, but they are an important part of functional ecosystems and imperative for the dispersal of fungi through these systems. An international team of researchers has found that wild [bonobos \(\*Pan paniscus\*\)](#) in the rainforests of the [Kokolopori Bonobo Reserve](#) in the Democratic Republic of Congo forage and feed on a previously undescribed species of crystal-encrusted truffle.

‘Bonobos likely locate the newly-described species, *Hysterangium bonobo*, by catching its smell wafting through the air or by digging in the soil and sniffing their hands,’ said senior author Dr. Matthew Smith, a researcher in the Department of Plant Pathology at the University of Florida.



*Fresh fruiting body of *Hysterangium bonobo* in hand, note the slight brownish discoloration from handling. Scale bar – 2 cm. Alexander Georgiev.* ‘The truffles are small enough to be swallowed whole, and their microscopic spores are kept intact by thick cell walls as they journey through a bonobo’s digestive tract.’

‘Why they eat these, I’m not sure,’ added co-author Dr. Alexander Georgiev, a primatologist at Bangor University. ‘Perhaps they like

the taste of them. I personally love mushrooms and have never considered what I get out of them nutritionally. They just taste amazing.”

Edible mushrooms widely prized for their aromas, truffles are often ecosystem linchpins, and *Hysterangium bonobo* is no exception.

Although it looks like a homely potato, it plays a key role in enabling trees to absorb nutrients from the soil and supports the diets of animals.

Its irregularly shaped outer layer is also lined with microscopic crystal-encrusted filaments, possibly used for defense or aroma diffusion.

*Hysterangium bonobo* is known in the local Bantu language (Bongando) as ‘*simbokilo*,’ a name linked to a longer phrase roughly translated as ‘*Don’t let your brother-in-law leave because traps baited with this will bring in plenty of food.*’

Local communities use this species for baiting traps to catch several species of small mammals.

“Kokolopori people have celebrated their interdependence with bonobos for generations,” said co-author Albert Lotana Lokasola, a graduate student at the University of Kisangani.

“Our traditional knowledge of the diets of animals such as bonobos, duikers and rodents that includes food items new to science should be valued, preserved and protected.”

Although little is known about *Hysterangium bonobo*, it shares a number of characteristics with those of high culinary value. “Even though some truffles are specialized food items, they all evolved in a similar way,” Dr. Smith said. “They smelled really good, so animals dug them up and spread the spores around.”



***Broken Hysterangium bonobo fruiting body revealing brown gleba and columella at the center. Alexander Georgiev.***

“It’s important to realize that even though this paper presents a novel interaction and the description of a new species for the Western scientific community, in reality these are interconnected associations that have been known about for untold generations by the locals in the region,” said first author Todd Elliott, a Ph.D. candidate at the University of New England.

“As foreign scientists, we must take the time to ask and learn from indigenous people and locals in areas where we work because they usually intimately know about the organisms that we think are new.” The discovery is described in a [new paper](#) published in the journal *Mycologia*.

*Todd F. Elliott et al. Hysterangium bonobo: A newly described truffle species that is eaten by bonobos in the Democratic Republic of Congo. Mycologia, published online September 4, 2020; doi: 10.1080/00275514.2020.1790234*

<https://bit.ly/2HTo0EH>

## **Migrating Jupiter May Have Made Venus Uninhabitable Long Ago**

***Early Jupiter’s formation, it [moved](#) closer to and then away from the Sun, this movement likely triggered Venus onto a path toward its [current, inhospitable state](#)***

Early in the formation of Jupiter as a planet, it [moved](#) closer to and then away from the Sun due to interactions with the planetary disk of the young Solar System, and this movement likely triggered Venus onto a path toward its [current, inhospitable state](#), according to a [new paper](#) published in the *Planetary Science Journal*.

“Scientists consider planets lacking liquid water to be incapable of hosting life as we know it,” said [Dr. Stephen Kane](#), an astrobiologist in the Department of Earth and Planetary Sciences at the University of California, Riverside. “Though Venus may have lost some water early on for other reasons, and may have continued to do so anyway.” “One of the interesting things about the Venus of

today is that its orbit is almost perfectly circular,” he added.

“With this project, I wanted to explore whether the orbit has always been circular and if not, what are the implications of that?”

To answer these questions, Dr. Kane and colleagues created a model that simulated the Solar System, calculating the location of all the planets at any one time and how they pull one another in different directions.

They measured how non-circular a planet’s orbit is between 0, which is completely circular, and 1, which is not circular at all. The number between 0 and 1 is called the eccentricity of the orbit. “An orbit with an eccentricity of 1 would not even complete an orbit around a star; it would simply launch into space,” Dr. Kane said.

“Currently, the orbit of Venus is measured at 0.006, which is the most circular of any planet in our Solar System.”

However, the team’s model shows that when Jupiter was likely closer to the Sun about a billion years ago, Venus likely had an eccentricity of 0.3, and there is a much higher probability that it was habitable then.

“As Jupiter migrated, Venus would have gone through dramatic changes in climate, heating up then cooling off and increasingly losing its water into the atmosphere,” Dr. Kane said.

Earlier this year, astronomers [detected](#) phosphine gas in the cloud decks of Venus. In Earth’s atmosphere, phosphine is uniquely associated with anthropogenic activity or microbial presence.

“Phosphine is typically produced by microbes. It is possible that it represents the last surviving species on a planet that went through a dramatic change in its environment,” Dr. Kane said.

“For that to be the case, however, the microbes would have had to sustain their presence in the sulfuric acid clouds above Venus for roughly a billion years since the planet last had surface liquid water — a difficult to imagine though not impossible scenario.”

“There are probably a lot of other processes that could produce the

gas that haven’t yet been explored,” he said.

“Ultimately, it is important to understand what happened to Venus, a planet that was once likely habitable and now has surface temperatures of up to 462 degrees Celsius (864 degrees Fahrenheit).”

“I focus on the differences between Venus and Earth, and what went wrong for Venus, so we can gain insight into how the Earth is habitable, and what we can do to shepherd this planet as best we can.”

*Stephen R. Kane et al. 2020. Could the Migration of Jupiter Have Accelerated the Atmospheric Evolution of Venus? Planet. Sci. J 1, 42; doi: 10.3847/PSJ/abae63*

<https://wb.md/3nghYho>

## **Stroke May Be First Symptom of COVID-19 in Younger Patients**

*Stroke may be the first presenting symptom of COVID-19 in younger patients, new research suggests.*

**Batya Swift Yasgur, MA, LSW**

Investigators carried out a meta-analysis of data, including 160 patients with COVID-19 and stroke, and found that nearly half of patients under the age of 50 were asymptomatic at the time of stroke onset.

Although younger patients had the highest risk of stroke, the highest risk of death was in patients who were older, had other chronic conditions, and had more severe COVID-19-associated respiratory symptoms.

“One of the most eye-opening findings of this study is that for patients under 50 years old, many were totally asymptomatic when they had a stroke related to COVID-19, [which] means that, for these patients, the stroke was their first symptom of the disease,” lead author Luciano Sposato, MD, MBA, associate professor and chair in stroke research, Schulich School of Medicine and Dentistry, Western University, London, Ontario, Canada.

The study was [published online](#) September 15 in *Neurology*, the medical journal of the American Academy of Neurology.

### **Anecdotal Reports**

"In early April of 2020, we realized that COVID-19 was a highly thrombogenic disease," Sposato told *Medscape Medical News*. "Almost in parallel, I started to see anecdotal reports in social media of strokes occurring in patients with COVID-19, and there were also very few case reports."

The investigators "thought it would be a good idea to put all the data together in one paper," he said, and began by conducting a systematic review of 10 published studies of COVID-19 and stroke (n = 125 patients), which were then pooled with 35 unpublished cases from Canada, the United States, and Iran for a total of 160 cases.

The analysis examined in-hospital mortality rates of patients with stroke and COVID-19.

In addition, the researchers conducted a second review of 150 papers, encompassing a final cohort of 3306 COVID-19 patients with stroke of any type and 5322 with [ischemic stroke](#).

"Some studies reported data for only ischemic stroke, and some reported data for all strokes considered together, which resulted in a different number of patients on each meta-analysis, with a lower number of 'any stroke' cases," Sposato explained. "This review looked at the number of patients who developed a stroke during admission and included thousands of patients."

Sposato noted that the first review was conducted on single case reports and small case series "to understand the clinical characteristics of strokes in patients with COVID-19 on an individual patient level," since "large studies, including hundreds of thousands of patients, usually do not provide the level of detail for a descriptive analysis of the clinical characteristics of a disease."

Cluster analyses were used to "identify specific clinical phenotypes

and their relationship with death."

Patients were stratified into 3 age groups: <50, 50-70, and >70 years ("young," "middle-aged," and "older," respectively). The median (IQR) age was 65 years (54.0 - 76.3) and 43% were female.

### **Mortality "Remarkably High"**

The review showed that 1.8% (95% CI, 0.9% - 3.7%) of patients experienced a new stroke, while 1.5% (0.8% - 2.8%) of these experienced an ischemic stroke.

"These numbers are higher than historical data for other infectious diseases — for example, 0.75% in SARS-CoV-1, 0.78% in [sepsis](#), and 0.2% in [influenza](#)," Sposato commented.

Moreover, "this number may be an underestimate, given that many patients die without a confirmed diagnosis and that some patients did not come to the emergency department when experiencing mild symptoms during the first months of the pandemic," he added.

Focusing on the review of 160 patients, the researchers described in-hospital mortality for strokes of all types and for ischemic strokes alone as "remarkably high" (34.4% [95% CI, 27.2% - 42.4%] and 35.7% [95% CI, 27.5% - 44.8%], respectively), with most deaths occurring among ischemic stroke patients.

"This high mortality rate is higher than the [roughly] 15% to 30% reported for stroke patients without COVID-19 admitted to intensive care units," Sposato said.

### **High-Risk Phenotype**

Many "young" COVID-19 patients (under age 50) who had a stroke (42.9%) had no previous risk factors or comorbidities. Moreover, in almost half of these patients (48.3%), stroke was more likely to occur before the onset of any COVID-19 respiratory symptoms.

Additionally, younger patients showed the highest frequency of elevated cardiac troponin compared with middle-aged and older patients (71.4%, vs 48.4% and 27.8%, respectively). On the other hand, mortality was 67% lower in younger vs older patients (OR,

0.33; 95% CI, 0.12 - 0.94;  $P = .039$ ).

Sposato noted that the proportion of ischemic stroke patients with large vessel occlusion was "higher than previously reported" for patients with stroke without COVID-19 (47% compared with 29%, respectively).

"We should consider COVID-19 as a new cause or risk factor for stroke. At least, patients with stroke should probably be tested for SARS-CoV-2 infection if they are young and present with a large vessel occlusion, even in the absence of typical COVID-19 respiratory symptoms," he suggested.

The researchers identified a "high-risk phenotype" for death for all types of stroke considered together: older age, a higher burden of comorbidities, and severe COVID-19 respiratory symptoms. Patients with all three characteristics had the highest in-hospital mortality rate (58.6%) and a threefold risk of death, compared with the rest of the cohort (OR, 3.52; 95% CI, 1.53 - 8.09;  $P = .003$ ).

"Several potential mechanisms can explain the increased risk of stroke among COVID-19 patients, but perhaps the most important one is increased thrombogenesis secondary to an exaggerated inflammatory response," Sposato said.

### Not Just Elders

Commenting on the study for *Medscape Medical News*, Jodi Edwards, PhD, director of the Brain and Heart Nexus Research Program at the University of Ottawa Heart Institute in Canada, said the findings are "consistent with and underscore public health messaging emphasizing that COVID-19 does not only affect the elderly and those with underlying health conditions, but can have serious and even fatal consequences at any age."

Edwards, who was not involved with the study, emphasized that "adherence to public health recommendations is critical to begin to reduce the rising incidence in younger adults."

Sposato acknowledged that the study was small and that there "can

be problems associated with a systematic review of case reports, such as publication bias, lack of completeness of data, etc, so more research is needed."

*Sposato is supported by the Kathleen & Dr Henry Barnett Research Chair in Stroke Research (Western University, London, Canada); the Edward and Alma Saraydar Neurosciences Fund (London Health Sciences Foundation, London, Canada); and the Opportunities Fund of the Academic Health Sciences Centre Alternative Funding Plan of the Academic Medical Organization of Southwestern Ontario (AMOSO) (Ontario, Canada). Sposato reports speaker honoraria from Boehringer Ingelheim, Pfizer, Gore, and Bayer and research/quality improvement grants from Boehringer Ingelheim and Bayer. The other authors' disclosures are listed on the original article. Edwards has disclosed no relevant financial relationships.*

*Neurology*. Published online September 15, 2020. [Full text](#)

<https://wb.md/2Sii8a2>

## Innate Immune Response Produces 'Phenomenal' Breast Cancer Control

Kathy D. Miller, MD

*Hi. It's Dr Kathy Miller with Indiana University. There is another really important [study](#) from the [science weekend at ESMO](#) that I want to make sure you see because I fear it might be overlooked.*

It's the PARADIGM analysis. This was a correlative analysis, not an individual clinical trial. The authors were interested in looking at the potential impact of our innate immune response, our body's ability to recognize a triple-negative tumor and potentially to control it on outcome.

To avoid the potential confounders of the effects of our treatment, the investigators looked at women who did not receive systemic therapy. This is a really unique cohort. All of these women were younger than age 40, had triple-negative or low ER-expressing tumors (ER and PR less than 10%), 50% of them were T1Cs (tumors between 1 and 2 cm), and all were lymph node-negative.

Overall, tumors from 481 patients were evaluated for the impact of tumor-infiltrating lymphocytes. Those who had the highest degree of infiltration — the 75th cohort or the highest quartile of patients

— had a 93% overall survival at 15 years.

That's phenomenal and clearly shows the power of the immune system when it's able to recognize the tumor.

Also, it gives us the potential to think about how we could identify patients with triple-negative disease, which is the type of disease that strikes fear in our hearts. How could we identify a group of patients who might need less therapy and maybe don't need chemotherapy at all?

This is not something for you to put into practice on Monday morning, but it sure does make you think, and it gives us a way to think about designing clinical trials in the future.

*Kathy D. Miller, MD, is associate director of clinical research and co-director of the [breast cancer](#) program at the Melvin and Bren Simon Cancer Center at Indiana University. Her career has combined both laboratory and clinical research in breast cancer.*

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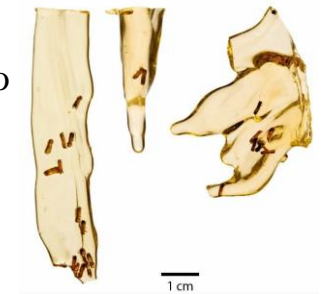
## Researchers extract DNA from insects embedded in resin

*For the first time, scientists successfully extracted genetic material from insects that were embedded in six- and two-year-old resin samples.*

For the first time, Senckenberg scientist Mónica Solórzano-Kraemer, together with lead authors David Peris and Kathrin Janssen of the University of Bonn and additional colleagues from Spain and Norway, successfully extracted genetic material from insects that were embedded in six- and two-year-old resin samples. DNA—in particular, DNA from extinct animals—is an important tool in the identification of species. In the future, the researchers plan to use their new methods on older resin inclusions, as well. The study was published today in the scientific journal *PLOS ONE*. The idea of extracting DNA from resin-embedded organisms inevitably invokes memories of the blockbuster "Jurassic Park." "However, we have no intention of raising dinosaurs," says Dr.

Mónica Solórzano-Kraemer of the Senckenberg Research Institute and Natural History Museum. "Rather, our current study is a structured attempt to determine how long the DNA of insects enclosed in resinous materials can be preserved."

To this end, lead author Dr. David Peris of the University of Bonn, the amber researcher from Frankfurt, and researchers from the Universities of Barcelona and Bergen and the Geominero Museum (IGME) in Valencia examined the genetic material of so-called [ambrosia beetles](#) that were trapped in the resin of amber trees (Hymenaea) in Madagascar. "Our study fundamentally aimed to clarify whether the DNA of insects embedded in resin continues to be preserved. Using the [polymerase chain reaction](#) (PCR) method, we were able to document that this is, indeed, the case in the six- and two-year-old resin samples we examined," explains Solórzano-Kraemer.



*Resin with embedded ambrosia beetles. Credit: David Peris*

To date, similar tests of inclusions in several-million-year-old amber and several-thousand-year-old copals had failed, since more recent environmental impacts had caused significant changes to the DNA of the embedded insects or even destroyed it. Therefore, resin-embedded samples were deemed unsuitable for genetic examinations.

Solórzano-Kraemer adds, "We are now able to show for the first time that, although it is very fragile, the DNA was still preserved in our samples. This leads to the conclusion that it is possible to study the genomics of organisms embedded in resin."

It is still not clear just how long the DNA can survive inside the resin. To address this question, the researchers plan to apply the method in a stepwise fashion from the most recent to the oldest samples to determine the "shelf life" of the [resin](#)-embedded DNA.

"Our experiments show that water in the inclusions is preserved much longer than previously assumed. This could also affect the [genetic material](#)'s stability. The extraction of functional DNA from several-million-year-old amber is therefore rather unlikely," says Solórzano-Kraemer.

*More information:* Peris et al. DNA from resin-embedded organisms: Past, present and future, PLOS ONE (2020). DOI: [10.1371/journal.pone.0239521](https://doi.org/10.1371/journal.pone.0239521)

<https://wb.md/2GC4c7Z>

## Fewer Deaths in Hospitalized COVID Diabetes Patients on Sitagliptin

*Patients with type 2 diabetes hospitalized for COVID-19 who were taking just sitagliptin were 77% less likely to die compared with similar patients taking insulin.*

Mitchel L. Zoler, PhD

Patients with [type 2 diabetes](#) hospitalized for COVID-19 who were taking just one glucose-lowering drug, the oral dipeptidyl peptidase-4 (DPP-4) inhibitor [sitagliptin](#), were 77% less likely to die compared with similar patients taking [insulin](#), in a retrospective, observational, case-control study in Italy.

Sitagliptin (*Januvia*, Merck) treatment was also linked with significant and clinically meaningful drops in the rate of need for intensive care or [mechanical ventilation](#) compared with patients who received insulin, Sebastiano B. Solerte MD, PhD, and colleagues report in their study [published online](#) September 29 in *Diabetes Care*.

The authors acknowledge that the study's design means this finding can't be considered definitive. Despite this limitation, "We think it's reasonable to try sitagliptin if a patient is admitted to the hospital with type 2 diabetes and COVID," said Paolo Fiorina, MD, PhD, senior investigator of the study, in a [statement](#).

The researchers are about to start a prospective, randomized trial to try to confirm the benefit seen with sitagliptin in a total of about

170 patients in the [SIDIACO](#) (The Effect of Sitagliptin Treatment in COVID-19 Positive Diabetic Patients) study.

"I'm excited by our findings, because we still have very few therapeutic options for the many diabetic patients affected by COVID," said Fiorino, a nephrologist and diabetes researcher affiliated with the Boston Children's Hospital division of nephrology and the University of Milan.

And, Fiorino told *Medscape Medical News* in an email, "Our data are related to sitagliptin but I believe that there will be a class effect [of DPP-4 inhibitors]."

## SARS-CoV-2 Virus May Bind to DPP-4 Receptor

The Italian group notes that type 2 diabetes has been associated with worse outcomes in COVID-19 and that the presence of diabetes increases the mortality risk associated with the virus, particularly in those with more severe COVID-19.

And poorly controlled blood glucose levels are associated with markedly higher mortality in patients with type 2 diabetes and COVID-19 compared with similar patients with better metabolic control.

The researchers decided to study a DPP-4 inhibitor such as sitagliptin because of evidence that the SARS-CoV-2 virus may bind DPP-4 when entering respiratory cells.

"We decided to try sitagliptin and collect the data. COVID-19 mortality in patients with diabetes is high, and the drug is very safe, so we felt there was no reason not to use it," Fiorina explained.

During March and April 2020, they enrolled 338 consecutive adults with documented type 2 diabetes hospitalized with laboratory-confirmed SARS-CoV-2 infection at seven academic centers in Northern Italy. All patients stopped their diabetes treatment on admission, and then patients received either sitagliptin or insulin (intravenous or subcutaneous) as their sole diabetes intervention while hospitalized, in addition to all other standard-of-care



medications.

Enrolled patients averaged 69 years old (> 90% were at least 70). Slightly more than two thirds were men, and average diabetes duration was about 9 years. Body mass index among the enrolled patients averaged just under 30 kg/m<sup>2</sup>, and average [A1c](#) at enrollment was 7.5%.

The study's primary endpoint was the rate of death at 30 days. Overall, 31 (18%) of sitagliptin-treated patients died compared with 63 (37%) of those taking insulin, a 19% absolute difference that was significant, and that translated into a 77% relative reduction after adjustment for baseline differences in age, sex, comorbidities, and ongoing treatments.

The analysis identified two other parameters that had significant links with 30-day death. For each added year of age, mortality increased by 7%, and patients with a history of cardiovascular disease had a 2.5-fold increased mortality rate.

The data also showed that sitagliptin recipients were almost 50% less likely to be admitted to ICU, compared with insulin-treated patients ( $P = .03$ ), and their need for mechanical ventilation was cut by 73% compared with those on insulin ( $P = .003$ ). The incidence of patients with a two-point or greater improvement in their clinical severity score was 52% on sitagliptin and 34% on insulin.

Researchers also ran four subgroup analyses that showed the impact of sitagliptin was consistent regardless of age ( $\geq 70$  years vs  $< 70$  years), sex, A1c level at entry ( $\leq 7.5\%$  vs  $> 7.5\%$ ), or body mass index (obese or nonobese).

The authors suggested three possible key explanations for the benefits associated with sitagliptin treatment:

- ***Binding of sitagliptin to the DPP-4 protein on cell surfaces may interfere with these proteins acting as binding sites for the SARS-CoV-2 virus.***
- ***Sitagliptin may exert anti-inflammatory and immunoregulatory***

***effects, such as reducing excessive and prolonged cytokine responses.***

- ***Sitagliptin may improve glycometabolic control that may help moderate the clinical progression of COVID-19 infection.***

As well as the planned prospective, randomized trial in those with type 2 diabetes and severe COVID-19, the researchers suggest that sitagliptin could also be tested as a potential COVID-19 treatment in patients without diabetes.

*The study received no commercial funding. Solerte, Fiorina, and their coinvestigators have reported no relevant financial relationships.*

*Diabetes Care.* Published online September 29, 2020. [Abstract](#)

<https://wb.md/2GoVL0f>

## **Split Pool Testing Ups Efficiency for SARS-CoV-2 Detection**

***"Split pool" strategy for detecting SARS-CoV-2 in multiple samples could generate results faster than single test assays, as well as reduce number of false positives & false negatives***

**Damian McNamara**

A "split pool" strategy for detecting SARS-CoV-2 in multiple samples could generate results faster than single test assays. The approach could also reduce the number of false positives and false negatives compared with currently approved pooled testing, new evidence suggests.

"It's not too good to be true," Eugene Litvak, PhD, lead author of an editorial outlining the new strategy, told *Medscape Medical News*.

"This protocol requires far fewer tests and results in 10 times fewer false positives and false negatives" compared with single assays and [FDA-approved pooled testing](#). The editorial was [published online](#) September 24 in the *American Journal of Public Health*.

Pooled testing for [syphilis](#) as well as for [HIV](#) and other infectious agents has been used for decades to save time and resources. More recently, the FDA approved combined testing of up to five samples for SARS-CoV-2 for Quest and LabCorp under emergency use authorizations.

The Dorfman approach, approved in July, essentially allows labs to test combined samples using a single assay. If results come back positive for SARS-CoV-2, the individual samples are retested. If the pooled results are negative, each sample is considered to be free of the virus.

A drawback of the Dorfman approach is the potential to produce "high rates of false negative results," Litvak and colleagues note. The danger, they add, is that people who are given a false negative finding might behave as if they were virus free.

### **Divide and Conquer?**

The new approach, split pool testing, also combines samples for initial testing, but with modifications. All results are repeated; if a panel of 16 or 32 samples yields a negative overall finding, the same combined sample is tested again using the same or a different assay. If still negative, all tests in the sample are declared negative.

If a panel initially tests positive, the sample is split in half and retested for any remaining positives. This is done as many times as necessary to identify the presence of SARS-CoV-2, even down to a single test.

Litvak and colleagues evaluated the split testing strategy in a setting in which five million Americans per day are tested for the virus, as some experts recommend.

"We tested the protocol in a range of positivity rates, from 0.04% to 2.4%, so we are predicting two extremes," said Litvak, who is president and CEO of the Institute for Healthcare Optimization in Newton, Massachusetts, and is affiliated with the Harvard T. H. Chan School of Public Health in Boston.

The average positivity rate across the United States is currently 1.2% to 1.4%, Litvak added.

### **Fewer False Negatives**

The split pool approach yielded 60% of the false negative results compared with individual tests at both these low and higher

prevalence rates.

Compared with individual sample testing, split pooling also would save resources — it requires only 10% of the number of tests at a 0.04% prevalence rate and only 41% of tests at a 2.4% prevalence level. "When it comes to false negatives, the Dorfman protocol produces far worse results than split pooling — almost 10 times (9.8) as many as the split pooling method delivers in both prevalence situations," the authors note.

In addition, split pool testing would reduce the number of false positive findings. Although split pool testing could still yield 6000 false positives at the lower prevalence rate, individual testing would generate 99,960 false positives, for example.

Split pool testing is "more efficient, much less expensive, and comparably more accurate," Litvak said.

Litvak added a caveat. "When you get into a zone somewhere between a 10% to 20% prevalence rate, the test would not be useful. Almost every pooled test sample would be positive," he added. "But it could definitely be used in the US now."

"Given the rapidly rising number of infections now emerging in a number of states, it is surely time to try new strategies such as pooled testing. But by no means should pooled testing follow the Dorfman protocol," the authors note.

They add, "We can't afford to adopt strategies, such as individual testing and Dorfman pooling, that could run the risk of giving false assurances to large numbers of infected people, potentially making the toll of this terrible pandemic worse than it already is."

### **More Value in Low-Prevalence Settings**

"A pooled testing approach in low-risk populations and in low-prevalence areas can be valuable. However, false negative results in pooled sample testing, especially when the pools are relatively small, say four or five people, are unlikely to be important in areas where universal masking remains in effect," Samir Shah, MD, told

*Medscape Medical News* when asked to comment.

The split pooling protocol "seems to add the most value when large-scale testing is performed.

"I think scenarios of repeat or second round testing under the split pooling protocol will likely add a lot of cost but potentially only marginal benefit when large-scale testing of populations is not being done, as is the current situation in the US," added Shah, professor of pediatrics and director of the Division of Hospital Medicine at Cincinnati Children's Hospital Medical Center in Ohio. Pooled testing in US schools and school athletics could be helpful in informing quarantine decisions to minimize the likelihood of student-related transmission, Shah said.

One concern remains the timely reporting of individual and pooled test results, he added. "If one has to wait several days for a test result, those results are less helpful," he said.

*Litvak and Shah have disclosed no relevant financial relationships.*

*Am J Public Health.* Published online September 24, 2020. [Editorial](#)

<https://wb.md/36t7pSn>

## Children's Share of New COVID-19 Cases Is on the Rise

*Cumulative percentage of COVID-19 cases in children continues to climb, but "the history behind that cumulative number shows substantial change,"*

**Richard Franki**

The cumulative percentage of COVID-19 cases reported in children continues to climb, but "the history behind that cumulative number shows substantial change," according to a new analysis of state health department data.

As of September 10, the 549,432 cases in children represented 10.0% of all reported COVID-19 cases in the United States following a substantial rise over the course of the pandemic — the figure was 7.7% on July 16 and 3.2% on May 7, Blake Sisk, PhD,

of the American Academy of Pediatrics and associates reported September 29 in [Pediatrics](#).

Unlike the cumulative number, the weekly proportion of cases in children fell early in the summer but then started climbing again in late July. "In the last 8 weeks, children represented between 12%-15.9% of new weekly reported cases," Sisk and associates write.

Despite the increase, however, the proportion of pediatric COVID-19 cases is still well below children's share of the overall population (22.6%). Also, "it is unclear how much of the increase in child cases is due to increased testing capacity, although CDC data from public and commercial laboratories show the share of all tests administered to children ages 0-17 [years] has remained stable at 5%-7% since late April," they said.

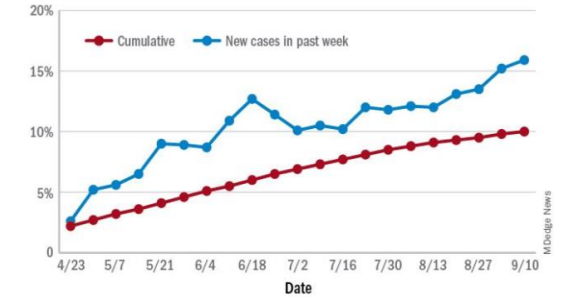
Data for the current report were drawn from 49 state health department websites (New York state does not report ages for COVID-19 cases), along with New York City, the District of Columbia, Puerto Rico, and Guam. Alabama changed its definition of a child case in August and was not included in the trend analysis (see graph), the investigators explained.

Those data show "substantial variation in case growth by region: in April, a preponderance of cases was in the Northeast. In June, cases surged in the South and West, followed by mid-July increases in the Midwest," Sisk and associates said.

The increase among children in Midwest states is ongoing with the number of new cases reaching its highest level yet during the week ending September 10, they reported.

*Pediatrics.* Published September 29, 2020. [Full text](#)

Proportion of COVID-19 cases that occurred in children



Note: Data drawn from health dept. websites of 48 states, N.Y.C., D.C., Puerto Rico, and Guam. Source: American Academy of Pediatrics

<https://bit.ly/3ldLl2n>

## Due to Extremely Rare Situation, Woman Suffers Brain Fluid Leak From COVID-19 Swab

A [COVID-19 nasal swab test punctured a US woman's brain lining, causing fluid to leak from her nose and putting her at risk of life-threatening infection, doctors \[reported in a medical journal\]\(#\) Thursday.](#)

Issam Ahmed, AFP

The patient, who is in her 40s, had an undiagnosed rare condition and the test she received may have been carried out improperly, a sequence of improbable events that means the risk from nasal tests remains very low.

But her case showed health care professionals should take care to follow testing protocols closely, Jarrett Walsh, senior author of the paper that appeared in [JAMA Otolaryngology-Head & Neck Surgery](#), told AFP.

People who've had extensive sinus or skull base surgery should consider requesting oral testing if available, he added.

"It underscores the necessity of adequate training of those performing the test and the need for vigilance after the test has been performed," added ear, nose and throat specialist Dennis Kraus of Lenox Hill Hospital in New York, who wasn't involved in the paper.

Walsh, who practices at the University of Iowa Hospital, said the woman had gone for a nasal test ahead of an elective hernia surgery, and afterward noticed clear fluid coming out of one side of her nose. She subsequently developed headache, vomiting, neck stiffness, and aversion to light, and was transferred to Walsh's care.

"She had been swabbed previously for another procedure, same side, no problems at all. She feels like maybe the second swab was not using the best technique, and that the entry was a little bit high," he said. In fact, the woman had been treated years earlier for intracranial hypertension - meaning that the pressure from

cerebrospinal fluid that protects and nourishes the brain was too high. Doctors at the time used a shunt to drain some of the fluid and the condition resolved.

But it caused her to develop what's called an encephalocele, or a defect at the base of the skull which made the brain's lining protrude into the nose where it was susceptible to rupture.

This went unnoticed until old scans were reviewed by her new doctors, who carried out surgery to repair the defect in July. She has since fully recovered. Walsh said he believes the symptoms she developed were a result of irritation to the lining of the brain.

If the problem hadn't been treated, she could have developed a potentially life-threatening brain infection from bacteria that traveled up the nose. Or, air could have entered the skull and placed excess pressure on the brain.

Most testing protocols call for clinicians to follow the path of the floor of the nose, which lies above the roof of the mouth, rather than pointing the swab up - or if they point it up, to do so with great care.

Walsh said that though this was likely a very rare occurrence, it was a reminder of the need for high-quality training, given that hundreds of millions more tests will be performed before the [pandemic](#) is over.

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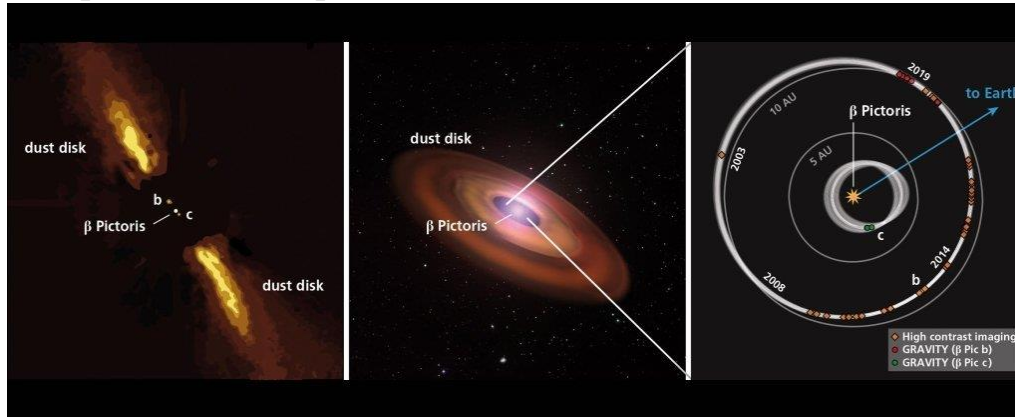
## Scientists Reveal First Direct Image of an Exoplanet Only 63 Light-Years Away

*Now, astronomers have revealed images of an indirectly found exoplanet*

[Michelle Starr](#)

Most of the exoplanets we've confirmed to date have never actually been seen directly. We confirm their presence by indirect means, such as the effect they have on their host star. But now, astronomers have revealed images of an indirectly found exoplanet.

It's not just an impressive feat of skills and technology. The combination of methods has given us a superb toolkit for measuring an exoplanet. For the first time, astronomers have measured both the brightness and the mass of an exoplanet - which has given us a new probe into how planets form.



*Illustrations of Beta Pictoris system (l.; c.); the system's dimensions (r.).*

(GRAVITY Collaboration/Axel M. Quetz, MPIA Graphics Department)

The exoplanet is Beta Pictoris c ( $\beta$  Pic c), a gas giant orbiting the star - you guessed it - Beta Pictoris, just 63 light-years away. It's a very young, very bright star, around 23 million years old; as such, it's still surrounded by [a lot of dusty debris](#), and its exoplanets - we've confirmed two to date - are just babies, around 18.5 million years old.

$\beta$  Pic c is the second of those planets, and it was discovered using the radial velocity method. Stars, you see, don't sit stationary while planets whirl around them; the two bodies exert a gravitational tug on each other, and the orbit is around a [mutual centre of gravity](#).

So, if you look at a star and you can see it wobbling a little in place - its light lengthening into redder wavelengths, or redshifting, as it moves away, and shortening into bluer wavelengths, or blueshifting, as it moves closer, that often means its being tugged by an exoplanet. The bigger the exoplanet, the bigger the gravitational tug

it exerts on the star.

Beta Pictoris b ( $\beta$  Pic b), a gas giant up to 13 times the mass of Jupiter, was discovered in 2008 via direct imaging. So, it was expected that the star would wobble.

But, while studying observational data taken over the preceding 16 years, a wobble noticed by astronomer Anne-Marie Lagrange of Grenoble Observatory in France and colleagues was inconsistent with  $\beta$  Pic b. Instead, it seemed to be a second, previously undetected exoplanet.

They [unveiled their newly discovered exoplanet -  \$\beta\$  Pic c - last year](#). Enter the ExoGRAVITY collaboration, a project using the [GRAVITY instrument](#) on the Very Large Telescope Interferometer to directly image exoplanets. The ExoGRAVITY team thought  $\beta$  Pic c would make an excellent candidate for direct imaging.

They had been looking for an exoplanet with a good set of radial velocity data, and since  $\beta$  Pic c's sibling had already been directly imaged, it seemed a good bet.

Very few exoplanets can be directly imaged with our current technology. They need to be sufficiently distant from their star; otherwise they disappear into the glare. Our most reliable exoplanet detection methods work best on very close stars. And it's helpful if the exoplanet is quite young, since such planets are still warm enough to emit thermal radiation.

As it turned out,  $\beta$  Pic c was perfect. Those years of wobble data provided an excellent profile of the exoplanet's movement; the ExoGRAVITY team, led by astronomer Mathias Nowak of the University of Cambridge in the UK, was able to home in on the location and obtain direct images. That work has now led to an exoplanet dataset the likes of which we've never had before.

The radial velocity data were used to calculate the exoplanet's mass and orbit; it clocks in at around 8.2 times the mass of Jupiter, and orbits the star at 2.7 [astronomical units](#), with an orbital period of 3.4

years. So far, so normal.

But the direct images revealed a surprise -  $\beta$  Pic c is surprisingly faint, six times fainter than its sibling, even though the two exoplanets are of similar size, suggesting that it's much cooler.  $\beta$  Pic c's brightness suggests its temperature is around 1,250 Kelvin, compared to [1,724 Kelvin for  \$\beta\$  Pic b](#).

This could be a clue as to how the exoplanet formed: In models, the temperature of a baby exoplanet is related to its formation method.

In the disc instability formation model, part of the protoplanetary disc of dust and gas swirling around the newborn star collapses directly into a gas giant. In this model, the exoplanet has no solid core, and forms hotter and brighter.

In the core accretion model, pieces of rock in the protoplanetary disc stick together, first via electrostatic forces, then via gravity, forming a larger and larger body, building a planet from the bottom up. The resulting exoplanet has a solid core, and forms cooler and dimmer.

Because  $\beta$  Pic c is smaller and dimmer than expected, and because the disc instability model requires the exoplanet to form much farther from its host star than  $\beta$  Pic c is today, the team believes that the exoplanet formed via core accretion.

It's a fascinating result, but there is still work to be done. We don't have a reliable mass estimate for  $\beta$  Pic b - it could be anywhere between 9 and 13 times the mass of Jupiter. It's orbiting the star at a greater distance than  $\beta$  Pic c, which means we don't have enough wobble data to infer its mass. How it formed will be harder to gauge until we can narrow this down.

And there's more work to be done on  $\beta$  Pic c. The next step will be to take detailed spectra of the light being emitted by the exoplanet. From this, scientists can work out the planet's atmospheric composition - a key technique in looking for signs of life elsewhere in the galaxy.

The research has been published in two papers in *Astronomy & Astrophysics*, [here](#) and [here](#).

<https://wb.md/2GBmWVu>

## 'Superspreaders' Driving the COVID-19 Pandemic, Contact-Tracing Study Shows

*8% of infected individuals were responsible for 60% of new infections*

Ralph Ellis

A small number of infected people are the main cause of the coronavirus's spread, according to a massive contact tracing study conducted in two Indian states.

The study [published in Science](#) found that 8% of infected individuals were responsible for 60% of new infections. Meanwhile, 71% of infected individuals did not infect anybody.

"Superspreading events are the rule rather than the exception when one is looking at the spread of COVID-19, both in India and likely in all affected places," said lead researcher [Ramanan Laxminarayan](#), a senior research scholar at the Princeton Environmental Institute (PEI), according to a [news release from Princeton](#).

The release said this was the largest contact tracing study of any disease in the world.

Researchers from the PEI, Johns Hopkins University, and the University of California, Berkeley, coordinated with public health officials in the Indian states of Tamil Nadu and Andhra Pradesh. They studied 575,071 people who had been exposed to 84,965 confirmed cases of COVID-19, the release said.

The study confirmed that children and young adults were the key demographics in spreading the virus and that they're most likely to spread the virus to somebody their own age.

The role of children has been in question since the pandemic began. Young adults make up about a third of COVID-19 cases, the news release said.

"Kids are very efficient transmitters in this setting, which is something that hasn't been firmly established in previous studies," Laxminarayan said. "We found that reported cases and deaths have been more concentrated in younger cohorts than we expected based on observations in higher-income countries."

The releasesaid COVID-19 deaths in India occurred, on average, six days after hospitalization, compared to 13 days in the United States. Deaths in India have been concentrated in ages 50-64, compared to the 60-plus demographic in the United States.

India has the second-most COVID cases in the world with 6.3 million, according to Johns Hopkins University. The United States has 7.2 million. India has a much bigger population — 1.3 billion people compared to around 329 million in the U.S.

#### Sources

Science. "Epidemiology and transmission dynamics of COVID-19 in two Indian states" <https://science.sciencemag.org/content/early/2020/09/29/science.abd7672>

"Superspreading events are the rule rather than the exception when one is looking at the spread of COVID-19, both in India and likely in all affected places," said lead researcher [Ramanan Laxminarayan](#), a senior research scholar at the Princeton Environmental Institute (PEI), according to a news release from Princeton.

<https://environment.princeton.edu/people/ramanan-laxminarayan/>

Princeton University. "Largest COVID-19 contact tracing study to date finds children key to spread, evidence of superspreaders."

<https://www.princeton.edu/news/2020/09/30/largest-covid-19-contact-tracing-study-date-finds-children-key-spread-evidence>

<https://bit.ly/3jzdDUp>

## Melting Antarctic Snow Is Revealing The Preserved Remains of 800-Year-Old Penguins

As the world [warms up](#), melting ice sheets across the globe are exposing everything from trapped [methane gas](#) to [Viking remains](#).

[David Nield](#)

Now a new discovery has been made in the receding snow packs: the remains of 800-year-old penguins.

Having discovered what initially appeared to be fresh [Adélie penguin](#) remains at Cape Irizar on the Antarctic coastline,

researchers were surprised to discover that carbon-dating put the carcasses at a minimum of 800 years old. Some of the less well-preserved remains even date back around 5,000 years, the team says.

The site was originally identified by the pebble mounds used to build penguin nests, with penguin chick bones scattered on the surface. That didn't make sense – there's no record of a penguin colony in this spot since records began in the early 1900s.



*Penguin remains.* (Steven Emslie)

After further excavation and the recovery of penguin bone, feather, and eggshell, subsequent analysis revealed this was in fact a long-abandoned penguin habitat.

"Overall, our sampling recovered a mixture of old and what appeared to be recent penguin remains implying multiple periods of occupation and abandonment of this cape over thousands of years," [says marine biologist behind the discovery Steven Emslie](#), from the University of North Carolina Wilmington.

"In all the years I have been doing this research in Antarctica, I've never seen a site quite like this."

Penguins may have moved from the spot due to increasing snow cover or other climate shifts, but as more snow fell, the remains were preserved and frozen – kept in an almost fresh state until Emslie and his colleagues happened upon them. With the average annual temperature of this part of the continent rising by between 1.5 and 2 degrees Celsius since the 1980s, the trapped remains have now been revealed and are decomposing as normal.

"This recent snowmelt revealing long-preserved remains that were frozen and buried until now is the best explanation for the jumble of penguin remains of different ages that we found there," [says Emslie](#). Emslie suggests that so-called '[fast ice](#)' stretching inland from the

sea may have begun to form as temperatures cooled, leaving the site inhospitable for penguins for much of the year. Now the reverse effect is underway with much of the ice melting.

The [climate change](#) currently happening on our planet is not just revealing the remains of long-dead animals, it's also bringing some organisms [back to life](#). Unfortunately, on balance, we're on track to [lose many more species](#) than we gain.

As for Cape Irizar, the researchers think that its long history of hosting penguins might be about to enter a new chapter after a hiatus that's lasted for centuries.

"[Penguins] need pebbles for their nests, so they are going to find all the pebbles that are already on the land at this site very attractive," Emslie told the [New York Times](#). "I would not be surprised to see them make this place their home again in the near future." The research has been published in [Geology](#).

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

## Snakes Have Been Found Slicing Open Live Toads And Devouring Their Organs One by One

*Pity the [toads](#) that encounter Asian kukri snakes in Thailand.*

Mindy Weisberger

These snakes use enlarged, knifelike teeth in their upper jaws to slash and disembowel toad prey, plunging their heads into the abdominal cavities and feasting on the organs one at a time while the toads are still alive, leaving the rest of the corpse untouched.

While you're recovering from the horror of that sentence, "perhaps you'd be pleased to know that kukri snakes are, thankfully, harmless to humans," amateur herpetologist and naturalist Henrik Bringsøe, lead author in a new study describing the gruesome technique, [said in a statement](#).

This grisly dining habit was previously unknown in [snakes](#); while some rip chunks from their prey, most snakes gulp down their meals whole.

Scientists had never before seen a snake bury its head inside an animal's body to slurp up organs - sometimes taking hours to do so, Bringsøe and his colleagues reported.



*A Small-banded kukri snake with its head inside an Asian black-spotted toad.*  
(Winai Suthanthangjai)

The victims of this horrific organ-slurping were poisonous toads called *Duttaphrynus melanostictus*, also known as Asian common toads or Asian black-spotted toads; they are stout and thick-skinned, measuring about 2 to 3 inches (57 to 85 millimeters) in length, according to [Animal Diversity Web](#) (ADW), a wildlife database maintained by the University of Michigan's Museum of Zoology.

During the deadly battle, the toads fought "vigorously" for their lives, with some defensively secreting a toxic white substance, according to the study. The snakes' grisly evisceration strategy could be a way to avoid the toad's poisonous secretions while still enjoying a tasty meal, the researchers wrote.

Kukri snakes in the *Oligodon* genus are so named because their slashing teeth resemble the kukri, a forward-curving machete from Nepal.

While kukri snakes aren't a threat to people, their teeth can cause painful lacerations that bleed heavily, because the snakes secrete an anticoagulant from specialized oral glands, according to the study.

"This secretion, produced by two glands, called Duvernoy's glands and located behind the eyes of the snakes, are likely beneficial while the snakes spend hours extracting toad organs," Bringsøe explained.

### Macabre mealtime

The researchers described three observations in Thailand of kukri snakes (*Oligodon fasciolatus*), which can measure up to 45 inches



(115 centimeters) long, consuming Asian common toads.

In the first incident, which took place in 2016, the toad was already dead when the witnesses discovered the scene, "but the soil around the two animals was bloody, indicating there had been a fight which eventually killed the toad," the scientists wrote.

The snake sawed through the toad's body by swinging its head from side to side; it then slowly inserted its head into the wound "and subsequently it pulled out organs like liver, heart, lung and part of the gastrointestinal tract."

In a second event, an epic battle between a kukri snake and a toad on 22 April 2020 lasted nearly three hours; the snake attacked, withdrew, and attacked again, deterred only temporarily by the toad's poison defense.

After finally subduing the toad, the snake extracted and swallowed organs while the toad was still breathing, according to the study.

On June 5, 2020, a kukri snake took a different approach and didn't disembowel the toad at all, instead devouring it whole. But in a fourth observation this year on June 19, the snake eviscerated its toad prey, slicing into the abdomen to reach its organ meal.

A kukri snake swallowing a juvenile toad. (Kanjana Nimnuam)

Young toads potentially produce less poison than adults do, which may have enabled the snake in the June 5 observation to safely gulp it down in one piece; another possibility is that kukri snakes are immune to the toad species' toxins, but they disembowel adults anyway because the toads are simply too big for them to swallow, the researchers reported.

However, there's not yet enough data to answer these questions, Bringsøe said in the statement. "We will continue to observe and report on these fascinating snakes in the hope that we will uncover further interesting aspects of their biology," he said.

The findings were published online September 11 in the journal [\*Herpetozoa\*](#).