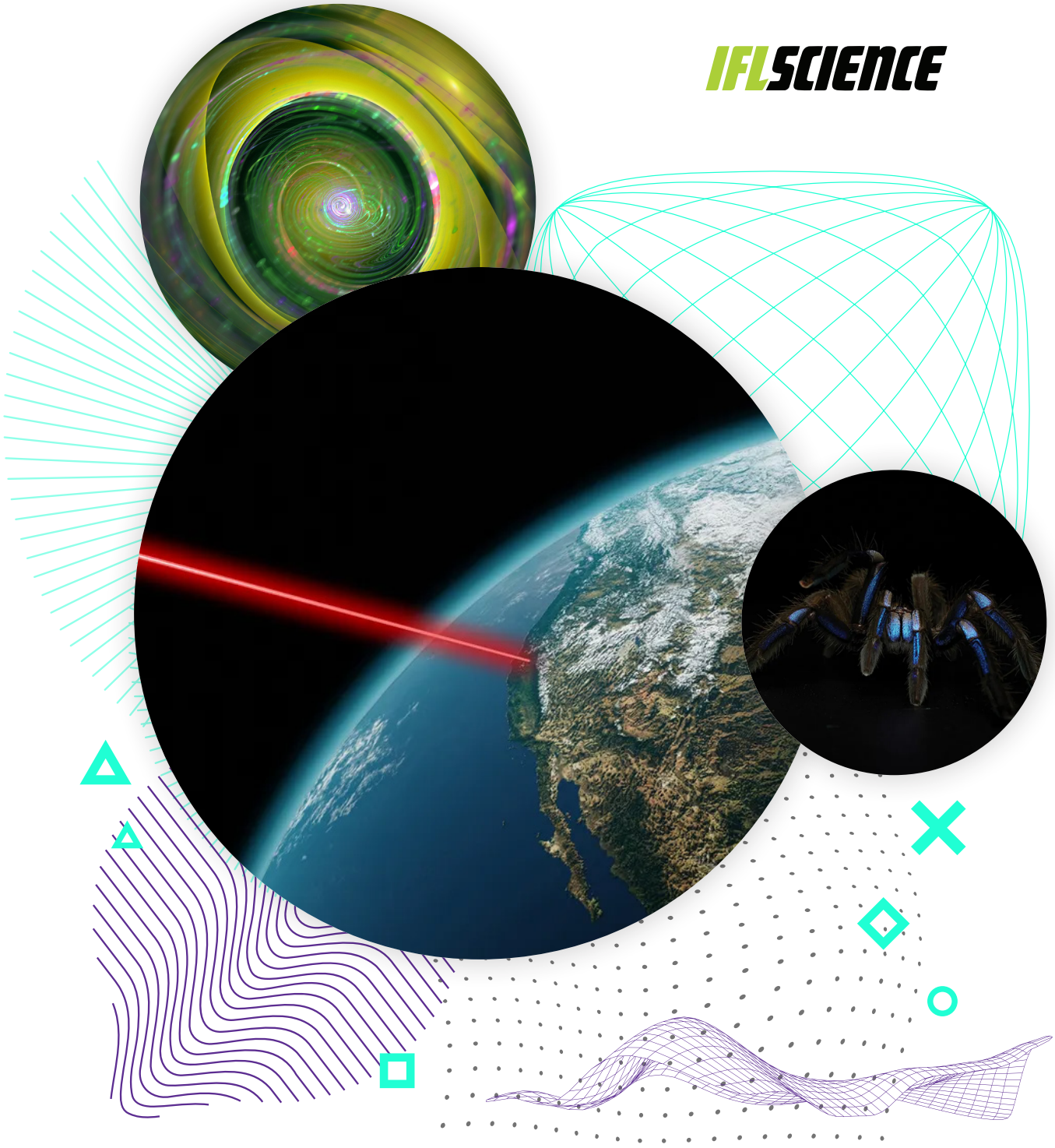

2023 In Science News: Our Top 12 stories of the year

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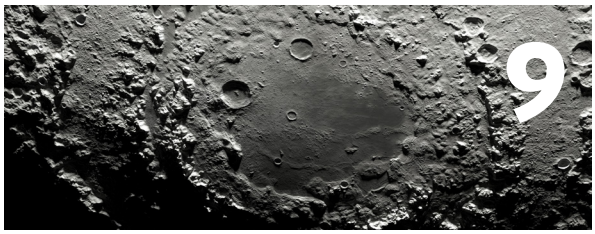
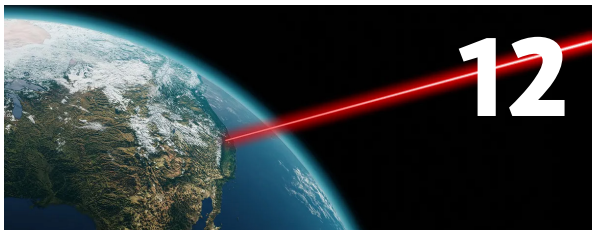


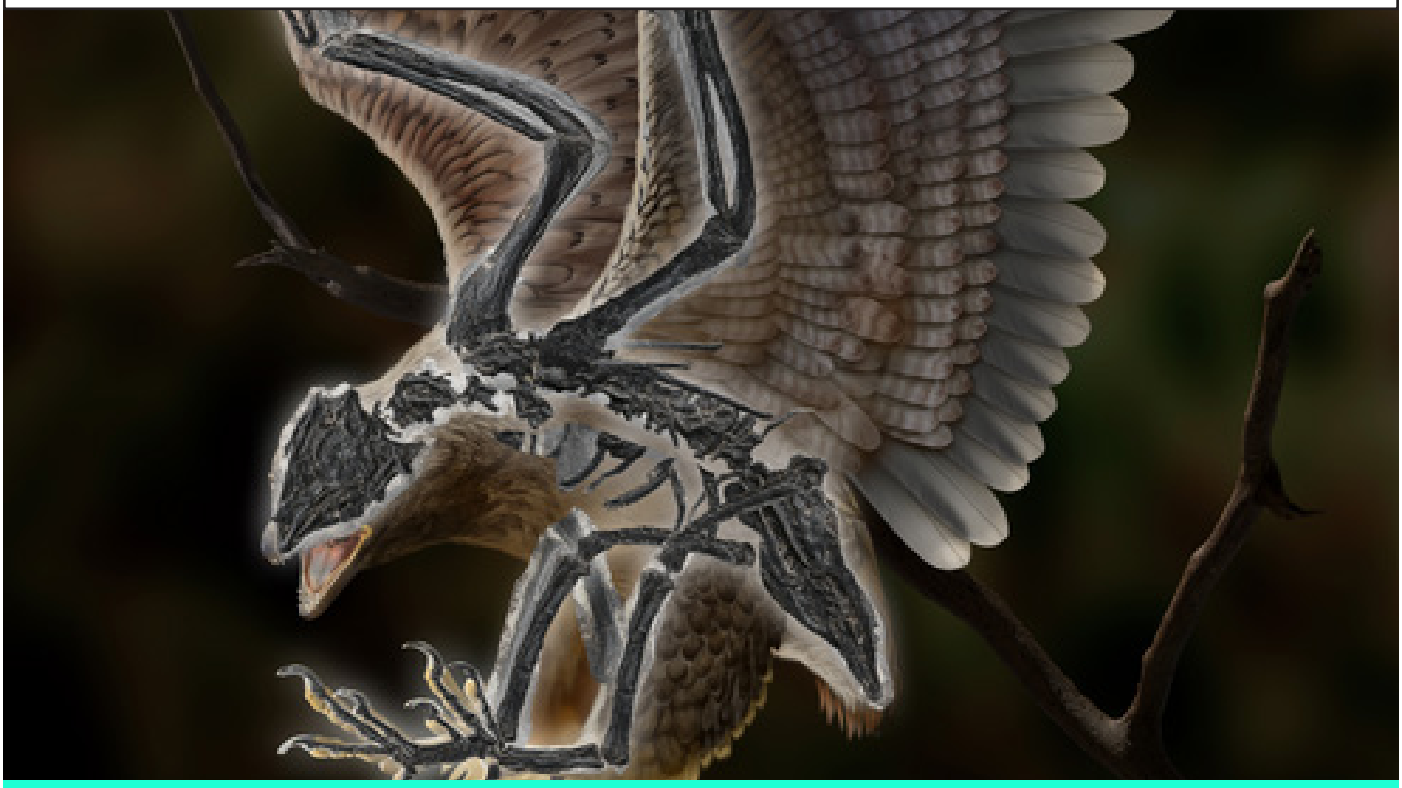


Introduction

As the year draws to a close, we can now look back at the scientific stories that helped shape it. From groundbreaking discoveries that challenged the boundaries of our understanding, to technological marvels set to reshape our future, join us as we take a look at the dynamic world of science in 2023.

DISCOVERY OF A "BIRD" WITH A HEAD LIKE *T. REX* PUZZLES SCIENTISTS

2



The curious 120-million-year-old specimen has an evolutionarily decoupled body and skull. Image credit: ZHAO Chuang

Palaeontologists have made a puzzling discovery – a bizarre, bird-like fossilized creature with a skull that is morphologically similar to that of a dinosaur. Although it is commonly accepted that birds descended from these prehistoric reptiles, it's less common to find body parts that appear evolutionarily disparate from one another. That is, until something like this turns up.

The specimen from China, which belongs to a creature called *Cratonavis zhui*, exhibits a dinosaur-like skull that sits atop a body more similar to that of modern birds. Even more remarkable, *C. zhui* has features that differ from those of even ancient birds.

Using a high-resolution CT (computed tomography) scanner, a team of palaeontologists from the Institute of Vertebrate Paleontology and Paleoanthropology (IVPP) of the Chinese Academy of Sciences tried to piece together the body of this 120-million-year-old puzzle from its fossilized remains.

Reconstruction of the bird's skeleton revealed a skull that was almost identical to a ***Tyrannosaurus rex*** (only substantially smaller), despite having a body that is much more similar to a modern bird. This unusual arrangement, which seemingly hails from different evolutionary timescales, is an example of **mosaicism**, where something is made up of parts that appear unrelated.

"The primitive cranial features speak to the fact that most Cretaceous birds such as *Cratonavis* could not move their upper bill independently with respect to the braincase and lower jaw, a functional innovation widely distributed among living birds that contributes to their enormous ecological diversity", said Dr LI Zhiheng, a lead author of the study, in a **statement**.

C. zhui also differed from ancient birds in having an elongated scapula and first metatarsal. It is possible that this was an adaptation to compensate for this unusual creature's otherwise lousy ability to fly.

"The scapula is functionally vital to avian flight, and it conveys stability and flexibility," said Dr Wang Min, lead and corresponding author on the study.

"We trace changes of the scapula across the Theropod-Bird transition, and posit that the elongate scapula could augment the mechanical advantage of muscle for humerus retraction/rotation, which compensates for the overall underdeveloped flight apparatus in this early bird, and these differences represent morphological experimentation in [flying] behavior early in bird diversification."

Learn more about this story **here**.

SCIENTISTS HAVE TESTED THE "ENJUIN MUMMY" TO FIND OUT WHAT IT REALLY IS 3

Surprisingly, it did contain animal parts. Image credit: Kurashiki University of Science and the Arts.

Scientists from Kurashiki University of Science and the Arts have tested the remains of what was thought to be a "mermaid mummy" to find out exactly what it was. Spoiler, it was not a mermaid.

The **Enjuin "mummy"** was originally found in a box at the Enjuin Temple in Asaguchi, Okayama Prefecture, Japan. **According** to a note found with the odd specimen, the supposed "mermaid" was "caught in a net off the sea off of Tosa [...] in the Genbun era [1736-1741 CE]."

"We have worshipped it, hoping that it would help alleviate the coronavirus pandemic even if only slightly," the head priest at the temple told **The Asahi Shimbun**, a Japanese news outlet, before the mermaid was studied. "I hope the research project can leave (scientific) records for future generations."

The scientists were not investigating whether it was actually a mermaid, but they wanted to know what it was.

The team undertook **a series of tests**, including surface observations, X-rays, computed tomography (CT) scans, radiocarbon dating, and DNA analysis. What could it possibly be?

Well, their analysis confirmed that it was animal. Well, at least parts of it were and these parts came from different things. In a move that would sit well with a story stuck somewhere between Frankenstein's Monster and *The Island of Doctor Moreau*, whoever created the "mermaid" had used fins – dorsal, anal, and pelvic fins, as well as bones – to form the lower half.

Pufferfish skin had been grafted onto the arms, shoulders, neck, and cheeks. The scales of which were dated to around 1800 CE.

The beastie's hair came from some sort of mammal, while keratin had been used for the nails.

The body, however, was less animal. It was made from a combination of paper, cloth, and some cotton padding, along with a plaster-like substance.

It turns out the Enjuin mummy is just **another** fishy story to go along with all the other **fake mermaids** out there.

Learn more about this story **here**.

PLASTIC ROCKS FOUND ON REMOTE VOLCANIC ISLAND ARE A "TERRIFYING" DISCOVERY 4

Trindade Island where this discovery took place. Image credit: Global_Pics/ iStock

Geologists have discovered a "new and terrifying" development that demonstrates how human activity is impacting the natural world – "plastic rocks". These strange and disturbing specimens were found on a remote volcanic island off the coast of Brazil in March 2023.

The rock-mess has been dubbed "plastiglomerates", as it is a mix of sedimentary granules and other debris that have been fused together by plastic melted by volcanic activity.

The discovery was first reported by **Reuters** after a geologist from the Federal University of Paraná found the rocks on Trindade Island, which is located in the Atlantic Ocean, 1,140 kilometers (708 miles) from Brazil's southeastern state of Espirito Santo. The island is home to green turtles and has no permanent human settlement.

At first, the scientists could not identify what the bluish-green thing was, but subsequent chemical analysis showed that it consisted of both sediment and plastic. The latter component likely came from fishing nets which are a major contributor to ocean pollution across the world.

"This is new and terrifying at the same time because pollution has reached geology," Fernanda Avelar Santos, a geologist at the Federal University of Paraná, told the news agency.

"We identified (the pollution) mainly comes from fishing nets, which is very common debris on Trinidade Island's beaches. The (nets) are dragged by the marine currents and accumulate on the beach. When the temperature rises, this plastic melts and becomes embedded with the beach's natural material," Santos added.

Although plastiglomerates have now been found across the world, the specimens from Trindade Island are particularly worrying as it is relatively remote and home to diverse, rare wildlife. These hideous rocks are a dire testament to the impact human pollution is having on the planet. A **report** published in the same month revealed there are more than 170 trillion pieces of plastic loose in the world's oceans.

Learn more about this story **here**.

RECORD-BREAKING DEEPEST FISH EVER CAUGHT ON CAMERA 8,330 METERS DOWN

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Rather than a salamander, this is one of the deepest fish ever seen on camera. Image Credit: Minderoo-UWA Deep Sea Research Centre

Scientists shattered deep-sea records in April 2023 by capturing footage of fish over 8 kilometers (4.8 miles) beneath the ocean's surface and filming even deeper. The researchers believe they are now approaching the maximum depths at which fish can survive.

In the Izu-Ogasawara trench, part of the western Pacific Ocean, an unknown species of *Pseudoliparis*, a **snailfish** variety, was filmed at a staggering depth of 8,336 meters (27,350 feet). This surpasses the previous record held in the **Mariana trench** at 8,178 meters (26,830 feet). While the Mariana is renowned as the deepest and most studied trench, the Izu-Ogasawara, being the warmest, proves more biologically enticing.

Professor Alan Jamieson, leading the expedition, told IFLScience that, while depth and pressure play crucial roles in trench ecosystems, temperature is also a vital factor. The Izu-Ogasawara's warmth, coupled with the high productivity of surrounding Japanese waters, make it a more hospitable environment as more material drifts down to feed life in the deep.

Contrary to popular belief, the team aboard the research ship DSSV Pressure Drop reasoned that the warmer conditions in the Izu-Ogasawara would allow for life to exist at greater depths. Their findings, capturing *Pseudoliparis belyaevi* at 8,022 meters (26,319 feet) and an unknown species at 8,336 meters, challenged assumptions about the deep sea.

Jamieson explained that even though the Mariana's surface waters are more tropical, the trench itself is colder due to its proximity to the Southern Ocean, influenced by Antarctic processes. The research revealed that the ecology in the Izu-Ogasawara differs, making it a unique and diverse habitat.

"The Japanese trenches were incredible places to explore; they are so rich in life, even all the way at the bottom," Jamieson said in a **statement**.

While these snailfish adaptations to extreme depths are intriguing, considering they typically inhabit shallower waters, the expedition demonstrated the richness of life even in the deepest reaches of the Japanese trenches.

Jamieson concluded that finding fish at greater depths is unlikely, as no other similarly deep and warm trenches exist. The research sheds light on the remarkable ability of these creatures to thrive in extreme environments, challenging previous assumptions about the limits of life in the deep sea.

Learn more about this story **here**.

WORLD'S FIRST X-RAY OF A SINGLE ATOM ACHIEVED

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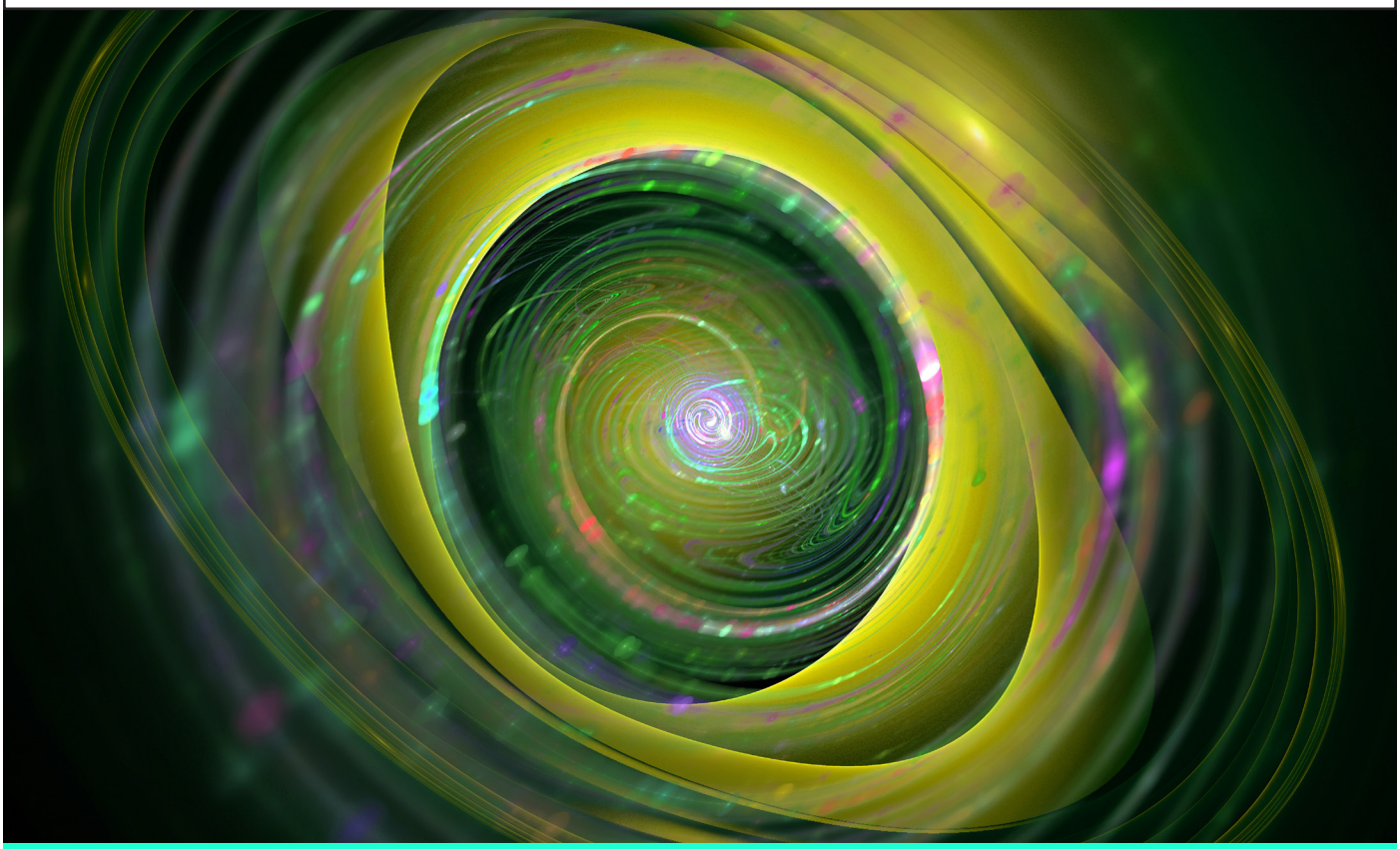

This is definitely not the X-ray of the atom, but it does look pretty. Image credit: Lana Po/ Shutterstock

X-rays are not just useful for seeing fractured bones or decaying teeth. This extremely energetic light plays an important role in our understanding of the molecular world. But despite their use in so many scientific fields, researchers have never been able to study an atom with X-rays. That is until recently.

A team of researchers have successfully characterized a single atom using X-rays. Not only were they able to distinguish the type of atoms being observed (there were two), but they were also able to study their chemical behavior.

"Atoms can be routinely imaged with scanning probe microscopes, but without X-rays, one cannot tell what they are made of. We can now detect exactly the type of a particular atom, one atom-at-a-time, and can simultaneously measure its chemical state," senior author Professor Saw Wai Hla, from the University of Ohio and the Argonne National Laboratory, said in a **statement**.

"Once we are able to do that, we can trace the materials down to ultimate limit of just one atom. This will have a great impact on environmental and medical sciences and maybe even find a cure that can have a huge impact for humankind. This discovery will transform the world."

The researchers were able to track both an iron atom and a terbium atom, an element that is among the so-called rare-earth metals. To achieve this, both atoms were inserted into their respective molecular hosts. A conventional X-ray detector was supplemented with a special alternative that had a sharp metal tip designed to capture the X-ray excited electrons.

This technique also allowed the team to observe the atom's chemical states, which behaved differently. Much like examining fingerprints, the detector can be used to compare the composition – both chemical and physical – of independent materials.

It could have huge impacts on the future study of quantum information and the detection of trace elements in environmental and medical research.

Learn more about this story **here**.

JUST ONE PROTEIN IS ALL THAT'S NEEDED TO SPARK HUNTINGTON'S DISEASE

7

In Huntington's disease, a genetic mutation leads to buildup of an abnormal form of the protein huntingtin inside the neurons of the striatum and cortex. Image credit: Kateryna Kon/Shutterstock

In June 2023, a group of scientists announced an important finding; they had figured out the structure of the protein that triggers Huntington's disease, something that has remained one of the biggest mysteries in neuroscience. This discovery ushers in new hope for a treatment that could stop the disease all together.

This news alone would be worth celebrating, but there's more. Because the proteins are implicated in other neurodegenerative illnesses, such as Alzheimer's disease, this new finding may have groundbreaking implications for those too.

The protein in question is called huntingtin (HTT), which, in someone living with Huntington's disease, **mutates** and develops an abnormally long strand of repeating amino acids within its structure. This strand is called a polyglutamine (polyQ) stretch. Usually, there are an average of **17-20** repeats of this sequence, but in Huntington's, however, there can often be 40 or more.

Importantly, the more repeats there are in the strand, the earlier the disease's symptoms, such as personality changes and movement disorders, start to appear.

The mutant form of the protein accumulates in the brain and folds into a shape that is toxic to cells. Proteins that behave like this are called amyloids and are involved in other disorders as well. For example, both **Alzheimer's disease** and **Parkinson's disease** are linked to clusters of abnormal beta-amyloid proteins. When different amyloid precursors build up in the rest of the body, it can lead to pathologies known as **amyloidosis**.

In this new study, the researchers determined the structure of the amyloid nucleus for the HTT protein, the "spark" that causes the chain reaction of protein misfolding.

"This is the first time anyone has experimentally determined the structure of an amyloid nucleus even though most major neurodegenerative diseases are associated with amyloids," senior author Dr Randal Halfmann said in **statement**.

Armed with this knowledge, the team hopes future work will find ways to stop the toxic cascade of protein misfolding from starting at all.

As Halfmann put it, "We've now figured out what the first link in the chain looks like, and, in doing so, have discovered a new way to stop it."

Learn more about this story **here**.

SCIENTISTS INSERTED NEANDERTHAL AND DENISOVAN GENES INTO MICE – HERE'S WHAT HAPPENED

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Researchers used CRISPR to insert the ancient gene into mice. Image credit: Roni Setiawan/Shutterstock

A gene carried by both **Neanderthals and Denisovans** has been inserted into mice to see how it may have contributed to the body shape of our ancient ancestors. The gene, which was transferred to the rodents through CRISPR gene editing technology, saw the mice develop larger heads, twisted ribs, and shortened spines.

The gene they inserted is called *GLI3* and plays an important role in embryonic development in modern humans. Mutations in this gene can lead to physical malformations, such as polydactyly – the growth of extra fingers or toes, as well as skull deformations.

Interestingly, both Neanderthals and Denisovans had a slightly altered version of GLI3, which had a substituted amino acid at one end of the coding region. However, neither species of ancient hominid had extra toes or any life-threatening cranial defects.

However, as the researchers pointed out, these extinct ancient ancestors did display several morphological characteristics that differed from those of modern humans. These included "elongated and low crania, larger brow ridges, and broader rib cages."

To find out how the ancient form of the *GLI3* gene might affect the development of our ancestors, the scientists first engineered mice to carry a faulty version of the gene. This caused the rodents to develop severe skull and brain deformities as well as polydactyly, showing how a functioning version of the gene is essential for healthy embryonic growth.

In contrast, the mice that carried the version of the gene possessed by Neanderthals and Denisovans demonstrated "altered skeletal structures, such as enlarged cranium, altered shapes of vertebrae, and rib malformations." This suggests that the ancient gene did not completely disrupt embryonic development but did influence the morphology of these hominids.

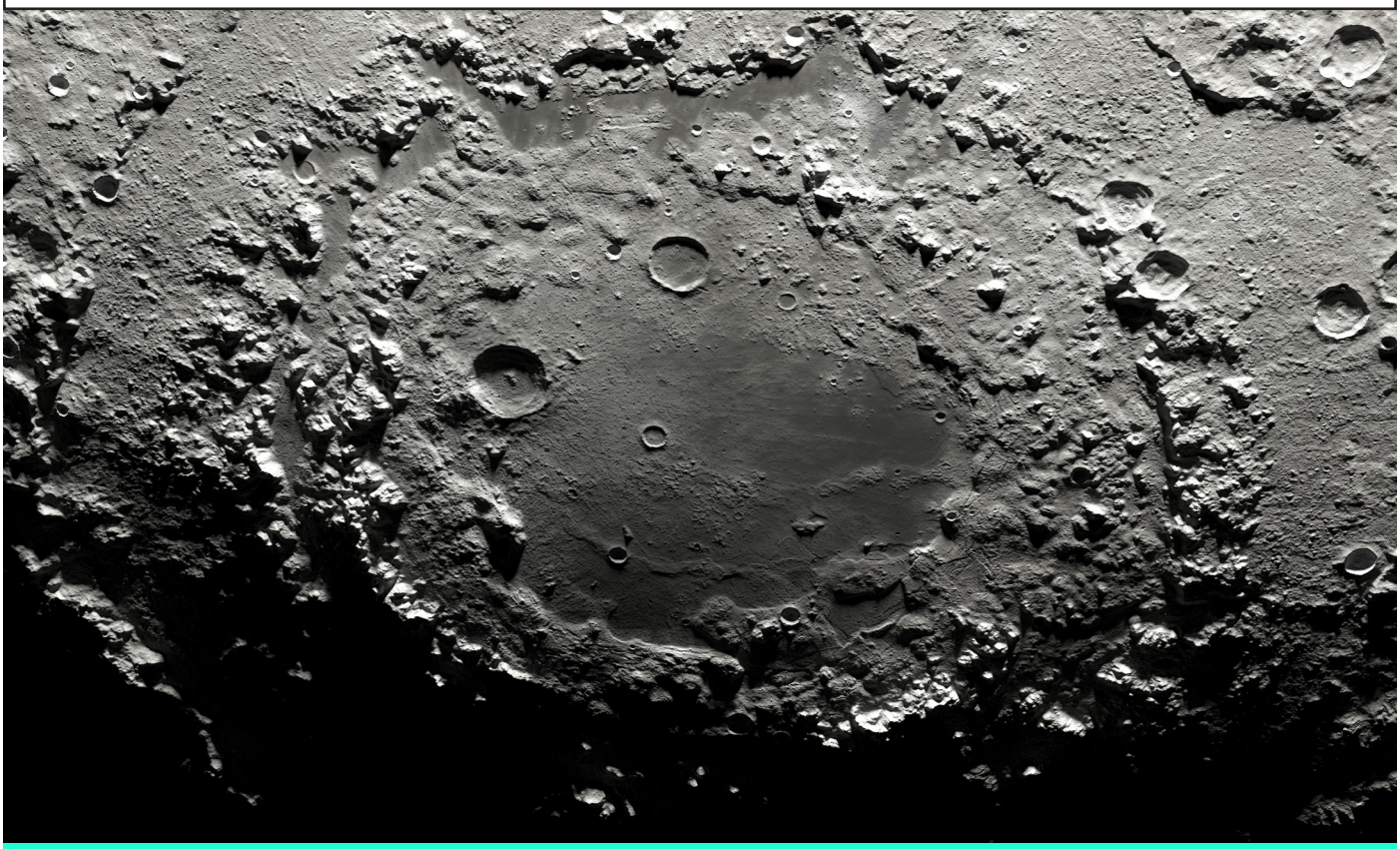
The mice given the archaic gene had fewer vertebrae and stronger rib torsion when compared to regular mice. This mirrors important differences between modern humans and Neanderthals. Some of the rodents also "exhibited asymmetric shapes of rib cages associated with scoliosis," which, the authors explain, is something recent studies have identified in Neanderthals.

It would seem, then, that some version of the *GLI3* gene may have been somehow involved in giving our extinct ancestors their characteristic head and body shape.

Learn more about this story **here**.

INDIAN MOON ROVER HITS JACKPOT, DETECTS WEALTH OF ELEMENTS AT LUNAR SOUTH POLE

9



Lunar far side imaged by Chandrayaan-3 on August 19, 2023. Image credit: FoxPictures/Shutterstock

India's Chandrayaan-3 lunar mission was proven to be both a scientific success and a technological triumph in August. Their Pragyan rover managed to analyze the composition of the Moon's surface close to the lunar south pole and returned data that has value beyond the previous missions. This is because the area being studied is close to the likely location for future bases.

Alas, the mission still has not discovered the most valuable prize – water ice. However, the Indian Space Research Organization (ISRO) has announced the Laser-Induced Breakdown Spectroscopy (LIBS) instrument carried by Chandrayaan-3 did confirm the presence of sulfur. This, according to their **statement** is something "that was not feasible by the instruments onboard the orbiters."

LIBS uses intense pulsing laser light to turn materials into plasma, the electromagnetic spectrum of which can be used to identify the composition (its elements at least, not the molecules in which they were combined). Amazingly, this was achieved with less than 1.2 watts of power.

Besides sulfur, the early results revealed aluminum, calcium, iron, chromium, titanium, manganese, silicon, and oxygen. Although the research has not yet discovered any hydrogen, the search for this valuable element is very much "underway".

It is the evidence of water, preserved in frozen form at the bottom of craters near the lunar poles, which has mostly driven the latest Moon races after decades of neglect. It is the hunt for this substance that has motivated India to land at 69 degrees South. It also motivated Russia too, but to a much more disastrous **outcome**.

At the moment, it is unlikely that the Moon will ever become a place for long-term occupation, even when the costs of space travel decline. This is because it will likely be too expensive to transport materials to its surface. The only economically viable solution would be to use whatever the Moon can provide.

If Chandrayaan-3 can find ice on the Moon, then this would be a monumental discovery. But regardless, every element that is accounted for is one less that we would need to bring from the Earth in the future. Sulfur in particular could potentially be used to make **concrete**.

Learn more about this story **here**.

MEET THE GORGEOUS NEW TARANTULA FROM THAILAND WITH RARE ELECTRIC BLUE HAIR

10

How can anyone find something this beautiful, scary? Image credit: Chomphuphuang, N., et al (2023) Zookeys (CC BY 4.0); cropped

Watch out! There is a new species of tarantula that has been discovered in Thailand! This fantastic spider has brilliant violet and metallic blue hairs on its legs, on its fang-like mouthparts, and on top of its carapace (upper part of the exoskeleton). The blue coloration is from photonic nanostructures rather than an expression of pigment.

This new species was found in the Phang-Nga province of Thailand. The researchers collected the tarantula that has now been allocated to the genus *Chilobrachys*, which means that the total number of species in the genus is 32. The species was found in the mangrove forests where it lives in tree hollows. It is thought that the species could also live in burrows on land and at different elevations.

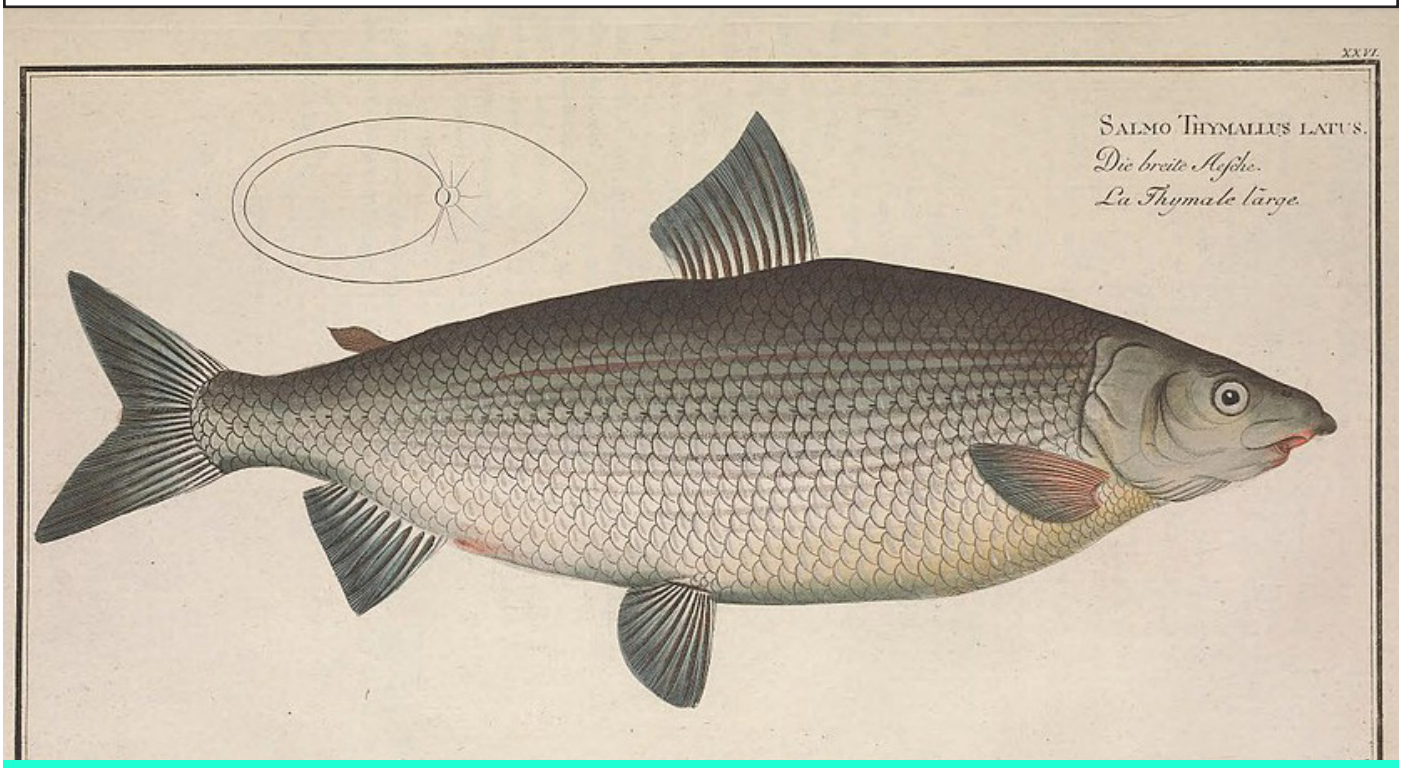
The name of the new species is *Chilobrachys natanicharum* sp. nov. The name was decided by an auction campaign, where the proceeds went towards money for cancer patients and the education of the Lahu children in Thailand. The Lahu children are part of an Indigenous hill tribe and many are denied education due to poverty. The name was the combination of the winners of the auction.

While a new species discovery is glorious news, it must be noted that the habitat where this tarantula has been discovered is slowly being destroyed. This, along with the hunting of the species, means the populations of spiders has plummeted across Thailand. Therefore, to tackle this situation, conservation efforts of habitats and species, and better monitoring practices to prevent further declines, need to occur.

Learn more about this story **here**.

FISH SPECIES THOUGHT TO BE EXTINCT IS ACTUALLY ALIVE AND THRIVING

11



The houting was officially recognized as extinct in 2008, but it seems it is very much alive. This image was created in 1785.
Image credit: Schmidt, F. G via Wikimedia Commons (no known copyright).

In 2008, a species of fish that used to be common in North Sea estuaries was officially classified as extinct. However, recent studies have shown that this was a mistake. Not only is the fish alive, but it is alive and flopping.

The fish in question is the houting, which was classified as extinct according to the International Union for Conservation of Nature's (IUCN) **Red List of Threatened Species**. The IUCN made its decision based on morphological analysis of the gill rakers and the snouts of this fish species.

According to earlier assessments, the fish that were thought to be houting (*Coregonus oxyrinchus*) were actually a different species of European whitefish (*Coregonus lavaretus*). Houting, the scientists concluded, were therefore extinct. But all was not as it seemed.

"It often happens that there is confusion as to whether animals are one species or not. Especially when fish are involved," Rob Kroes, from the Department of Freshwater and Marine Ecology at the University of Amsterdam, said in a **statement**.

Kroes and colleagues from the Natural History Museum, London, isolated mitochondrial DNA (mDNA) from the historical houting specimens and used it to create a **phylogenetic tree**. This diagram shows the lines of evolutionary descent of different species, and it revealed that houting (*C. oxyrinchus*) are in fact the same group as the European whitefish (*C. lavaretus*).

"The European whitefish is fairly widespread in Western and Northern Europe, both in freshwater rivers and lakes, estuaries and the sea," Kroes added. "Because we found no species difference between houting of the past and today's European whitefish, we do not consider the houting to be extinct."

It seems the species now needs its official Latin name updated to address this confusion. However, a definitive adjustment of the name requires more research into its DNA.

Learn more about this story **here**.

EARTH JUST RECEIVED A LASER-BEAMED MESSAGE FROM 16 MILLION KILOMETERS AWAY

12

The Deep Space Optical Communications tool onboard the Psyche probe successfully sent the most distant data transmission via laser beam to and from Earth. Image credit: ProleR/Shutterstock.com Modified by IFLScience

In November 2023, a deep space experiment traveling on NASA's Psyche spacecraft sent a message to Earth via laser beam. The message was fired through the void from beyond the Moon, representing an achievement that may transform how spacecrafts communicate.

This was the furthest-ever demonstration of this type of optical communication. The Deep Space Optical Communications (DSOC) beamed a near-infrared laser encoded with test data from around 16 million kilometers (10 million miles) away. This is around 40 times further away than the Moon is from Earth.

The beam was registered at the Hale Telescope at Caltech's Palomar Observatory in California.

The DSOC is a two-year tech demonstration riding along on Psyche as it travels to its asteroid namesake. The demonstration achieved "first light" on November 14, NASA's Jet Propulsion Laboratory (JPL), which managed both missions, explained.

"Achieving first light is one of many critical DSOC milestones in the coming months, paving the way toward higher-data-rate communications capable of sending scientific information, high-definition imagery, and streaming video in support of humanity's next giant leap: sending humans to Mars," Trudy Kortes, director of Technology Demonstrations at NASA HQ, said in a **statement**.

Optical communications have been sent from **Earth's orbit** before, but this is the furthest distance yet by laser beams. Laser communication can transmit vast amounts of data at incredible speeds by packing it into the oscillations of specific light waves.

NASA usually relies on radio waves to communicate with missions further away than the Moon, and both use electromagnetic waves to transmit data, but lasers are far more effective. According to NASA, the DSOC tech demonstration aims to show transmission rates 10-100 times greater than current top radio communication systems.

"Optical communication is a boon for scientists and researchers who always want more from their space missions, and will enable human exploration of deep space," said Dr Jason Mitchell, director of the Advanced Communications and Navigation Technologies Division within NASA's Space Communications and Navigation program. "More data means more discoveries."

Learn more about this story **here**.

75-MILLION-YEAR-OLD FOSSIL IS FIRST-EVER TYRANNOSAUR FOUND WITH STOMACH CONTENTS

13

Gorgosaurus looking gorgeous. Image credit: kamomeen/Shutterstock

Imagine being judged 75 million years after you died for your last meal. This is what happened to a Tyrannosaur (*Gorgosaurus*), as its fossilized remains have recently been analyzed by scientists.

There were two different species found in the *Gorgosaurus* stomach, inlcuding the legs of two small feathered dinosaurs known as *Citipes elegans.*

"It feels rather unfortunate for the *Citipes*, but lucky for us," study co-author **Dr Darla Zelenitsky of the University of Calgary** told IFLScience. Zelenitsky describes the *Gorgosaurus* specimen as a "once in a career fossil" – though, it's worth noting that her career has involved **a few of these** by now – because of its uniqueness as the first Tyrannosaur ever found with preserved stomach contents.

It was very clear that the cause of death for the *Citipes* was Tyrannosaur, but the death of the *Gorgosaurus* was more of a mystery. It was found in the bottom of a river channel deposit, which does not mean that it died from drowning – but that this was an ideal environment to be buried in because rivers transport a lot of sediments.

Finding a fossil like this gives a snapshot of behavior and can impact our capacity to learn about extinct animals. The discovery helped the researchers dive into the idea of how they dominate different ecosystems and how their diets changed as they got older – where they represented different positions on the food chain.

Previous research revealed that adults liked to chomp on big herbivores, and they used their massive skulls and their large teeth to bite through bone. However, it was unknown if the juveniles, who were a lot smaller, did the same.

"Now we have evidence that the young Tyrannosaurs had a different diet from adults, we want to try to pinpoint if there are any other things we can say about it, like what type of prey did they feed upon, or at what exact timing did the diet change, and how," co-author **Dr François Therrien of the Royal Tyrrell Museum told IFLScience**.

Learn more about this story **here**.