

Welcome to the May 2023 issue

SCIENCE NEWS *Monthly* is produced by the Science Department, St Benedict's Catholic Secondary School, Bury St Edmunds, Suffolk, UK.

GENETICS – What really killed Beethoven?

It's well-known that Beethoven's storied career was cut short by progressive hearing loss that left the composer completely deaf by age 45. Beethoven also suffered from gastrointestinal issues and a deteriorating liver. That faulty organ is thought to be responsible for the composer's skin reportedly turning yellow in the summer of 1821. On March 26, 1827, he succumbed to what many historians suspect was liver failure while in his apartment in Vienna. But was it the cause of his death?

The root cause of Beethoven's plethora of health issues has been a source of fascination to many. But working out what ailed a man that lived nearly two centuries ago is no easy task. Researchers have had to rely on notes from the composer's two autopsies, preformed after he was exhumed in 1863 and 1888, and other historical documents. Now, an analysis of several locks of hair passed down through families and gathered by collectors shows that Beethoven carried several genetic risk factors for liver disease, according to a report published in the journal *Current Biology*.





"This elevated risk — paired with a potential liver infection and the composer's alleged drinking habits — may have hastened Beethoven's premature death at the age of 56", says Tristan Begg, a biological anthropologist at the University of Cambridge. In 2014, Begg and his colleagues decided to reconstruct Beethoven's genetic instruction book, or genome. First, the team needed a piece of the composer himself. Luckily, around 30 separate locks of hair attributed to Beethoven had survived, in the possession of collectors and the descendants of people who first received the hair in the 19th century.

Begg partnered with Beethoven enthusiasts to ask the owners of these locks to part with a few strands. The team was able to gather samples from eight locks said to have been snipped from 1821 to 1827.

The researchers used some of the best-preserved locks to reconstruct the composer's genome. This analysis didn't uncover any genetic markers for deafness or intestinal issues. But the team did identify several risk factors for liver disease, including a variant of the gene *PNPLA3* that would have tripled the composer's risk of developing liver issues in his lifetime. Those risk factors alone shouldn't have doomed Beethoven.

But the scientists also found traces of the **hepatitis B virus**, which damages livers, in one of the strands reportedly collected shortly after Beethoven's death. The risk to the liver from a hepatitis B infection would have been further compounded by regular alcohol use, the researchers say. Some contemporaries claimed that the composer was drinking heavily by the end of his life.

While we don't know exactly what combination of factors killed Beethoven, *"this is a fascinating detective story,"* says Ian Gilmore, a hepatologist at the Royal Liverpool University Hospital in England, who was not involved with the research.

One question still remains, though: why did Beethoven become deaf so early in his life? Beethoven started to lose his hearing when he was 26 years old and by the last decade of his life it was completely gone. This is a question that even modern-day genetics cannot answer!

https://www.sciencenews.org/article/beethoven-hair-dna-composer-death

MEDICINE – CANCER: The Good News and the Bad News

In 2014 a cancer study was set up called **TRACERx**. It has been a major research initiative which takes practical steps to make precision medicine for lung cancer patients a reality. Using cutting-edge methods to collect and analyse genomic data, TRACERx aims to identify patients who could benefit from trials of new targeted treatments. Two reports have recently been published that can be viewed as "good news" and "bad news".

FIRST THE GOOD NEWS - Million-year-old viruses help fight cancer

Relics of ancient viruses - that have spent millions of years hiding inside human DNA - help the body fight cancer, say scientists. The study by the Francis Crick Institute showed the dormant remnants of these old viruses are woken up when cancerous cells spiral out of control. This unintentionally helps the immune system target and attack the tumour. The team wants to harness the discovery to design vaccines that can boost cancer treatment, or even prevent it.

The researchers had noticed a connection between better survival from lung cancer and a part of the immune system, called B-cells, clustering around tumours. B-cells are the part of our body that manufactures antibodies and are better known for their role in fighting off infections.



Precisely what they were doing in lung cancer was a mystery but a series of intricate experiments using samples from patients and animal tests showed they were still attempting to fight viruses. "It turned out that the antibodies are recognising remnants of what's termed endogenous retroviruses," said Prof Julian Downward, an associate research director at the Institute.

Retroviruses have a nifty trick of being able to slip a copy of their own genetic instructions inside our DNA; in fact, more than 8% of our "human" DNA actually has a viral origin. Some of these retroviruses became a fixture of our genetic code tens of millions of years ago and are shared with our evolutionary relatives, the great apes Other retroviruses may have entered our DNA a few thousand years ago. Some of these foreign instructions have, over time, been co-opted and serve useful purposes inside our cells, but others are tightly controlled to stop them spreading.

However, chaos dominates inside a cancerous cell when it is growing uncontrollably and the once tight control of these ancient viruses is lost. These ancient genetic instructions are no longer able to resurrect whole viruses but they can create fragments of viruses that are enough for the immune system to spot a viral threat. The immune system is tricked into believing that the tumour cells are infected and it tries to eliminate the virus, so it's sort of an alarm system. The antibodies summon other parts of the immune system that kill off the "infected" cells - the immune system is trying to stop a virus but in this case is taking out cancerous cells.

This is an ironic role-reversal for retroviruses that may well have caused cancers in our ancient ancestors, but are now acting to protect us. The researchers want to enhance that effect by developing vaccines to teach the body how to hunt for endogenous retroviruses.

https://www.bbc.co.uk/news/health-65266256.amp

AND NOW THE BAD NEWS - Study reveals cancer's 'infinite' ability to evolve

An unprecedented analysis of how cancers grow has revealed an "almost infinite" ability of tumours to evolve and survive, say scientists. The results are derived from the ongoing TRACERx study and provide the most indepth analysis of how cancers evolve and what causes them to spread.

Cancers change and evolve over time - they are not fixed and immutable. They can become more aggressive: better at evading the immune system and able to spread around the body. A tumour starts as a single, corrupted cell, but becomes a mixture of millions of cells that have all mutated in slightly different ways. TRACERx tracked that diversity and how it changes over time inside lung cancer patients and say the results would apply across different types of cancer.

"It has surprised me how adaptable tumours can be," says Professor Charles Swanton, from the Francis Crick Institute and University College London. "I don't want to sound too depressing about this, but I think - given the almost infinite possibilities in which a tumour can evolve, and the very large number of cells in a late-stage tumour, which could be several hundred billion cells - then achieving cures in all patients with late-stage disease is a formidable task."

With the development of cures for cancer seeming increasingly difficult, our attention must inevitably become focussed on prevention. Professor Swanton went on to say "If we want to make the biggest impact we need to focus on prevention, early detection and early detection of relapse."

https://www.bbc.co.uk/news/health-65266256.amp

ENVIRONMENT - How 'rewiggling' Swindale Beck brought its fish back

Swindale Beck is a stretch of river close to Haweswater Reservoir in Cumbria - one of England's largest lakes. About 200 years ago, the community of Swindale embarked on an ambitious project to straighten this section of the beck, with the aim of speeding the flow of water through the valley and increasing the amount of farmland surrounding it. That had unintended consequences, as is often the case when we 'tinker' with our natural surroundings. The faster-flowing water was too swift for fish like salmon and trout to spawn, and the river carried more sediment downstream, making it murkier.

So back in 2016, the RSPB and its partners - including the water company that owns the land - embarked on a remeandering or "rewiggling" project. After studying the valley to locate the original path carved out by the river, the charity enlisted a team of diggers to recreate that curvy channel. It is now about 180m (200 yards) longer than the straight line that had been in the valley bottom for two centuries.

Swindale Beck returns to natural shape



Source: Google Earth

BBC

The transformation was almost immediate. "About three months after the diggers left - we had salmon and trout spawning in the river again," recalls Lee Schofield from the RSPB. The re-established, meandering curves have slowed down the flow of water, which creates aquatic habitat at each bend. "We now have vegetation in the river, where young fish can shelter," explained Lee. "There are gravel banks, deep pools and riffles - shallow, turbulent parts of the river where the water draws in oxygen. It all benefits the whole food chain. It's like a living thing moving through the valley now, while the old, straightened river was just like a sad canal."

The RSPB runs its own farm in this valley and says it has shown that conservation and farming can work together and mutually benefit each other. Lee Schofield says seeing the river's clear, meandering water - and its wildlife - return is inspiring. "We as a species can rebuild and restore places like this. We can create space for nature."

https://www.bbc.co.uk/news/science-environment-65341994

ASTRONOMY - Astronomers solve the 60-year mystery of quasars

In the late 1950s using a new generation of radio telescopes astronomers began detecting very powerful radio emissions coming from points in the sky where there was no visible object. Then, in 1962, one of these radio sources was confirmed to be a distant object located by a large, optical telescope. But what could it be? Such objects were described as "quasi-stellar [meaning: star-like] radio sources", or "quasi-stellar objects" (QSOs), a name which reflected their unknown nature, and this became shortened to **"quasar"**.

Quasars can shine as brightly as a trillion stars packed into a volume the size of our Solar System. In the decades since they were first observed, it has remained a mystery what could trigger such powerful activity. New work led by scientists at the Universities of Sheffield and Hertfordshire has now revealed that it is a consequence of galaxies crashing together. Most galaxies have supermassive black holes at their centres. They also contain substantial amounts of gas – but most of the time this gas is orbiting at large distances from the galaxies drive the gas towards the black hole at the galaxy centre; just before the gas is consumed by the black hole, it releases extraordinary amounts of energy in the form of radiation, resulting in the characteristic quasar brilliance.

The image on the right is from the Hubble Space Telescope and shows two quasars that are the result of two galaxies colliding. They are 10 billion light years from Earth.



Professor Clive Tadhunter, from the University of Sheffield's Department of Physics and Astronomy, said: "Quasars are one of the most extreme phenomena in the Universe, and what we see is likely to represent the future of our own Milky Way galaxy when it collides with the Andromeda galaxy in about five billion years. It's exciting to observe these events and finally understand why they occur – but thankfully Earth won't be anywhere near one of these apocalyptic episodes for quite some time."

Quasars are important to astrophysicists because, due to their brightness, they stand out at large distances and therefore act as beacons to the earliest epochs in the history of the Universe.

https://www.sciencedaily.com/releases/2023/04/230425205342.htm

SPORTS SCIENCE - How to be heat-safe when playing sports

In hot, humid conditions, many athletes are at risk of overheating. There is nothing new in this but, with our planet becoming generally warmer, it is becoming of greater concern – and it is not just global warming. More and more sports fields are now artificial turf and the problem is this: artificial turf absorbs more of the Sun's heat than natural grass and re-radiates it back at ground level. This means that although the general air temperature might be 28° C, the temperature of the artificial turf might be 55° C.

When things heat up, the body's first line of defence is to sweat. This moisture carries away heat as it evaporates off the skin. If you can't sweat away the heat — say, because



it's too hot or humid outside — then your blood starts to heat up. Your body's temperature will also rise. Your pulse can race as your heart works overtime, trying to pump blood through your body. This is known as "exertional heat illness". When someone gets sick from doing intense activity in warmer-than-usual or high temperatures the symptoms vary from muscle cramps and excessive sweating to heat exhaustion. That last condition can involve dizziness, nausea, confusion and passing out. Heat stroke is the most severe type of heat illness. This can happen when the body's core temperature exceeds 40°C, at which point someone can pass out and have seizures — it may even be fatal.

Preventing exertional heat illness starts with hydration. Water is key to controlling body temperature. It helps you sweat. If you're dehydrated, your body will hold onto the water it has rather than sweating it away. And that makes it harder to cool off and easier to get heat illness. Water is the best thing to drink. But when your body sweats, you also lose salt. Salt helps the body stay hydrated. It also keeps minerals in your body balanced so that muscles and nerves can work properly. Electrolyte sports drinks can help replace that key nutrient.

Athletes can also be protected when it's hot by easing them into games and practices. It takes at least three days in a row of hot or warmer-than-usual temperatures for the body to start adapting. Those adaptations include a lower heart rate while exercising, a lower core-body temperature and an increased sweat rate. The body also ups its blood plasma volume when it's hot — by about 15 percent. Plasma makes up the largest portion of whole blood. Because of the increase in plasma volume, the cardiovascular system can work more efficiently.

https://www.snexplores.org/article/how-to-be-heat-safe-when-playing-sports

SPORTS SCIENCE - With a little help from Physics, you really can "Bend it like Beckham!"

When David Beckham curled a free kick into the goal against Greece to take England to the finals of the 2002 World Cup, he was exploiting a bizarre physical effect known in physics as the **MAGNUS EFFECT**.

A ball that is kicked head-on travels with the air flowing past it symmetrically in all directions. Friction with the surface of the ball causes the airflow to initially follow the contour of the ball before forming a turbulent wake that trails behind. The interactions of this wake with the surrounding air are extremely complex but they form a significant part of the overall aerodynamic drag on the ball. However, this interaction changes when the ball is initially kicked <u>off-centre</u>, sending it spinning on its own axis as it travels.





The air flowing past the side of the ball rotating towards the direction of travel has a higher relative speed than the air over the opposite side. This deflects the ball's wake sideways, in the direction of the spin, which creates a reaction force in the opposite direction. This means that a ball kicked at the right of its centre will spin anti-clockwise and be deflected to the left. This deflection is called the Magnus effect, after the 19th-Century German physicist Heinrich Gustav Magnus. Although the spin of the ball slows down as it travels due to friction with the air, this is much less significant than the aerodynamic drag that causes the ball to

this is much less significant than the aerodynamic drag that causes the ball to lose forward speed. So the Magnus effect stays fairly constant even as the ball slows down. This causes the curvature to increase noticeably towards the end of the ball's trajectory and the

effect is even more pronounced with very light balls. Table tennis provides the most extreme demonstrations of this with very dramatic deflections achieved by experienced players.

https://www.sciencefocus.com/science/the-magnus-effect/

PALAEONTOLOGY - Couple unearths one of world's greatest fossil finds in mid-Wales

There is good evidence in ancient rocks that life began around 3.8 billion years ago in the form of simple, singlecelled organisms akin to the bacteria we see today. Although these organisms went on to live clumped together in colonies, known as microbial mats, nothing much happened until about 540 million years ago, at the beginning of what geologists call the Cambrian period. This has become known as the **Cambrian Explosion**.

The event was characterised by the appearance of many of the major phyla (between 20 and 35) that make up modern animal life. Many other phyla also evolved during this time, the great majority of which became extinct during the following 50 to 100 million years. Now a remarkable geological fossil location in the UK has revealed a fascinating insight into the past.

Dr Joseph Botting and Dr Lucy Muir investigated a 10-metre-wide quarry in a sheep field near to their home in Llandrindod, central Wales. The rocks there appeared to be teeming with tiny fossils. Now researchers believe the site could help plug gaps in scientific understanding of how evolution proceeded after the Cambrian explosion – the period when the ancestors of most modern animals are believed to have evolved. It could even prove to be as important as the Burgess Shale in Canada that preserves one of the world's first complex marine ecosystems.



The Welsh site, known as Castle Bank, dates from the Middle Ordovician period, about 460m-70m years ago. It represents a community of diverse and mostly diminutive (1mm to 5mm in body length) marine organisms that existed at a time when ocean covered what is now mid-Wales. Many of the 170-odd fossils discovered so far have preserved soft tissues such as digestive systems, eyes, optic nerves and brains, and include worms, starfish, sponges, crustaceans and extinct arthropods.

The site is important because it gives us a new window into how life was evolving at the time. The Cambrian explosion was a period when many new and complex life forms arose. But by 400m years ago, almost all of these creatures had disappeared, eventually replaced by the ancestors of many modern animals. The Castle Bank fossils could help to bridge that gap, providing an insight into how life was evolving at a time when there was virtually no life on land, but animals and algae were thriving in the seas.

Couple unearths one of world's greatest fossil finds in mid-Wales (msn.com)

ARCHAEOLOGY - An ancient woman's DNA recovered from a 20,000-year-old pendant

Artefacts made of stone, bones or teeth provide important insights into the subsistence strategies of early humans, their behaviour and culture. However, until now it has been difficult to attribute these artefacts to specific individuals, since burials and grave goods were very rare in the Palaeolithic. In order to directly link cultural objects to specific individuals and thus gain deeper insights into Palaeolithic societies, an international, interdisciplinary research team, led by the Max Planck Institute for Evolutionary Anthropology in Leipzig, has developed a novel, non-destructive method for DNA isolation from bones and teeth.

Archaeologists excavating the famous Denisova Cave in Russia. In 2019, unaware of the new method being developed in Leipzig, they cleanly excavated and set aside an Upper Palaeolithic pendant made from the tooth of a Wapiti deer. From this, the geneticists in Leipzig isolated not only the DNA from the animal itself, but also large quantities of ancient human DNA. "The amount of human DNA we recovered from the pendant was extraordinary," says Elena Essel, an archaeologist from the University of Leiden, "almost as if we had sampled a human tooth." The findings are published in the journal Nature.



Based on the analysis of mitochondrial DNA, the small part

of the genome that is exclusively inherited from the mother to their children, the researchers concluded that most of the DNA likely originated from a single human individual. Using the wapiti and human mitochondrial genomes they were able to estimate the age of the pendant at 19,000 to 25,000 years. In addition to mitochondrial DNA, the researchers also recovered a substantial fraction of the nuclear genome of its human owner. Based on the number of X chromosomes they determined that the pendant was made, used or worn by a woman. They also found that this woman was genetically closely related to contemporaneous ancient individuals from further east in Siberia, the so called "Ancient North Eurasians" for whom skeletal remains have previously been analysed.

The scientists now hope to apply their method to many other objects made from bone and teeth in the Stone Age to learn more about the genetic ancestry and sex of the individuals who made, used, or wore them.

THE CHEMISTRY OF ART – Why some Renaissance artists egged their paintings

Art historians often wish that Renaissance painters could shell out secrets of the craft. Now, scientists may have cracked one using chemistry and physics. Around the turn of the 15th century in Italy, oil-based paints replaced egg-based tempera paints as the dominant medium. During this transition, artists including Leonardo da Vinci and Sandro Botticelli (his *Lamentation Over The Dead Christ* is depicted on the right) also experimented with paints made from oil <u>and</u> egg. But it has been unclear how adding egg to oil paints may have affected the artwork.



"Usually, when we think about art, not everybody thinks about the science which is behind it," says chemical engineer Ophélie Ranquet of the Karlsruhe Institute of Technology in Germany. In the lab, Ranquet and colleagues whipped up two oil-egg recipes to compare with plain oil paint. One mixture contained fresh egg yolk mixed into oil paint, and had a similar consistency to mayonnaise. For the other blend, the scientists ground pigment into the yolk, dried it and mixed it with oil — a process the old masters might have used, according to the scant historical records that exist today. Each medium was subjected to a battery of tests that analysed its mass, moisture, oxidation, heat capacity, drying time and more.

In both concoctions, the yolk's proteins, phospholipids and antioxidants helped slow paint oxidation, which can cause paint to turn yellow over time. In the mayo-like blend, the yolk created sturdy links between pigment particles, resulting in stiffer paint. Such consistency would have been ideal for techniques like impasto, a raised, thick style that adds texture to art. Egg additions also could have reduced wrinkling by creating a firmer paint consistency. Wrinkling sometimes happens with oil paints when the top layer dries faster than the paint underneath, and the dried film buckles over looser, still-wet paint.

"The more we understand how artists select and manipulate their materials, the more we can appreciate what they're doing, the creative process and the final product," says Ken Sutherland, director of scientific research at the Art Institute of Chicago, who was not involved with the work. Research on historical art mediums can not only aid art preservation efforts, Sutherland says, but also help people gain a deeper understanding of the artworks themselves.

https://www.sciencenews.org/article/renaissance-artists-egg-oil-paintings

ASTRONOMY – The coldest place in the Universe: the Boomerang Nebula

When it comes to our everyday temperatures, there are two scales – Celsius (formerly "centigrade") and Fahrenheit. However, in science there is a third **thermodynamic temperature scale**, also known as the **Kelvin scale** after the Glasgow-based engineer and physicist William Thomson, 1st Baron Kelvin (1824–1907), better known as **Lord Kelvin**.

The Kelvin thermodynamic temperature scale is defined through the laws of thermodynamics so as to be absolute or universal and not reliant on the properties of matter – for example, the property of water becoming a solid (freezing) defines zero on the Celsius scale, while water becoming a gas (boiling) define 100. The thermodynamic scale of temperature has its origin or zero point at **absolute zero** $(0^{\circ}K)$. This is the temperature at which, in theory, the fundamental particles of matter have minimum vibrational motion, retaining only quantum mechanical-induced particle mot ion. On the Celsius scale, absolute zero is **minus 273.15°**. It is still argued whether or not it is possible to achieve absolute zero – although we have got very close, we haven't got there yet.

However, where is the coldest place in the Universe – and is it 0°K? Well the answer lies in a nebula 5000 light years from Earth, the **Boomerang Nebula**. This is a reflecting cloud of dust and ionized gases — a young planetary nebula with a dying red giant star at its centre. Once a star much like our sun, it has been shedding its outer layers as expected during the last stages of its life. But it has been found to be losing its mass about 100 times faster than other similar dying stars and this means that it is also blasting away most of its heat energy.

The upshot of this is a very cold region of space. The Boomerang Nebula's deep interior temperature is a teeth-chattering -458 degrees Fahrenheit or -272 degrees Celsius, meaning that the Boomerang Nebula is just a degree Celsius above absolute zero.

https://www.space.com/coldest-place-in-the-universe

ARCHAEOLOGY - Archaeologists map important archaeological landscape where first Australians lived more than 60,000 years ago

The ancestors of Aboriginal Australians began arriving from south-east Asia approximately 65,000 years ago, during the last ice age. Arriving by sea, they settled the continent and had formed approximately 250 distinct language groups by the time of European settlement in the 18th century, maintaining some of the longest known continuing artistic and religious traditions in the world. Much is still unknown about the earliest years of settlement, but the results of recent archaeological investigations are beginning to shed some light.

Scientists at Flinders University (Australia) have used subsurface imaging and aerial surveys to see through floodplains in the Red Lily Lagoon area of West Arnhem Land in Northern Australia. Red Lily Lagoon has exceptional archaeological significance in Arnhem Land as it is situated at one of the easternmost points of the East Alligator River floodplain, where the modern river, the Arnhem Plateau, creates a significant boundary between the low-lying floodplains and the sandstone highlands, which have been occupied by humans for over 60,000 years and are the location of countless significant sites, including some of the most iconic rock art panels in Australia.



By examining how sediments now buried beneath the flood plains changed as sea levels rose, the researchers can see how the transformation of Red Lily Lagoon had resulted in the growth of mangroves that have supported animal and marine life in a region where ancient Indigenous rock art is located. This transformation has, in turn, fostered an environment that has inspired the subjects and animals in the ancient rock art. In their findings published in in the scientific journal *PLOS ONE*, the researchers say environmental changes at the lagoon are reflected in the rock art because fish, crocodiles and birds were featured in the art when the floodplain transformed to support freshwater habitats for new species.



The main tool the researchers used was Electric Resistivity Tomography (ERT), a rapid, low-cost, non-invasive method that can map large areas of the Australian landscape to better understand their ancient history. This has important implications for locating new sites but also for developing a more nuanced understanding of the regional geography, and its impact on past human behaviour.

Traditional owner and co-author Alfred Nayinggull described the importance of this research as "We want people to see and want people to know what's been happening many thousand years ago in the past."

https://phys.org/news/2023-05-archaeologists-important-archaeological-landscape-australians.html

QUANTUM PHYSICS – It's that cat again!

There are probably two favourite, imaginary felines – one, The Cheshire Cat popularised by Lewis Carroll in *Alice's Adventures in Wonderland* and known for its distinctive mischievous grin; the other, Schrödinger's Cat that can be both alive <u>and</u> dead at the same time. Using a tiny crystal of sapphire, physicists claim to have demonstrated a state where quantum mechanics works on a large scale.

Scientists put a jiggling piece of sapphire crystal in what's known as a "cat state," in which an object exists in two different states simultaneously. The



new sapphire cat has a mass of only 16 micrograms, but this is huge on the quantum scale. While quantum particles (atoms and their components) are capable of existing in two distinct states simultaneously — what's called a superposition — those effects wash out for cat-sized stuff. But the new research appears to challenge that assumption.

In the new experiment, the researchers jiggled a portion of a sapphire crystal in such a way that its atoms moved in two directions at once. That's a distinction that "captures the spirit" of Schrödinger's Cat. The jiggling was confined within a sliver of the crystal consisting of 100 million billion atoms. That's large enough that, if extracted from the rest of the crystal, it would be visible to the naked eye.



Still, the oscillations of the atoms were tiny, about a millionth of a billionth of a millimetre — not exactly the scale of everyday objects. In future work, physicists hope to scale up not only the mass, but also the size of the oscillations. Then it may get really interesting – enough to make a Cheshire Cat smile!

ECOLOGY - World's 'oldest' tree able to reveal planet's secrets

In a forest in southern Chile, a giant tree has survived for thousands of years and is in the process of being recognized as the oldest in the world. This is about more than just a competition to enter the record books though, as the tree in question is a font of valuable information. Known as the "Great Grandfather," the trunk of this tree measuring four metres (13 feet) in diameter and 28 meters tall is also believed to contain scientific information that could shed light on how the planet has adapted to climatic changes.

Believed to be more than 5,000 years old, it is on the brink of replacing Methuselah, a 4,850-year-old Great Basin bristlecone pine found in California in the United



States, as the oldest tree on the planet. "It's a survivor, there are no others that have had the opportunity to live so long," said Antonio Lara, a researcher at Austral University and Chile's centre for climate science and resilience, who is part of the team measuring the tree's age.

The Great Grandfather lies on the edge of a ravine in a forest in the southern Los Rios region, 800 kilometres (500 miles) to the south of the capital Santiago. It is a *Fitzroya cupressoides*, a type of cypress tree that is endemic to the south of the continent. Also known as the Patagonian cypress, it is the largest tree species in South America. It lives alongside other tree species, such as coigue, plum pine and tepa, Darwin's frogs, lizards, and birds such as the chucao tapaculo and Chilean hawk. For centuries its thick trunk has been chopped down to build houses and ships, and it was heavily logged during the 19th and 20th centuries.



Scientists build tree-ring chronologies by starting with living trees and then finding progressively older specimens—including archaeological wood—whose outer rings overlap with the inner rings of more-recent specimens The tree was discovered in 1972 and, in 2020, researchers attempted to date it using dendrochronology - a technique that exploits the annual growth increments of trees to provide a precise estimate of the age (or period since formation) of a wood sample. They extracted a sample from the Great Grandfather using the longest manual drill that then existed, but even then they did not reach the centre. They estimated that their sample was 2,400 years old and used a predictive model to calculate the full age of the tree - 5000 years.

There are very few thousand-years-old trees on the planet. These ancient trees have genes and a very special history because they are symbols of resistance and adaptation. They are nature's best athletes. They are like an open book and we are like the readers who read every one of their rings. Those pages show dry and rainy years, depending on the width of the rings. Fires and earthquakes are also recorded in those rings, such as the most powerful tremor in history that hit this area in 1960.

The Great Grandfather is also considered a time capsule that can offer a window into the past.

https://phys.org/news/2023-04-world-oldest-tree-reveal-planet.html

<u>WORD(S) OF THE MONTH:</u> ALTITUDE (*noun, "AL-tih-tewd"*)

The word "altitude" has a few different meanings. First, it can refer to how high something is above sea level on Earth. Planes, for instance, fly at an altitude of several kilometres/miles. And if you're at the top of a mountain, you will be at a higher altitude than when you're next to the ocean. Altitude can also be used to describe heights on other planets.

Another use of "altitude" appears in geometry. Here, the word refers to the height of a triangle. That height is found by drawing a line from one point on the triangle to the opposite side, such that the line meets that side at a right angle.

Altitude has a third definition in astronomy. In this case, the word describes the angle between the horizon and some object in the sky. For instance, if a star is right on the horizon, its altitude is 0 degrees. If the star is exactly overhead, its altitude is 90 degrees.