

Welcome to the December 2022 issue

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

ANIMALS - Living mystery: This critter has 38x more DNA than you do!

Salamanders, like their close amphibian cousins frogs and toads, should go through a typical lifecycle – egg-to-tadpole-to adult...but they don't. They never grow up, quite literally, because they stay as "tadpoles".

A recent study, published in the journal *Proceedings of the National Academy of Sciences* (US), looked at a salamander known as the Neuse River waterdog (*Necturus lewisi*) that is found living in rivers and streams of North Carolina, USA. It moves slowly — as if its fat little body is stuffed full of lead. In fact, it really is stuffed. Each cell in its body is crammed full of DNA — 38 times as much DNA as a human cell contains.

It begins life as a tadpole, before growing legs. But unlike its hopping relatives, the waterdog never



outgrows its larval body. Its tail always remains finned, like a tadpole's. Its clumsy little legs never grow large enough for its body. Its rear feet never finish sprouting their toes. And it spends its whole life breathing through larval gills. They jut out from its neck like puffy peacock feathers. Because the waterdog never grows up, it must spend its entire life in water. But why?

It's all to do with the huge amount of DNA that is crammed into every cell of this animal's body. An animal's genome is the complete set of DNA in each of its cells. Each molecule of DNA is shaped like a very long ladder. And each rung on the ladder is known as a "base pair." The Neuse (Noose) River waterdog has the largest genome of any four-legged beast on Earth. The genomes of most mammals, birds, reptiles and fish fall within a narrow size range — roughly one billion to four billion base pairs. But salamander genomes range more wildly — from 10 billion up to 120 billion base pairs. This huge load of DNA has utterly warped salamanders' bodies. It keeps many species from ever reaching adulthood. It leaves others with simplified brains, poor eyesight and bendy bones that never harden.

DNA is often called the blueprint of life. Genes in our DNA determine whether we have feathers, scales or hair. They guide how our blood vessels branch and our nerve cells connect. But salamanders are revealing that DNA also shapes us in ways that have nothing to do with genes or the data they hold. Like the creamy filling in a Twinkie, DNA expands to fill as much space as it can. Every species struggles to keep its DNA from growing too much. This struggle has shaped every animal — from aardvarks to zebrafish — and us.

In the 1950's, when the mystery of the DNA molecules was being finally solved, it was supposed that the more advanced the animal, the more DNA it must have. But studies on a variety of species showed that this was not so and that some, salamanders in particular, had more DNA than any other species, including humans. However, it turned that these species, such as salamanders, do not actually have more genes. Much of the DNA molecule does not appear to do anything and is often described as "junk DNA". Among this non-gene DNA are things known as transposons. Salamanders and lungfish have way more "junk DNA" than other animals — and especially more of those transposons. So what is going on?

Think of transposons as DNA parasites. Parasites often harm their hosts, making them less healthy. Transposons operate like parasites of the genome. These snippets of DNA constantly make new copies of themselves, which they then insert into a host's genome. And that can sometimes harm the host. To try and avoid this problem, all animals have special proteins that work like an immune system for the genome. These proteins make it harder for transposons to copy themselves. But it is now thought that something has gone horribly awry in salamanders and their transposons had multiplied out of control. The result being that are destined for a life of eternal childhood.

https://www.snexplores.org/article/salamander-genome-size-aging-dna-transposons

The following item was spotted by Dr R Davies

ANIMAL BEHAVIOUR - Ancient eel migration mystery unravelled

Every year, eels leave European rivers to travel in an epic migration to the Sargasso Sea in the North Atlantic to breed for a single time, then die. Although this final destination has long been suspected and is generally considered to be fact, until now there has been no direct evidence.

By fitting eels with satellite tags, researchers have now accurately tracked the creatures on the final leg of their route and, sure enough, they do end in the Sargasso Sea. At last, the mystery surrounding one of nature's epic migrations has been solved. And they say the information will help in the conservation of the critically endangered species.





"This is the first time we've been able to track eels to the Sargasso Sea and we are delighted we have the first direct evidence of adult European eels reaching their spawning area," said Ros Wright of the Environment Agency, who led the research. "Their journey will reveal information about eel migration that has never been known before."

The life cycle of the eel has long puzzled scientists. Even the Greek philosopher Aristotle pondered the question of where eels came from, deciding that they sprang up spontaneously from the mud. Almost 100 years ago, it was assumed that their destination was the Sargasso

Sea, in the western Atlantic near the Bahamas, but until now final proof had been lacking.

Eel specialist at the Environment Agency, Dan Hayter, has been monitoring eels in the River Blackwater in Essex for 20 years and has seen a drastic decline over that time. "We do catch eels here every single year," he explained. "Compared with the historic numbers, they're very low now, and there's been a 95% decline since the 1980s." Unravelling the routes taken and locating where eels spawn is critical for understanding the reasons behind their decline and to inform conservation measures.

https://www.bbc.co.uk/news/science-environment-63259738

The following item was spotted by Mrs H Dunn

HEALTH - Black Death 700 years ago affects your health now

The devastation of the plague pandemic left such an incredible genetic mark on humanity that it's still affecting our health nearly 700 years later. Up to half of people died when the Black Death swept through Europe in the mid-1300s. A pioneering study analysing the DNA of centuries-old skeletons found mutations that helped people survive the plague. But those same mutations are linked to auto-immune diseases afflicting people today.

Researchers suspected an event of such enormity must have shaped human evolution. They analysed DNA taken from the teeth of 206 ancient skeletons and were able to precisely date



the human remains to before, during or after the Black Death. The analysis included bones from the East Smithfield plague pits which were used for mass burials in London with more samples coming from Denmark.

The standout finding, published in the journal *Nature*, surrounded mutations in a gene called **ERAP2**. If you had the right mutations you were 40% more likely to survive the Black Death. The gene's job is to make the proteins that chop up invading microbes and show the fragments to the immune system, priming it more effectively to recognise and neutralise the foe. The gene comes in different versions - those that work well and those that do nothing - and you get a copy from each parent. So the lucky ones, who were most likely to survive, inherited a high-functioning version from mum and dad. And the survivors had children and so passed those helpful mutations on so they suddenly became much more common.

Even today those plague-resisting mutations are more common than they were before the Black Death. The problem is they have been linked to auto-immune diseases such as the inflammatory bowel disease Crohn's - what helped keep your ancestors alive 700 years ago could be damaging your health today.

https://www.bbc.co.uk/news/health-63316538

The following item was spotted by Mr D Steward

ASTRONOMY - James Webb telescope spies 'Pillars of Creation'

The images we have been receiving from the James Webb Space Telescope (JWST) since it went operational in June have been truly stunning...and they will keep on coming. Because JWST's instruments are designed to view the Universe in the long near-infrared and infrared wavelengths as well as visible wavelengths, the images show much higher and clearer resolution of distant objects.

One of the recent images shows us an astronomical feature within a nebula known as the *Eagle Nebula*. Although the nebula was discovered in 1745, it was a photo taken in 1995 by the Hubble Space Telescope that excited the world – the features have become known as the *Pillars of Creation*. Now JWST has revealed them in all their glory.

The so-called "Pillars of Creation" are cool, dense clouds of hydrogen gas and dust in the Serpens constellation, some 6,500 light-years from Earth. The pillars lie at the heart of what astronomers refer to as Messier 16 (M16), or the Eagle Nebula. This is an active star-forming region. Webb, with its infrared detectors, is able to see past much of the light-scattering effects of the pillars' dust to examine the activity of the new-born suns.

"I've been studying the Eagle Nebula since the mid-1990s, trying to see 'inside' the light-years long pillars that Hubble showed, searching for young stars inside them. I always knew that when James Webb took pictures of it, they would be stunning. And so they are," Prof Mark McCaughrean, the Senior Advisor for Science at the European Space Agency, told BBC News.

The M16's pillars are being illuminated and sculpted by the intense ultraviolet light from massive nearby stars. That radiation is also dismantling the towers. Indeed, if you could magically transport

yourself to this location today, the pillars are very probably no longer there. We only see them because we're looking at them in the past. The light that Webb detects has taken 6,500 years to reach its mirrors.

https://www.bbc.co.uk/news/science-environment-63319814

Another piece of news spotted by Mr D Steward

PALAEONTOLOGY - 500 million year-old fossils reveal answer to evolutionary riddle

An exceptionally well-preserved collection of fossils discovered in eastern Yunnan Province, China, has enabled researchers to solve a centuries-old riddle in the evolution of life on Earth, revealing what the first animals to make skeletons looked like. The results have been published in the journal *Proceedings of the Royal Society B*.

The first animals to build hard and robust skeletons appear suddenly in the fossil record in a geological blink of an eye around 550-520 million years ago during an event called the *Cambrian Explosion*. Many of these early fossils are simple hollow tubes ranging from a few millimetres to many centimetres in length. However, what sort of animals made these skeletons was almost completely unknown, because they lack preservation of the soft parts needed to identify them as belonging to major groups of animals that are still alive today.

The new collection of 514 million year old fossils includes four specimens of *Gangtoucunia aspera* with soft tissues still intact, including the gut and mouthparts. These reveal that this species had a mouth fringed with a ring of smooth, unbranched tentacles about 5 mm long. It's likely that these were used to sting and capture prey, such as small arthropods. The fossils also show that *Gangtoucunia*



had a blind-ended gut (open only at one end), partitioned into internal cavities, that filled the length of the tube. These are features found today only in modern jellyfish, anemones and their close relatives (known as *cnidarians*), organisms whose soft parts are extremely rare in the fossil record. The study shows that these simple animals were among the first to build the hard skeletons that make up much of the known fossil record.

Corresponding author Dr Luke Parry, Department of Earth Sciences, University of Oxford, said: 'This really is a one-in-million discovery. These mysterious tubes are often found in groups of hundreds of individuals, but until now they have been regarded as 'problematic' fossils, because we had no way of classifying them. Thanks to these extraordinary new specimens, a key piece of the evolutionary puzzle has been put firmly in place.'

https://www.ox.ac.uk/news/2022-11-02-500-million-year-old-fossils-reveal-answer-evolutionary-riddle



The following item was spotted by Mr M Tanguay

ANIMALS - Photos suggest rhino horns have shrunk over past century, due to hunting

By scrutinising over a century's worth of photos, University of Cambridge researchers have made the first ever measurements that show rhinoceros horns have gradually decreased in size over time. The researchers measured the horns of 80 rhinos, photographed in profile view between 1886 and 2018. The photographs, held by the Rhino Resource Centre – an online repository – included all five species of rhino: white, black, Indian, Javan and Sumatran. Horn length was found to have decreased significantly in all species over the last century.

The researchers think rhino horns have become smaller over time due to intensive hunting. Rhino horns command a high price and are in demand both as a financial investment, and for their use in traditional medicines in China and Vietnam.



Hunting has not only caused severe declines in rhino populations; the researchers suggest that shooting rhinos with the longest horns has increasingly left smaller-horned survivors – which have reproduced more and passed on their smaller traits to future generations. This has been shown for other animals before, but never rhinos.

"We were really excited that we could find evidence from photographs that rhino horns have become shorter over time. They're probably one of the hardest things to work on in natural history because of the security concerns," said Oscar Wilson, formerly a researcher in the University of Cambridge's Department of Zoology, first author of the report. He added: "Rhinos evolved their horns for a reason – different species use them in different ways such as helping to grasp food or to defend against predators – so we think that having smaller horns will be detrimental to their survival."

The images suggest that there was very little effort to promote rhino conservation to the public before the 1950s. But after this the focus suddenly changed from hunting the animals to trying to keep them alive. The researchers say this shift coincides with the collapse of European empires, when African countries became independent and European hunters no longer had easy access to Africa for hunting.

https://www.sciencedaily.com/releases/2022/11/221101100731.htm

MATERIALS SCIENCE - These fabrics change colour as they stretch

What if your clothing shifted shades from red to green to blue as you moved and stretched?

The colours of crayons, paints and clothing usually come from chemicals in dyes and pigments. Those substances reflect one colour and absorb others. For instance, the pigments in a red crayon reflect the red light that people's eyes detect. A new material instead changes shades due to something known as **structural colour**. It's caused by an arrangement of surfaces inside a material that reflect only certain hues. For example, a blue butterfly has microscopic layers of scales in its wings. These are arranged so that they reflect back only blue light. All other colours pass through the scales. The



angle at which a viewer looks at the wing — or at any structurally coloured surface — can alter how much light they see reflected back. This often causes the colours to shimmer or shine.

Many researchers have found ways to make structurally coloured materials. But this is the first creation of large, detailed, stretchy images using low-cost, widely available equipment. *"I want to have a leotard that changes colour as I'm running around,"* explains graduate student Ben Miller. Miller studies mechanical engineering at the Massachusetts Institute of Technology in Cambridge (US). He teamed up with mechanical engineer Mathias Kolle and undergraduate student Helen Liu to create the new fabric. They didn't even have to invent anything completely new. They used a technique from more than 100 years ago. *"Ben was the smartest person in the world to see this,"* Kolle says. The group published its discovery in the journal *Nature Materials*.

Miller didn't think up the stretchy material all at once. His first spark of inspiration hit in art class. His professor brought in examples of holographic art. To Miller, the holograms' tiny structures looked awfully similar to examples of structural colour found in nature. Miller stuck structurally coloured film onto a stretchy material. As it stretches, the dense areas within the film get closer together. That changes the colour of light they reflect. An area that starts out red will now appear green and then blue.

https://www.snexplores.org/article/innovation-2022-color-change-stretch-fabric-technology

Here's another item was spotted by Dr R Davies

HEALTH - FDA Approves First Drug That Can Delay Onset of Type 1 Diabetes

Type 1 diabetes (diabetes mellitus) is a disease that occurs when the immune system attacks and destroys the cells in the pancreas that make insulin. Insulin is essential for regulating the level of glucose in the blood. People with a type 1 diabetes diagnosis have increased blood glucose that requires insulin shots (or wearing an insulin pump) to survive and must check their blood glucose levels regularly throughout the day. Although it can appear at any age, type 1 diabetes is usually diagnosed in children and young adults. Untreated or poorly controlled, type 1 diabetics can develop serious, eventually life-threatening, symptoms.

Now there is a new treatment that could help many at-risk patients by delaying the onset of later stages of type 1. It is a drug called **Tzield (teplizumab-mzwv)** and has recently been approved by the U.S. Food and Drug Administration (FDA). Tzield binds to certain immune system cells and delays progression to stage 3 type 1 diabetes. Tzield may deactivate the immune cells that attack insulin-producing cells, while increasing the proportion of cells that help moderate the immune response. Tzield is administered by intravenous infusion once daily for 14 consecutive days.



In final clinical trials there was a statistically significant delay in the development of stage 3 type 1 diabetes – for up to 50 months. "The approval of a first-in-class therapy adds an important new treatment option for certain at-risk patients," said John Sharretts, M.D., director of the Division of Diabetes, Lipid Disorders, and Obesity in the FDA's Center for Drug Evaluation and Research. "The drug's potential to delay clinical diagnosis of type 1 diabetes may provide patients with months to years without the burdens of disease."

https://www.fda.gov/news-events/press-announcements/fda-approves-first-drug-can-delay-onset-type-1-diabetes

And another item spotted by Dr R Davies

GEOLOGY - Mauna Loa: World's largest active volcano erupts in Hawaii

Mauna Loa is the world's largest active volcano, located inside Hawaii Volcanoes National Park, and covers half of the US state's Big Island. The volcano rises 13,679ft (4,169m) above sea level and spans an area of more than 2,000 sq miles (5,179 sq km). There are other larger volcanoes but these are classified as dormant, meaning they have not erupted for a long time, or extinct, meaning they are almost certain not to erupt in future.

Mauna Loa erupted at 23:30 local time on Sunday 27th November (09:30 GMT Monday) at Moku'āweoweo, the volcano's summit caldera. Calderas are hollows that form beneath the summit at the end of an eruption.



It followed a series of warnings that an eruption was possible after a spate of recent earthquakes in the region, including more than a dozen reported tremors on Sunday. The lava flow is mostly contained within the summit, but residents have been placed on alert and were earlier warned about the risk of falling ash. The US Geological Service (USGS) has said the situation could change rapidly. The volcano's alert level has also been upgraded from an "advisory" to a "warning" - the highest classification. No evacuation orders have been issued and populated areas are unlikely to be impacted at this stage, emergency officials say.

Mauna Loa has erupted 33 times since 1843. The previous eruption in 1984 sent lava flows within 5 miles of Hilo, the island's most populous town. But the Big Island's population has more than doubled since 1980 to around 200,000 residents and Hawaii's civil defence agency has warned residents could face a "lava disaster".



"These lava flows rarely present a risk to life, but they can be extremely destructive to infrastructure," said Dr Jessica Johnson, a British volcano geophysicist with the University of East Anglia who has worked at the Hawaiian Volcano Observatory.

Mauna Loa is a classic example of a **shield volcano** with a low, flat profile, unlike a stratovolvano that is tall and has steep, sloping sides. It is all to do with the silica content of the lava – Mauna Loa's lava is low in silica (it is a type of basalt) which makes the lava very runny, unlike other volcanoes whose

silica-rich lavas are thick, viscous and slow moving. Mauna Loa's lava flows run like fast-flowing rivers! https://www.bbc.co.uk/news/world-us-canada-63783633 https://www.bbc.co.uk/news/world-us-canada-63783633

Another item spotted by Mr D Steward

COVID NEWS - 'Programmable molecular scissors' could help fight COVID-19 infection

Cambridge scientists have used synthetic biology to create artificial enzymes programmed to target the genetic code of SARS-CoV-2 and destroy the virus, an approach that could be used to develop a new generation of antiviral drugs.

Enzymes are naturally occurring biological catalysts, which enable the chemical transformations required for our bodies to function – from translating the genetic code into proteins, right through to digesting food. Although most enzymes are proteins, some of these crucial reactions are catalysed by RNA, a chemical cousin of DNA, which can fold into enzymes known as ribozymes. Some classes of ribozyme are able to target specific sequences in other RNA molecules and cut them precisely. In 2014, Dr Alex Taylor and colleagues at the Cambridge Institute of Therapeutic Immunology & Infectious Disease (CITIID), University of Cambridge, discovered that artificial genetic material known as XNA – in other words, synthetic chemical alternatives to RNA and DNA not found in nature –



could be used to create the world's first fully-artificial enzymes, which Taylor named XNAzymes.

At the beginning, XNAzymes were inefficient, requiring unrealistic laboratory conditions to function. Earlier this year, however, his lab reported a new generation of XNAzymes, engineered to be much more stable and efficient under conditions inside cells. These artificial enzymes can cut long, complex RNA molecules and are so precise that if the target sequence differs by just a single nucleotide (the basic structural unit of RNA), they will recognise not to cut it. This means they can be programmed to attack mutated RNAs involved in cancer or other diseases, leaving normal RNA molecules well alone.

SARS-CoV-2 has the ability to evolve and change its genetic code, leading to new variants against which vaccines are less effective. To get around this problem, Taylor not only targeted regions of the viral RNA that mutate less frequently, but he also designed three of the XNAzymes to self-assemble into a 'nanostructure' that cuts different parts of the virus genome.

XNAzymes could potentially be administered as drugs to protect people exposed to COVID-19, to prevent the virus taking hold, or to treat patients with infection, helping rid the body of the virus. This sort of approach might be particularly important for patients who, because of a weakened immune system, struggle to clear the virus on their own.

<u>https://www.cam.ac.uk/research/news/synthetic-biology-meets-medicine-programmable-molecular-scissors-could-help-fight-covid-19-infection?utm_campaign=research&utm_source=linkedin&utm_medium=social</u>

Another item spotted by Mr D Steward

SPACE SCIENCE - ESA mulls Solaris plan to beam solar energy from space

The idea of collecting solar energy in space and "beaming" it down to Earth has been a long-held dream of science fiction, dating back to the 1930s. Since the advances in space exploration during the 1960s and later, the technology involved meant that the notion remained in the realm of fiction. However, it is now being looked upon as feasible and a special programme, **Solaris**, has been designed to look into the possibility.

A key focus of the Solaris programme is to establish whether it is possible to transfer the solar energy collected in space to electricity grids on Earth. This can't of course be done with an extremely long cable, so it has to be sent wirelessly, using microwave beams. The Solaris team has already shown that it is possible in principle to transmit electricity wirelessly safely and efficiently. Engineers sent 2 KW of power collected from solar cells wirelessly to collectors more than 30 metres away at a demonstration at the aerospace firm, Airbus in Munich in September. It will be a big step up to send gigawatts of power over thousands of miles, but according to Jean Dominique Coste, who is a senior manager for Airbus's blue sky division, it could be achieved in a series of small steps. "Our team of scientists have found no technical show-stoppers to prevent us from having space-based solar power," he said.

Separately from the ESA proposal, in the UK, a company, Space Solar, has been formed. It aims to demonstrate beaming power from space within six years, and doing so commercially within nine years.

 Sunlight
Solar panels in orbit abur of abur on energy
Solar panels in orbit abur of abur on energy
Bergy is bearned to Earth as microwaves

The satellite carrying the solar panels would need to be huge – the solar array would be about 1km square! <u>https://www.bbc.co.uk/news/science-environment-62982113</u>

HUMANS - Eight billion people now live on Earth — a new record

Eight billion. That's the number of people thought to be sharing our Earth right now. The global population likely hit this landmark on November 15. It's based on a report called World Population Prospects 2022. The United Nations issued it in July.

"The milestone brings important responsibilities," said Maria-Francesca Spatolisano of the United Nations. She was speaking at a news conference on July 11. "It also highlights the many challenges linked to population growth," she said. Those include meeting people's social and economic needs. Other issues relate to how people use Earth's resources and alter the environment.

Population growth isn't the same the world over, though The U.N. analysis looked at trends in different places. High-income countries will grow due to more people moving there, the report



predicts. In lower-income countries, populations will rise because there are more births than deaths. And in 61 countries, populations are expected to drop by 1 percent or more between now and 2050.



The global population is expected to peak in the 2080s — at about 10.4 billion. It will then level off until the end of the century. In some scenarios the global population will actually fall towards the end of the century. Teams at the United Nations calculated many projections, some of which are shown in gray. The red line is the median (middle value). The various estimates use different values for factors such as rates of births and deaths around the world. Estimates always have some uncertainty -they're no guarantee of what will happen. After all, many things affect birth and death rates and the movement of people from place to place. That leads to a wide range of possible outcomes.

https://www.snexplores.org/article/eight-billion-people-now-live-on-earth-new-record

WORD OF THE MONTH:

FLUORESCENCE

Fluorescence is the process where a material absorbs light at a high energy, short wavelength and then reemits light at a lower energy, usually visible, wavelength. Because reemission occurs so quickly (within about 10^{-8} seconds), the fluorescence ceases as soon as the original exciting source is removed, unlike phosphorescence, which persists as an afterglow.

A fluorescent lightbulb is coated on the inside with a powder and contains a gas; electricity causes the gas to emit ultraviolet radiation, which then stimulates the tube coating to emit light. The pixels of a television or computer screen fluoresce when electrons from an electron gun strike them. Fluorescence is often used to analyze molecules, and the addition of



a fluorescing agent with emissions in the blue region of the spectrum to detergents causes fabrics to appear whiter in sunlight.

X-ray fluorescence (XRF) is used for elemental analysis and chemical analysis, particularly in the investigation of metals, glass, ceramics and building materials, and for research in geochemistry, forensic science, archaeology and art objects. The material is bombarded by short wavelength X rays or gamma rays that causes the atoms in the material to become excited a immediately reemit longer wavelength X rays.

Fluorescence is one of the few methods that allow one to observe interactions between very low concentrations of biological molecules in real time. Fluorescence can measure parameters such as the diffusion of a protein, its movement through a cell or other medium, and its association with other biological molecules. Fluorescence methods are very versatile and can be applied to simple molecules in water to complex species in living cells.

This is "old news" but it makes fascinating reading – thanks to Mr M Tanguay again ANCIENT PHYSICS – Did Vikings navigate using a special, transparent crystal?

Iceland Spar, also known as Clear Calcite or Optical Calcite, is a variety of Calcite that was originally found in Iceland, Calcite being a mineral version of calcium carbonate. This mineral is double refractive, meaning objects appearing through it will look as though they're in two places at once. This Calcite variety is usually completely transparent and has endless amounts of rainbow inclusions within. Iceland Spar was first reported in 1837 by J.D. Dana, but its history dates far before then. Could the Vikings have used it to navigate their long sea voyages?

Vikings is the modern name given to seafaring people originally from Scandinavia (present-day Denmark, Norway and Sweden), who from the late 8th to the late 11th centuries raided, pirated, traded and settled throughout parts of Europe. They also voyaged as far as the Mediterranean, North Africa, Volga Bulgaria, the Middle East, and North America. - but how did they find



their way? Early navigation was certainly by using the stars at night and the Sun during the day, but what if it was cloudy? It is known that the ancient Chinese developed a rudimentary compass using "lodestone", which is actually a naturally magnetic iron mineral, magnetite. Although there is some suggestion that the Vikings used this type of compass, there is little evidence. For the Vikings, one daytime answer might have involved using a transparent block of the mineral, Iceland Spar.



In some Icelandic sagas-embellished stories of Viking life-sailors relied on so-called sunstones to locate the sun's position and steer their ships on cloudy days. The stone would have worked by detecting a property of sunlight called polarization. Polarization is when lightwhich normally radiates randomly from its sourceencounters something, such as a shiny surface or fog or clouds, that causes the rays to assume a particular orientation. Due to this property, as sunlight moves through the atmosphere, the resulting polarization gives away the direction of the original source of the light even on a completely cloudy day. If you know where the Sun is in the sky, you can work out what direction you have come from and where you are going. Detecting light's polarization is a natural ability of some animals, such as bees.

In 1969, a Danish archaeologist suggested real-life Vikings might have used sunstones to detect polarized light, using the stones to supplement sundials, stars, and other navigational aids. In 2010 Guy Ropars, a physicist at the University of Rennes in France, conducted an experiment with a potential Viking sunstone: a piece of Icelandic spar that had recently been found aboard the

Alderney, a British ship that sank in 1592. In the laboratory, Ropars and his team struck the piece of Icelandic spar with a beam of partly polarized laser light and measured how the crystal separates polarized from unpolarized light. By rotating the crystal, the team found that there's only one point on the stone where those two beams were equally strong—an angle that depends on the beam's original location. That would enable a navigator to test a crystal on a sunny day and mark the Sun's location on the crystal for reference on cloudy days.

Ropar's team then recruited 20 volunteers to take turns looking at the crystal outside on a cloudy day and measure how accurately they could estimate the position of the hidden Sun. Navigators subdivide the horizon by 360 degrees, and the team found that the volunteers could locate the sun's position to within 1 degree. However, the question still remains whether the Vikings really did use Iceland Spar crystals for navigation – a question that even 21st century physics cannot answer.

https://www.nationalgeographic.com/science/article/111111-vikings-sunstones-crystals-navigation-science