St Benedict's SCIENCE NEWS *Monthly*

Welcome to the February 2022 issue

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ECOSYSTEMS - Rewilding returns lost species to strengthen ecosystems

Rewilding is a form of ecological restoration with an emphasis on humans stepping back and leaving an area to nature, as opposed to more active forms of natural resource management. Rewilding efforts can aim to create ecosystems requiring only passive management. Successful long-term rewilding projects should need little ongoing human attention, as successful rewilding creates a self-regulatory and self-sustaining stable ecosystem, possibly with near pre-human levels of biodiversity.

In the last decade or so, more attention has turned to the animals in these ecosystems. Animals play important roles in their food webs. Insects pollinate flowers so that plants can reproduce. Herbivores mow down plants, keeping them from getting too abundant. Carnivores keep herbivores in check, so they do not wipe out the plant life. A functioning ecosystem is a balancing act. All players are essential to keep things running in a healthy way.

One example concerns a rather exotically named small marsupial: the TASMANIAN DEVIL. Immortalised for a certain generation in the image of the character, Taz, in the *Looney Tunes* cartoon series of the 1950s and 60s, this creature has always held a fascination as it could only be found in Tasmania.

Tasmanian devils were once an important part of the mainland Australian ecosystem. They mainly scavenge dead animals, explains Hayley Shute. She is the life sciences manager for Aussie Ark. This organisation in Tomalia, New South Wales, works to protect endangered species and devils help protect native species by driving away feral cats and foxes. Cats and red foxes were introduced to Australia by European colonisers. Widespread populations of these animals now threaten many small mammals on the continent, such as bilbies, quolls and potoroos. These animals are found nowhere else on Earth.

In March 2020, a group of conservationists fenced in a large area of eucalyptus forest in the hills of south-eastern Australia. They trapped and removed non-native foxes and feral cats. Then they trucked in and unloaded 28 PVC pipes. Each was wide and capped at both ends with a disk full of holes. They laid the pipes side-by-side on the ground beneath towering eucalyptus trees, then held their collective breath as they opened them. A mottled nose poked out from one tube, followed by the rest of a pointy black head. Whiskers twitched. Then a Tasmanian devil — the world's largest carnivorous marsupial — eased out onto the forest floor. It was soon followed by the others — the first devils in the wilds of mainland Australia in 3,000 years.

Reintroduction of Tasmanian devils to the Australian mainland is part of a concerted rewilding effort. All over the world, species have been disappearing from parts of their native habitats. Often people are the cause. It might be due to hunting or their introduction of invasive species. Those intruders can sometimes out-compete or prey on the natives until those natives are all gone. Affected species didn't go extinct everywhere. But they were no longer part of the complex web of life in that particular place. More and more, scientists have begun to reintroduce animals into spaces from which they had disappeared. The idea is that this rewilding will help return the ecosystem to its original state — or something close.

"The basic idea of rewilding is to give space for nature to do its job," says Henrique Pereira. He's a biodiversity conservation researcher at the German Centre for Integrative Biodiversity Research in Leipzig. *"The idea is to step back from trying to control nature,"* he says, *"and let nature do the work for us."*

https://www.sciencenewsforstudents.org/article/rewilding-lost-species-strengthen-ecosystems

ECOSYSTEMS – Invasive species threaten Antarctica by 'hitchhiking' on ships

The continent of Antarctica is often considered to be as close to a 'pristine' ecosystem as it is possible to get on Earth, but that could change according to a new study by Cambridge University, published in the *Proceedings of the National Academy of Sciences of the United States of America*.

Species from around the world that are "hitching a lift" on ships threaten Antarctica's marine ecosystem. That is the conclusion of the study that tracked research, fishing and tourist vessels that routinely visit the protected, otherwise isolated, region. It revealed that ships from 1,500 ports around the globe visit Antarctica.

"These ships travel all around the world," explained lead researcher Arlie McCarthy from the University of Cambridge. *"It means that almost anywhere could be a potential source for invasive species."* Those non-native species, she explained, *"can completely change an ecosystem. They can create entirely new habitats that would make it harder for those amazing Antarctic animals to find their own place to live."*

The research team, from the British Antarctic Survey and the University of Cambridge, used satellite data and international shipping databases to work out the weight of Antarctic traffic - and the origin of those ships. The scientists say that more stringent measures are needed to ensure that ships do not bring species that could disrupt Antarctica's fragile habitats. Any marine species that can cling to the hull of the ship and survive the journey to Antarctica could pose an invasive threat. Creatures, including mussels, barnacles, crabs and algae, are of particular concern, because they attach themselves to hulls, in a process termed "biofouling".

Mussels, for example, can survive in polar waters and spread easily, threatening marine life on the seabed. Their water filtering alters the marine food chain and also the chemistry of the water around them. *"This is the last place in the world where we don't have marine invasive species,"* explained Ms McCarthy. *"So we still have an opportunity to protect it."*

https://www.bbc.co.uk/news/science-environment-59914729
https://www.pnas.org/content/119/3/e2110303118

EVERYDAY SCIENCE – When you fill a bottle of water, why does the sound pitch get higher the fuller the bottle gets?

This is a question posed by Mr N POINTER, teacher of mathematics

In order to advance our knowledge of anything in life, not just in Science, it is essential that we ask the right questions – and Mr Pointer's question, about something that we all take for granted, is a perfect example.

In addition to the sound changing as we fill up a bottle, we can also consider the old trick of blowing across the open top of a bottle to make a fairly low pitched sound. Put some water into the bottle and try again: the pitch will get a little higher, and so on until the bottle is completely full. This all gives us a clue as to what is going on.

It is related to the proportions of water and air inside the bottle. As the bottle fills, the volume of air gets less and the pitch/frequency of the sound generated in the air gets higher. Interestingly, the reverse happens if you tap the side of the bottle with a wooden stick or mallet. The sound frequency/pitch gets lower as the amount of water in the bottle increases.

This phenomenon of air resonance in a cavity is known to physics as **Helmholtz resonance**, after the German physicist **Hermann von Helmholtz**. In fact he did more than characterise the sound phenomenon, in 1850 he invented a device called the **Helmholtz resonator**, which he used to identify the various frequencies or musical pitches present in music and other complex sounds. It has since been put to numerous industrial applications.

A note for all the acoustic guitar players out there: the fact that your guitar sounds the way it does is all because of the hollow cavity of the guitar's body and the size/shape of the "soundhole"- this is taken for granted. However, in terms of the physics, your guitar sounds the way it does because the soundhole, along with the volume of air enclosed by the body, forms a low frequency resonator that smoothes and extends the guitars bass response – it is, in fact, acting as a **Helmholtz resonator**!

Helmholtz, the physicist, is unknown to the general public, unlike names like Einstein and Hawking. It is only now appreciated Helmholtz' ideas have shaped and moulded modern science, and his insights have made profound impressions upon many of the greatest thinkers of the past hundred and fifty years. Now, over a hundred years after his death in 1894, science is beginning to allow researchers to test some of his most brilliant insights.

QUANTUM PHYSICS (and crazy maths!) - Quantum Theory Needs Complex Numbers

Physicists construct theories to describe nature. Let us explain it through an analogy with something that we can do in our everyday life, like going on a hike in the mountains. To avoid getting lost, we generally use a map. The map is a representation of the mountain, with its houses, rivers, paths, etc. By using it, it is rather easy to find our way to the top of the mountain. But the map is not the mountain. The map constitutes the theory we use to represent the mountain's reality.

Physical theories are expressed in terms of mathematical objects, such as equations, integrals, or derivatives. During history, physics theories evolved, making use of more elaborate mathematical concepts to describe more complicated physics phenomena. Introduced in the early 20th century to represent the microscopic world, the advent of **quantum theory** was a game-changer. Among the many drastic changes it brought, it was the first theory phrased in terms of **complex numbers**.

Invented by mathematicians centuries ago, complex numbers are made of a real and an imaginary part. It was Descartes, the famous philosopher considered as the father of rational sciences, who coined the term **"imaginary numbers,"** to strongly contrast it with what he called **"real numbers"**. Real numbers are easy: just about any number you can think of is a "real" number, such as 1, 12.38, −0.8625, ¾, √2 and 2022. Imaginary numbers are rather harder to get your head around: they are numbers that, when squared, give a negative result – this should not happen, of course, because when you square a positive number you get a positive result; and when you square a negative number you also get a positive result, because a negative times a negative gives a positive, for example −2 × −2 = +4 not -4. But we imagine such numbers exist, because we want them to!

The "unit" imaginary number (like 1 for real numbers) is **i**, which is the **square root of −1**. A **complex number** is then made up by a real number + an imaginary number, the general formula being as represented on the right. Examples are 1 + i,
39 + 3i, 0.8 − 2.2i, −2 + πi, √2 + i/2, where i is the square root of -1.

There's another thing: because either part could be 0, technically any real number or imaginary number can also be considered a complex number. Complex does not mean complicated, it just means that the two types of numbers combine to form a complex, like a housing complex — a group of buildings joined together.

Despite their fundamental role in mathematics, complex numbers were not expected to have a similar role in physics because of this imaginary part. And in fact, before quantum theory, Newton's mechanics or Maxwell's electromagnetism used real numbers to describe, say, how objects move, as well as how electromagnetic fields propagate. The theories sometimes employ complex numbers to simplify some calculations, but their axioms only make use of real numbers. Imaginary numbers are abstract concepts that are used when you need the square root of a negative number.

But quantum theory changed all this....it was none other than Erwin Schrödinger who was the first to introduce complex numbers in quantum theory. However, even he could not conceive that complex numbers could actually be necessary in physics at that fundamental level. It was as though he had found a map to represent the mountains but this map was actually made out of abstract and non-intuitive drawings. Such was his bewilderment that he wrote a letter to Lorentz on June 6, 1926, stating *"What is unpleasant here, and indeed directly to be objected to, is the use of complex numbers. Ψ is surely fundamentally a real function."* So even he thought that quantum theory could survive on real numbers alone – and so it was until.....

In a recent study published in the journal *Nature*, a broad group of physicists have proven that if certain quantum postulates were phrased in terms of real numbers, instead of complex, then **some predictions about quantum networks would necessarily differ**. Indeed, the team of researchers came up with a concrete experimental proposal involving three parties connected by two sources of particles where the prediction by standard complex quantum theory **cannot be expressed by its real counterpart**. This seems to show that complex numbers are necessary after all.

For sure, the tools developed to obtain this conclusion are such that they will allow physicists to achieve a better understanding of quantum theory, and will one day trigger the realisation and materialisation of so far unfathomable applications for the quantum internet.

https://scitechdaily.com/schrodingers-bewilderment-quantum-theory-needs-complex-numbers/

WORD(S) OF THE MONTH: COMPLEX (adj, *"KOM-pleks"*)

In general use as an adjective the word means *"consisting of many different and connected parts"*. As we know from above, in mathematics it is defined as *"denoting or involving numbers or quantities containing both a real and an imaginary part"*.
In chemistry, for example, it can be used as a verb: *"to make (an atom or compound) form a complex with another"*.
It is also used as a noun to describe a *"group or system of different things that are linked in a close or complicated way; a network"*.

MICROBIOLOGY - Drug-resistant bacteria evolved on hedgehogs long before our use of antibiotics

Given that there are a multitude of antibiotics available from pharmaceutical companies, many would think of them as something artificial and man-made. But this is not entirely so. One of the most famous antibiotics, penicillin, was discovered by Sir Alexander Fleming...and completely by accident! He left some samples of the bacterium *Staphylococcus aureus* to grow on culture plates while he went on holiday. On his return, Fleming noticed that one culture was contaminated with a fungus, and that the colonies of staphylococci immediately surrounding the fungus had been destroyed, whereas other staphylococci colonies farther away were normal, famously remarking *"That's funny"*. So the fungus was producing a natural antibiotic – penicillin.

That was in 1928, since when we have learned to produce a huge range of antibiotics to combat a variety of bacterial infections. With this has come the issue of drug resistance, when bacteria evolve a resistance to the antibiotic, forcing companies to develop ever-stronger drugs. Some strains of bacteria are no so highly resistant that they are very difficult to treat, probably the best known being **MRSA** (Methicillin-resistant staphylococcus aureus).

It was supposed that MRSA evolved in the current era of antibiotic use, but a new report in the journal *Nature* suggests that beneath the prickly spines of **European hedgehogs**, a microbial standoff may have bred a dangerous drug-resistant pathogen long before the era of antibiotic use in humans. On the skin of these critters, a fungus that produces natural antibiotics may have created the environment for drug resistance to evolve in the bacteria.

The team first found MRSA in hedgehogs by coincidence years ago when biologist Sophie Rasmussen, who was part of the new work and is now at the University of Oxford, approached a Danish research team about sampling a freezer full of their dead hedgehogs. Of these animals collected from Denmark, 61 percent carried MRSA. Analysing the *S. aureus*, the team found 16 strains of mecC-MRSA, named after the gene that confers resistance, and mapped the evolutionary relationships between them by comparing mutations across their genetic instruction manuals, or genomes. From the analysis, the team inferred that the three oldest lineages emerged 130 to 200 years ago in hedgehog populations, periodically infecting people and cattle long before penicillin hit the market in the 1940s. Hedgehogs may be the source of nine out of the 16 lineages, the researchers report.

The history of antibiotics in the last century is a cycle of new drug discoveries shortly followed by microbial resistance cropping up to those drugs. That shouldn't be a surprise. Because antibiotics have been on the planet for billions of years, and resistance is billions of years old, if scientists don't better understand where resistance comes from, even as researchers discover new drugs, all we'll be doing is playing catch-up.

https://www.sciencenews.org/article/drug-resistant-bacteria-hedgehog-mrsa

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CHEMISTRY - Breakthrough in separating plastic waste will revolutionise recycling

We can now tell the difference between a wide range of plastic types and thereby separate plastics according to their chemical composition. This is absolutely ground-breaking and it will increase the rate of recycling of plastics immensely. The technology has already been tested at pilot scale and it will be implemented at an industrial scale in spring 2022.

In contrast to common perceptions, plastic is in no way near one material. Rather, it is a combination of many materials (polymers) with different chemical compounds and additives such as pigments or fibres, depending on its use. It is very difficult to tell the difference between different types of plastics, and this is what makes it difficult to separate and recycle them. Plastic must be at least 96% pure by polymer type to be recycled in conventional industry. This means that the plastic has to be separated to an almost pure product in terms of chemical composition.

In collaboration with Vestforbrænding, Dansk Affaldsminimering Aps, and PLASTIX, researchers from the Department of Biological and Chemical Engineering at Aarhus University have now developed a new camera technology that can see the difference between 12 different types of plastics (PE, PP, PET, PS, PVC, PVDF, POM, PEEK, ABS, PMMA, PC, and PA12). Together, these constitute the vast majority of household plastic types. The study has been published in the scientific journal *Vibrational Spectroscopy*.

"With this technology, we can now see the difference between all types of consumer plastics and several high-performance plastics. We can even see the difference between plastics that consist of the same chemical building blocks, but which are structured slightly differently. We use a ***hyperspectral camera in the infrared*** *area, and* ***machine learning*** *to analyse and categorise the type of plastic directly on the conveyor belt. The plastic can then be separated into different types. It's a breakthrough that will have a huge impact on all plastics separation,"* says Associate Professor Mogens Hinge, who is heading the project at Aarhus University.

https://www.sciencedaily.com/releases/2022/01/220105174109.htm

ANIMALS - Here's how spider geckos survive on Earth's hottest landscape

The **Lut Desert** in Iran (also known as **Dasht-e Lut**, Persian for "Emptiness Plain") is the hottest place on Earth. Surface temperatures often reach 65° Celsius more frequently than anywhere else on the planet. The extreme heat makes it difficult for life to thrive and for years ecologists have regarded the desert as mostly barren. However, amazing as it may sound, there is one tiny creature that seems to do very well there.

It turns out that this apparently lifeless desert is home to the **Misonne's spider gecko** (*Rhinogecko misonnei*).

To find out how the geckos sustain themselves in this desolate oven, entomologist Hossein Rajaei of the State Museum of Natural History in Stuttgart, Germany and colleagues analysed the stomach contents of six geckos using DNA metabarcoding. The technique compares chunks of DNA with a species identification database, like a bar code scanner in a grocery store. *"It's very accurate, very comprehensive and very trustable,"* Rajaei says.

Within the geckos' digestive soup stewed DNA from 94 species, about 81 percent of which hail from outside the Lut Desert, the team reports in the *Journal of Zoological Systematics and Evolutionary Research*. The majority of these outsiders were winged insects such as flies, moths and wasps that migrate through the desert from bordering temperate landscapes. The remaining species — arachnids, arthropods and more moths — are endemic to the Lut, but are elusive in its heart, where the geckos were collected. The unexpected diversity highlights that there's more living in this desert than meets the eye.

The findings underscore the importance of intertwined food webs for animals to survive in hostile habitats, says Robert Pringle, an ecologist at Princeton University who was not involved in the research. *"The movement of insects from outside the immediate area subsidises the geckos and helps them to persist in this extreme desert environment,"* he says.

https://www.sciencenews.org/article/spider-gecko-earth-hottest-landscape

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STRANGE SCIENCE - Why do we still measure things in horsepower?

If you're buying a car and have no experience with power measurements or vehicle stats, you may be baffled by one of the vehicle's key capabilities: its **horsepower** rating. Based on that term, you may assume that a horse can produce around 1 horsepower. Linguistically, it makes perfect sense. In reality, however, it's way off the mark. So, how much horsepower can one horse produce? And how did this term get started, anyway?

The maximum output of a horse is actually much closer to 15 horsepower, according to the University of Calgary's Energy Education website. In fact, a more befitting name for the unit might be "humanpower," given that the average healthy person can produce just over 1 horsepower.

So where did the term come from, then? It was first coined in the late 1700s by **James Watt**, a Scottish engineer remembered for his iconic, and incredibly efficient, steam engines. Seeking a way to advertise the contraptions, he invented a unit of measurement that would effectively showcase the superiority of his steam engines compared with something people were familiar with: horses.

Watt determined — from personal observation rather than rigorous scientific study — that a working horse could turn a mill wheel 144 times each hour. Using this number, he estimated that horses were capable of pushing 32,572 pounds 1 foot per minute, or about 14,774.41 kilograms 1 meter per minute. For convenience, he rounded this up to 33,000 pounds foot-pounds of work per minute (14,968.55 kilograms), and the "**horsepower**" unit was born, according to *Encyclopaedia Britannica*.

Watt was, by all accounts, an engineering genius and was so revered by his peers that, in recognition of his pioneering deeds and endeavours, the "**watt**" unit of power was ultimately named after him in 1882. However, given that we now know a horse can exert far more than 1 horsepower, why do we still use a term Watt created?

"Because of the way language is always changing, there are more words that are estranged from their origins than people might realise," said Eric Lacey, a senior lecturer in English language at the University of Winchester in the United Kingdom. *"If horses hadn't been the most obvious sources of industrial energy in the early 19th century, it's doubtful the term would have been as popular, but the fact that a single word could both convey the desired redundancy of the old and simultaneously usher in the new meant it ended up at the forefront of everybody's minds."* In simple terms, the word has just stuck with us.

https://www.livescience.com/what-is-horsepower

PALAEONTOLOGY – Huge 'sea dragon' found fossilised in the bed of a Rutland reservoir

When it comes to Jurassic era marine fossils, one inevitably thinks of Dorset and the world famous "Jurassic Coast" and especially the Victorian fossil hunter, Mary Anning. Aged only 12 in 1811 she, together with her brother, discovered the first nearly-complete fossil skeleton of a creature that would become known as an **Ichthyosaur**, which means *"fish lizard"*. It was 5.2m (17ft) long. This has now been overtaken: it has been announced that, last year, the **UK's largest ichthyosaur fossil** was found in a reservoir in Rutland – it measures 10 metres long!

Ichthyosaurs, which are not dinosaurs, are an extinct group of species that lived between 250 and 90 million years ago. Like whales and dolphins, their ancestors had emerged from the water onto land and later returned, meaning ichthyosaurs breathed air. They lived both along coastlines and in the open ocean, and are believed to have been warm-blooded. The Rutland specimen, a member of the species *Temnodontosaurus trigonodon*, was discovered by Joe Davis, Conservation Team Leader at Leicestershire and Rutland Wildlife Trust. The team were draining a lagoon island at the reservoir, Rutland Water, for re-landscaping in February 2021 when they found it. They also discovered several other fossils alongside it, including ammonites. The fossil was excavated in August and September 2021 by a team led by ichthyosaur expert Dr Dean Lomax, a palaeontologist from Manchester University, and specialist palaeontological conservator Nigel Larkin. They encased it in plaster of Paris with wooden splints, and lifted it out of the ground to be studied at a research facility.

Dr Dean Lomax led the excavation effort. He called the discovery *"truly unprecedented"* and - due to its size and completeness - *"one of the greatest finds in British palaeontological history"*. *"Usually we think of ichthyosaurs and other marine reptiles being discovered along the Jurassic coast in Dorset or the Yorkshire coast, where many of them are exposed by the erosion of the cliffs. Here at an inland location is very unusual."* Rutland is more than thirty miles from the coast, but 200 million years ago higher sea levels meant it was covered by a shallow ocean.

If you think that being 10 metres long is impressive, fossil evidence elsewhere shows us that Ichthyosaurs could grow up to 25 metres in length, so maybe the Rutland specimen is just a youngster!

https://www.bbc.co.uk/news/science-environment-59915689
https://www.sciencefocus.com/news/rutland-ichthyosaur-fossils-uk/

THE BRAIN – Why nodding off may turn your creativity on

Do you ever feel guilty sitting down and having a quick snooze? Well don't, because nodding off now and then might actually give you creative insights and help your problem solving!

The twilight time between full wakefulness and being sound asleep may be packed with creative potential. In a new experiment, people who drifted into a light sleep were better problem solvers later. The results, published in the journal *Science Advances*, help demystify the fleeting early moments of sleep. They may even point out ways to boost creativity.

More work is needed to untangle the link between snoozing and creativity, but the results raise an interesting possibility. People may be able to learn to reach that twilight stage of sleep — or to produce the cocktail of brain waves associated with creativity — on demand. However, one should also be mindful of the great American scientist and businessman, Thomas Edison, who famously called sleep *"a criminal waste of time!"*

https://www.sciencenewsforstudents.org/article/sleep-nap-boost-creativity-neuroscience-brain

SPORTS SCIENCE - the science of the Winter Olympics

From scientific innovations to climate change, there's plenty of science among the sport and this year's Winter Olympics in China is no exception. It is stating the obvious to say that any the Winter Olympics are wholly reliant on snow, but this is becoming a problem, especially in China's games this year. Quite simply, there isn't enough of it!

Gradual global warming and subsequent climate change means that some areas that used to have abundant snow in winter now have a lack of it. Without it, athletes like skiers and snowboarders can't compete. Unfortunately, many cities may soon be too warm to host the Winter Olympics. The reason: human-caused climate change. If it doesn't get cold enough, snow can't fall. In fact, this is the first Winter Olympics ever that will completely depend on artificial, rather than natural, snow. That could become the norm in the future.

The Olympic games are a spectacle of speed and grace. Curlers deftly nudge stones into place. Figure skaters whip themselves into fancy twirls on the balance of a blade. Snowboarders ride rails and launch off ramps into daring flips and twists. Every Olympian has trained for years to show off their skills on the world stage. In contests between such elite athletes, tiny details can make the difference between silver and gold.

The chemistry of ski wax, for instance, affects how well skis glide across or grip snow. The recipe can make or break a skier's performance. Waxes allow athletes to control how their skis glide under some conditions and grip in others. All ski wax is not the same. The recipe an athlete uses must be tailored to match the feats they'll attempt and the snow they'll encounter. Chemicals in the wax help skis glide downhill. The wax does this by repelling water that forms as a ski slides across the snow. Cross-country skiers, in contrast, must go both uphill and downhill. Their ski wax, therefore, must help the athlete also grip the snow while climbing short hills during a race. Long before a race, various waxes will be tested. Then, technicians and racers pick a mix that they think will best match the snow on race day.

https://www.sciencenewsforstudents.org/article/lets-learn-about-science-winter-olympics

ANIMALS - How a disappearing ear bone turned bats into masters of echolocation

Most people know that bats have an almost unique means of finding their way around and hunting at night – echolocation. But exactly how they evolved the mechanism to do this has always been a bit of a mystery. Scientists have now discovered an anatomical quirk that may explain the many ways bats hunt with sound.

Bats use sound to hunt a dizzying array of prey. Some zero in on flowers to sip nectar, whereas others find cattle and suck their blood. Many nab insects mid-flight. One species of bat even senses small fish beneath the water and snatches them as osprey do. Now, scientists have discovered an anatomical quirk in the ears of some bats that could help explain how they evolved so many hunting specialties.

Researchers at the Department of Organismal Biology and Anatomy of the University of Chicago (USA) have published a fascinating new study in the journal *Nature*.

Bats' ears were long thought to be just a finely tuned version of the ears of nearly all mammals. Then, in 2015, Benjamin Sulser, a University of Chicago biology student on the hunt for a thesis project, took detailed 3D images of the inner ear of a bat skull. But he couldn't find a feature common in virtually all mammals—a bony tube that encases the nerve cells and connects the ear to the brain. The researchers realized they might have stumbled across an answer to a mystery that had bedevilled bat biologists for 2 decades—and an explanation for why some families of bats had such a diverse echolocation arsenal.

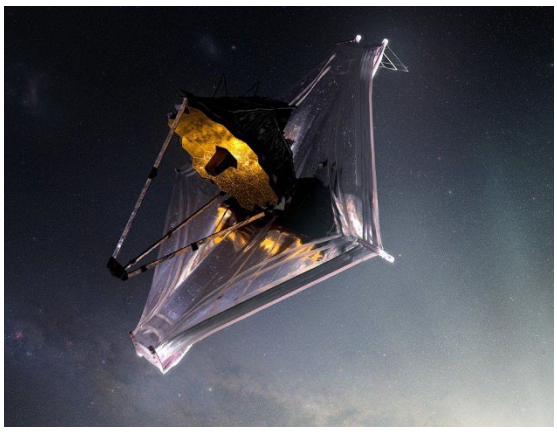
Bats known to have the missing bony, nerve channel to their brains use a broader range of sound frequencies, making them better at picking out complex details at short distances, and potentially enabling them to specialize in catching distinctive prey in specific habitats – a superb evolutionary adaptation.

The new study is *"one of the neatest papers, ever"* for revealing this overlooked anatomical feature, says Brock Fenton, a retired bat biologist and echolocation expert at the University of Western Ontario. The findings open questions about how variations in the nerve and its bony enclosure from one species to another might translate into subtle differences in how bats hunt.

https://www.science.org/content/article/how-disappearing-ear-bone-turned-bats-masters-echolocation

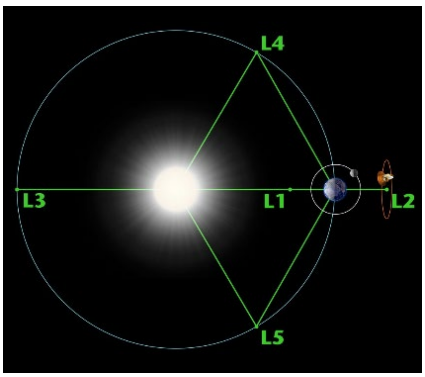
ASTRONOMY - JAMES WEBB SPACE TELESCOPE UPDATE

At 19:00 GMT on 24th January, one calendar month after its launch, Webb fired its onboard thrusters for nearly five minutes (297 seconds) to complete the final postlaunch course correction to its trajectory. This last mid-course correction burn inserted Webb toward its final orbital "home". Next on the to-do list: Cool down - Straighten out - Turn everything on – And take a look around. But this will take up to the next 4-5 months.



The telescope can't start doing science yet. *"We're a month in and the baby hasn't even opened its eyes yet,"* said Jane Rigby of NASA Goddard Space Flight Center in Greenbelt, Md. *"Everything we're doing is about getting the observatory ready to do transformative science. That's why we're here."* Webb sees in infrared light, wavelengths longer than what the human eye can see. But humans do experience infrared radiation as heat.

"We're essentially looking at the universe in heat vision," says astrophysicist Erin Smith of Goddard Space Flight Center and a project scientist on Webb. That means that the parts of the telescope that observe the sky have to be at about 40 Kelvins (–233° Celsius), which nearly matches the cold of space. That way, Webb avoids emitting more heat than the distant sources in the universe that the telescope will be observing, preventing it from obscuring them from view. Most of Webb has been cooling down ever since the telescope's sunshield unfurled on January 4. The observatory's five-layer sunshield blocks and deflects heat and light, letting the telescope's mirrors and scientific instruments cool off from their temperature at launch. The sunshield layer closest to the sun will warm to about 85° Celsius, but the cold side will be about –233° Celsius.



Where exactly is Webb? Unlike its "sister" telescope, Hubble, Webb is not in orbit around the Earth. In fact, technically it is not in orbit around the Sun either. It has arrived at a point about 1.5 million km (1 million miles) further away from Earth than the Sun, but in a direct line with the two. This point was chosen very carefully as it is one of 5 points in space where a relatively small object, like a spacecraft, will keep pace with the Earth as our planet orbits the Sun even though the craft is further away. Webb's location is at **LAGRANGE POINT L2**. However, this point is itself unstable, so Webb will have to directly orbit this point in space to maintain its position. It has enough fuel for its thrusters to do this over the next 10 years, which is the projected life of the mission.

By orbiting rather than being exactly at L2, Webb will never have the Sun eclipsed by Earth, which is necessary for Webb's thermal stability and for power generation. In fact, Webb's orbit around L2 is larger in size than the Moon's orbit around Earth! L2 is also convenient for always maintaining contact with the Mission Operations Center back on Earth.

Breaking news – Earth has a new "moon" – a Trojan Asteroid - and it's all because of the Lagrange Points!
This so-called "new moon" is actually the second. In 2010, astronomers discovered an asteroid which, although tens of millions of kilometres from us, was keeping pace with our orbit around the Sun some way ahead of us. It was a class of object known as a **Trojan Asteroid** and was named 2010 TK7. Trojan asteroids, which are also found accompanying Mars, Jupiter and Neptune, hang out in two locations near a planet where the gravitational pulls of that planet and the Sun balance each other – these are Lagrange Points L4 and L5 but, unlike L2, they are stable. 2010 TK7 is at L4.

Earth's second Trojan Asteroid, dubbed 2020 XL5, is a roughly 1-kilometre-wide asteroid and is also at L4, astronomer Toni Santana-Ros of the University of Barcelona and colleagues reported February 1 in the journal *Nature Communications*. The space rock was first spotted in December 2020, and follow-up observations suggested that it might be at L4. To confirm this, Santana-Ros and colleagues observed the asteroid using ground-based telescopes in 2021. Measurements of its brightness let the researchers estimate the asteroid's size — about three to four times as wide as 2010 TK7. They also scoured archival data and found the object in images dating to 2012.

"There is no doubt this is an Earth Trojan," Santana-Ros says. That decade-worth of observations let the team calculate the rock's orbit thousands of years into the future, confirming the asteroid's nature. It will hang around at L4 for at least 4,000 years, the team predicts. 2010 TK7, for comparison, will stick around for some 10,000 years. They are not part of the Earth-Moon system, but are temporary visitors, albeit for a long term.

https://www.bbc.co.uk/news/science-environment-59914936

https://www.sciencenews.org/article/earth-second-trojan-asteroid-orbit

https://www.sciencenews.org/article/james-webb-space-telescope-l2-lagrange-point