

Welcome to the April 2023 issue

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

PHYSICS & HOME ENTERTAINMENT – Incredible new TV set that actually allows you to smell the scenes as you watch them! Yes, it's.....

SMELL-e-VISIONTM!

Throughout the 1950s and 60s television sets became more affordable and more households bought a set. A major advance in the late 60s was the introduction of colour TV by the BBC on its new channel, BBC2, the first program in colour being the 1967 Wimbledon championships. As the technology of TV sets advanced with clearer vision and higher definition, some scientists turned their attention to enhancing the viewing experience by developing a TV set that would emit the odours associated with the program scenes that viewers were watching. Now, that dream has become a reality thanks to **QUANTUM PHYSICS**.

The idea came to a Dutch physicist, Professor Paul Van Reek, when he was watching a documentary about the coffee trade in the Netherlands. Wouldn't it be wonderful, he thought, if as well as watching the TV images of coffee roasting and the various specialty coffee shops, for which the Netherlands is famous, you could actually smell the coffee too. Next day at his Institute of Physics in Amsterdam, part of the Faculty of Science at the historic University of Amsterdam, he assembled a team of keen graduate and post-graduate scientists to work on the project.

Prof Van Reek decided to research the possibility of using **teleportation**. While human teleportation currently exists only in science fiction, teleportation is possible now in the **subatomic world of quantum mechanics**. In the quantum world, teleportation involves the transportation of information rather than the transportation of matter, and it is this transmission of information that the researchers used to design a novel type of television system: the *SMELL-e-VISION*TM.



Van Reek's team relied on research from 2013 at the University of Copenhagen that showed it possible to teleport information between two clouds of gas atoms using laser photons. This was possible according to the process known as **quantum entanglement**. We sense smell when certain gas atoms interact with specialised cells in our nasal cavity, so the team isolated the atoms responsible for the various distinctive odours of a range of coffee types. The atoms were scanned and the information transmitted to a television receiver hundreds of miles away that contained a corresponding mixture of atoms.



When the information was received, the second mixture of atoms "synchronised" with the first to reproduce, exactly, the smell of coffee. A calibrated device within the TV set then released some of the gas into the room so the viewers really got to "smell" the coffee that they were watching on the screen.

Although the system is still in an early developmental stage, Professor Van Reek is hopeful that he and his team can perfect it so that within just a year or two the Smell-e-Vision sets can go on general sale. He is currently working on adapting the system for use with cooking programs – just imagine watching the Hairy Bikers or Mary Berry at work in their kitchens and being able to sample the appetising food aromas in your own living room!

THANK YOU TO Mr M TANGUAY FOR SPOTTING THIS.....

ARTIFICIAL INTELLIGENCE - A deep-learning model identifies a powerful new drug that can kill many species of antibiotic-resistant bacteria.

Over the past few decades, very few new antibiotics have been developed, and most of those newly approved antibiotics are merely slightly different variants of existing drugs. Current methods for screening new antibiotics are often prohibitively costly, require a significant time investment, and are usually limited to a narrow spectrum of chemical diversity. Also, many candidate compounds for new antibiotics prove to be failures meaning that the costly and time-consuming R&D is wasted. This could be a thing of the past, thanks to Al.

machine-learning algorithm. MIT Using а researchers have identified a powerful new antibiotic compound. In laboratory tests, the drug killed many of the world's most problematic diseasecausing bacteria, including some strains that are resistant to all known antibiotics. It also cleared infections in two different mouse models. The computer model, which can screen more than a hundred million chemical compounds in a matter of days, is designed to pick out potential antibiotics that kill bacteria using different mechanisms than those of existing drugs. "We wanted to develop a platform that would allow us to harness the power of artificial intelligence to usher in a new age of antibiotic drug discovery," says James Collins, the



Termeer Professor of Medical Engineering and Science in MIT's Institute for Medical Engineering and Science (IMES) and Department of Biological Engineering. *"Our approach revealed this amazing molecule which is arguably one of the more powerful antibiotics that has been discovered."*

In their new study, the researchers also identified several other promising antibiotic candidates, which they plan to test further. They believe the model could also be used to design new drugs, based on what it has learned about chemical structures that enable drugs to kill bacteria. *"The machine learning model can explore, in silico, large chemical spaces that can be prohibitively expensive for traditional experimental approaches,"* says Regina Barzilay, the Delta Electronics Professor of Electrical Engineering and Computer Science in MIT's Computer Science and Artificial Intelligence Laboratory (CSAIL).

In this case, the researchers designed their model to look for chemical features that make molecules effective at killing E. coli. To do so, they trained the model on about 2,500 molecules, including about 1,700 FDA-approved drugs and a set of 800 natural products with diverse structures and a wide range of bioactivities. Once the model was trained, the researchers tested it on the Broad Institute's Drug Repurposing Hub, a library of about 6,000 compounds. The model picked out one molecule that was predicted to have strong antibacterial activity and had a chemical structure different from any existing antibiotics. Using a different machine-learning model, the researchers also showed that this molecule would likely have low toxicity to human cells.

The researchers decided to name the new antibiotic **HALICIN**, after the fictional artificial intelligence system, **Hal**, from "2001: A Space Odyssey". The researchers tested it against dozens of bacterial strains isolated from patients and grown in lab dishes, and found that it was able to kill many that are resistant to treatment, including *Clostridium difficile*, *Acinetobacter baumannii*, and *Mycobacterium tuberculosis*.

https://news.mit.edu/2020/artificial-intelligence-identifies-new-antibiotic-0220

NATURAL HISTORY - Non-native plants outnumber British flora, major report finds

Parts of Britain's landscape today would be unrecognisable to someone who grew up just 70 years ago, a major survey of plant life suggests. Non-native species have thrived while some native plants have been hit by modern agriculture and climate change. In a 20-year study, botanists counted more non-native than native species.

Britain is now one of the most nature-depleted countries in the world. That decline in biodiversity is also the subject of a new BBC documentary, Wild Isles, presented by Sir David Attenborough. One in every five plant species in the UK is listed as

threatened. The Plant Atlas 2020 is the third produced by the Botanical Society of Britain and Ireland (BSBI). The findings are "catastrophic" for native species, explains Kevin Walker, head of science at the BSBI. "The loss of grasslands, heathlands and other habitats would be really shocking for someone brought up in the 1950s," he suggests.

The survey also shows evidence for the first time of how climate change is affecting plant life, Dr Walker said.



ENVIRONMENT - Climate change: New idea for sucking up CO2 from air shows promise

Burning fossil fuels like oil, gas and coal to generate electricity emits CO2, which is the main driver of climate change. A process known as CARBON CAPTURE stops most of the CO2 produced from being released, and either re-uses it or stores it underground. The UK government is already planning a new power station where carbon dioxide is captured and stored under the North Sea - either in old oil and gas reservoirs, or permeable rocks known as saline aquifers. All this is hugely expensive, but scientists have discovered a new, cheaper way.



The authors say that this novel approach captures CO2 from the atmosphere up to three times more efficiently than current methods. The warming gas can be transformed into bicarbonate of soda and stored safely and cheaply in seawater. The new method could speed up the deployment of carbon removal technology.

This new approach, using off-the-shelf resins and other chemicals, promises far greater efficiency and lower cost, say the scientists involved. The research team have borrowed an approach used for applications in water, and "tweaked" existing materials to remove CO2 from the air. In tests, the new hybrid absorbing material was able to take in three times as much CO2 as existing substances. Storing it under the ground or sea in former oil wells is one widely used approach. But the new paper suggests that with the addition of some chemicals the captured CO2 can be transformed into BICARBONATE OF SODA and stored simply and safely in sea water.

The development, while in its early stages, has been welcomed by others in the field. "I am happy to see this paper in the published literature, it is very exciting, and it stands a good chance of transforming the CO2 capture efforts," said Prof Catherine Peters from Princeton University, an expert in geological engineering.

https://www.bbc.co.uk/news/science-environment-64886116

EGYPTOLOGY - Cosmic rays reveal 'hidden' 30-foot-long corridor in Egypt's Great Pyramid

For years, scientists have known there was something hidden above the entrance to the Great Pyramid. Now, they've finally revealed it. The Great Pyramid was built on orders of the pharaoh Khufu (ruled circa 2551 B.C. to 2528 B.C.) on the Giza plateau outside modern-day Cairo and today is about 456 feet (139 meters) high. It is the only surviving wonder of the ancient world and was the tallest building on Earth until 1311, when England's Lincoln Cathedral's 525-foot-tall (160 m) central tower was completed.

A new study, published in the journal *Nature Communications*, reveals that, just above the ancient entrance to the pyramid, there is likely a horizontal chamber that runs for 30 feet (9 m) in length and is 6.6 feet by 6.6 feet (2 by 2 m) in width and height. It is located behind a chevron-shaped structure that is visible outside the pyramid.

To learn more about the void, the scientists inserted an endoscope into the corridor to peer inside. "The first pictures taken with the endoscope seem to show there



is nothing, but we cannot see all the room precisely yet," study first author Sébastien Procureur, a physicist with the French Alternative Energies and Atomic Energy Commission (CEA).

The reason a physicist was involved is because the archaeologists used cosmic rays to reveal the corridor before then inserting a light endoscope to investigate its length. The instruments they used are called **muon detectors**. Scientists discovered this corridor while analysing so-called muon scans of the 4,500-year-old Great Pyramid. Muons are negatively charged elementary particles that form when cosmic rays collide with atoms in Earth's atmosphere. These high-energy particles constantly rain down on Earth but interact differently with stone than with air. For the past decade, scientists have been using muon detectors to search for hidden chambers in the Great Pyramid. *"To our knowledge, this study is the first characterization of the position and dimensions of a void detected by cosmic-ray muons with a sensitivity of a few centimetres only,"* the researchers wrote in the study. The scientists added that ground-penetrating radar was also used to gather information on the corridor.

Zahi Hawass, Egypt's former antiquities minister, said during a news conference that the 30-foot-long corridor was likely created to help relieve stress from the weight of the building material on the Great Pyramid. He noted that it is located behind a chevron-shaped structure that distributes weight. Such chevron "arches" are used higher up the Great Pyramid and it is possible that the one above the entrance could have been a "first test".

https://www.livescience.com/cosmic-rays-reveal-hidden-30-foot-long-corridor-in-egypts-great-pyramid

MORE ARCHAEOLOGY - The world's first horse riders

The use of animals for transport, in particular the horse, marked a turning point in human history. The considerable gain in mobility and distance had profound effects on land use, trade, and warfare. Current research has mostly focused on the horses themselves. However, horse-riding is an interaction of two components – the mount and its rider – and human remains are available in larger numbers and more complete condition than early horse remains. Yamnayans were mobile cattle and sheep herders, now believed to be on horseback.

Researchers have discovered evidence of horse riding by studying the remains of human skeletons found in burial mounds called kurgans, which were between 4500-5000 years old. The earthen burial mounds belonged to the Yamnaya culture. The Yamnayans had migrated from the Pontic-Caspian steppes to find greener pastures in today's countries of Romania and Bulgaria up to Hungary and Serbia.

"We studied over 217 skeletons from 39 sites of which about 150 found in the burial mounds belong to the Yamnayans. Diagnosing activity patterns in human

skeletons is not unambiguously. There are no singular traits that indicate a certain occupation or behaviour. Only in their combination, as a syndrome, symptoms provide reliable insights to understand habitual activities of the past," explains Martin Trautmann, Bioanthropologist in Helsinki and the lead author of the study.

The international team decided to use a set of six diagnostic criteria established as indicators of riding activity (the so-called "horsemanship syndrome"):

- 1. Muscle attachment sites on pelvis and thigh bone (femur);
- 2. Changes in the normally round shape of the hip sockets;
- 3. Imprint marks caused by pressure of the acetabular rim on the neck of the femur;
- 4. The diameter and form of the femur shaft;
- 5. Vertebral degeneration caused by repeated vertical impact;
- 6. Traumata that typically can be caused by falls, kicks or bites from horses.

If the primary use of horseback riding was as a convenience in a mobile pastoral lifestyle, in allowing a more effective herding of cattle, as means of swift and far-ranging raids or just as symbol of status needs further research.

https://www.sciencedaily.com/releases/2023/03/230303175829.htm

BIOCHEMISTRY - Newly discovered enzyme that turns air into electricity

Australian scientists at Monash University have discovered an enzyme that converts air into energy. The finding, published in the journal *Nature*, reveals that this enzyme uses the low amounts of the hydrogen in the atmosphere to create an electrical current. This finding opens the way to create devices that literally make energy from thin air.

Recent work by the team has shown that many bacteria use hydrogen from the atmosphere as an energy source in nutrient-poor environments. "We've known for some time that bacteria can use the trace hydrogen in the air as a source of energy to help them grow and survive, including in Antarctic soils, volcanic craters, and the deep ocean" Professor Greening said. "But we didn't know how they did this, until now." The researchers extracted the enzyme responsible for using atmospheric

hydrogen from a bacterium called *Mycobacterium smegmatis*. They showed that this enzyme, called **Huc**, turns hydrogen gas into an electrical current. Dr. Grinter notes, "Huc is extraordinarily efficient. Unlike all other known enzymes and chemical catalysts, it even consumes hydrogen below atmospheric levels—as little as 0.00005% of the air we breathe."

The researchers used several cutting-edge methods to reveal the molecular blueprint of atmospheric hydrogen oxidation. They used advanced microscopy (cryo-EM) to determine its atomic structure and electrical pathways, pushing boundaries to produce the most resolved enzyme structure reported by this method to date. They also used a technique called electrochemistry to demonstrate the purified enzyme creates electricity at minute hydrogen concentrations.

Huc is a "natural battery" that produces a sustained electrical current from air or added hydrogen. While this research is at an early stage, the discovery of Huc has considerable potential to develop small air-powered devices, for example as an alternative to solar-powered devices. The bacteria that produce enzymes like Huc are common and can be grown in large quantities, meaning we have access to a sustainable source of the enzyme. Dr. Grinter says that a key objective for future work is to scale up Huc production. "Once we produce Huc in sufficient quantities, the sky is quite literally the limit for using it to produce clean energy."

https://phys.org/news/2023-03-newly-enzyme-air-electricity-source.html





NATURE - Bumblebees learn to solve puzzles by watching peers, study finds

Bumblebees learn to solve puzzles by watching their more experienced peers, scientists in Britain have found. Experts from Queen Mary University of London trained a set of bees to open a puzzle box containing a sugar reward. These bees then passed on the knowledge to others in their colonies, the study found. The researchers discovered that "social learning" may have had a greater influence on the behaviour of bumblebees than previously imagined.

To carry out the study, the scientists created a puzzle box that could be opened by rotating a lid to access a sugar solution. The lid could be rotated clockwise by pushing a



red tab, while pushing a blue tab could rotate it anti-clockwise. The scientists trained "demonstrator" bees to use one of these methods to open the lid while the "observer" bees watched. When the observer bees tackled the puzzle, researchers found they chose the same method they had seen 98% of the time, even after discovering the alternative approach. The study also found that bees with a demonstrator opened more puzzle boxes than control bees. This suggests the bees learned the behaviour socially rather than discovering the solution themselves, the researchers said.

In other experiments where both "blue" and "red" demonstrator bees were released into the same groups of bees, the observer bees initially learned to use both methods, but eventually they developed a preference for one solution, which then dominated in that colony. This shows how a behavioural trend might emerge within the bee population, according to the study.

https://www.bbc.co.uk/news/uk-64884107

BIOCHEMISTRY - Scientists identify substance that may have sparked life on Earth

A team of scientists dedicated to pinpointing the primordial origins of metabolism – a set of core chemical reactions that first powered life on Earth – has identified part of a protein that could provide scientists clues to detecting planets on the verge of producing life.

It is not so much the question of <u>when</u> life began, but <u>how</u>? There is a consensus based on evidence in ancient rocks that life was evolving around 3.5-3.8 billion years ago, but exactly how the transition was made from nonliving (prebiotic) chemicals to fully functioning metabolic (biotic) systems is still something of a mystery.

A team of scientists at Rutgers University (New Jersey, US) dedicated to pinpointing the primordial origins of metabolism – a set of core chemical reactions that first powered life on Earth – has identified part of a protein that could also provide scientists clues to detecting planets on the verge of producing life. The research, published in *Science Advances*, has important implications in the search for extra-terrestrial life because it gives researchers a new clue to look for.

Based on laboratory studies, Rutgers scientists say one of the most likely chemical candidates that kick-started life was a simple peptide with two nickel atoms they are calling "Nickelback" not because it has anything to do with the Canadian rock band, but because its backbone nitrogen atoms bond two critical nickel atoms. A peptide is a constituent of a protein made up of a few elemental building blocks known as amino acids. An original instigating chemical, the researchers reasoned, would need to be simple enough to be able to assemble spontaneously in a prebiotic soup. But it would have to be sufficiently chemically active to possess the potential to take energy from the environment to drive a biochemical process.

They started by examining existing contemporary proteins known to be associated with metabolic processes. Knowing the proteins were too complex to have emerged early on, they pared them down to their basic structure. After sequences of experiments, researchers concluded the best candidate was Nickelback. The peptide is made of 13 amino acids and binds two nickel ions. Nickel, they reasoned, was an abundant metal in early oceans. When bound to the peptide, the nickel atoms become potent catalysts, attracting additional protons and electrons and producing hydrogen gas. Hydrogen, the researchers reasoned, was also more



abundant on early Earth and would have been a critical source of energy to power metabolism.

When scouring the universe with telescopes and probes for signs of past, present or emerging life, NASA scientists look for specific "biosignatures" known to be harbingers of life. Peptides like nickelback could become the latest biosignature employed by NASA to detect planets on the verge of producing life.

NATURE - Orca Mom Adopts Pilot Whale Calf and Takes Baby Under Her Fin

The unusual spectacle of an adult female killer whale spotted with the adopted – or abducted – calf of another species is causing experts to reassess orca behaviour. Orcas, or killer whales, are apex predators, best known for their ferocious hunting techniques. So when a female was seen apparently caring for the offspring of another species, it came as a bit of a surprise.

The unique sighting happened near Snæfellsnes, west Iceland, in August 2021, and is now the subject of a research paper published in the Canadian Journal of Zoology. "It's another level of empathy we see in these animals if they are capable of caring for



another species," says Mrusczok, who is president of conservation nonprofit Orca Guardians Iceland and a researcher at the West Iceland Nature Research Centre.

The question researchers have been unable to answer is whether the calf was adopted after being orphaned or abandoned, or whether Sædís stole the calf from its parents. "There are many possibilities ... but what we can say for sure is that the female showed protective behaviour towards the pilot whale calf," Mrusczok says. The newborn was seen swimming in the "drafting" position next to the orca, which means it was getting dragged along by her and needed less energy for swimming. It is not known if the attraction from the calf was mutual, or how long their association went on for.

Orcas and pilot whales have similar social structures, forming strong, long-term bonds between mother and offspring, so researchers believe that caregiving between the species could be a possibility. Although the calf was emaciated, it did appear that it was being cared for by the orca. One theory is that the orca may have had a miscarriage or lost a newborn just before this encounter, and could have been looking after the pilot whale calf as a substitute, although there is no evidence to support this.

Although this is the first time this behaviour, called *interspecific alloparenting*, has been observed in orcas, it has been seen in other cetacean species. Short-beaked common dolphins, common bottlenoses, Indian Ocean humpbacks and Indo-Pacific humpbacks have all been observed looking after the young of other species.

$\underline{https://www.theguardian.com/environment/2023/mar/10/killer-whale-orca-adopts-abducts-pilot-whale-calf-aoe}$

PHYSICS - New bubble popping theory could help track ocean pollution and viruses

Bubbles are great fun for everyone. But, it turns out, they can also be little menaces. When a bubble pops, it can concentrate and aerosolize any particles stuck on it. Not a big deal when it's a store-bought soapy bubble bursting in the yard or on your hand. But it's a major concern when the particles it carries are potentially hazardous.

At their simplest, bubbles are a thin layer of liquid surrounding a gas. The bubbles kids love blowing, for example, are a layer of water trapped between two layers of soap molecules, with air in the middle. If you poke the bubble, it creates a hole, which quickly widens—the whole bubble pops in less than one-tenth of a second—forcing the outer soapy layer to collapse, packing its molecules together in a denser space. All of that movement and change in



density—as well as the air inside flying up and out—propels drops of water and soap into the sky in a quick pop.

Bubbles caught in a crashing wave can send vaporised microplastics into the air where they might mess with the Earth's atmosphere; bubbles burst by a flushing toilet can fling bacteria meters and onto nearby surfaces; a frothing cruise ship hot tub was once shown to be a Legionnaires' disease super-spreader. Now, a new study by Boston University engineers illustrates why bubbles fire some contaminants into the air, while allowing others to sink harmlessly. After taking a close-up look at what happens when bubbles pop, the researchers found a new way to predict which particles are flung high—and which ones fall—overhauling a 40-year-old theory of fluid dynamics. Their results, which were published in *Physical Review Letters*, could help scientists track marine pollution or more accurately predict a virus' transmissibility.

"With this new theory, we can better model potential ocean sources of pollutants or how other particles in the ocean can get into the atmosphere and act as cloud condensation nuclei, altering the climate," says Lena Dubitsky, a doctoral student in the BU Fluid Lab and joint lead author on the paper. "In terms of public health, this model helps predict what drop size might contain the most pathogens." And that can be crucial in determining how easily a disease might spread or whether a small drop can sneak a virus through the defences protecting our lower respiratory tract.

ECOLOGY - A NEW CAT SPECIES! - Meet the Corsican 'Cat Fox': The Mysterious Feline Prowling the Remote Areas of a French Island

The existence of the Corsican cat fox on the island has been known to its inhabitants for a very long time. Since the 20th century, the population of the Corsican cat fox has been the subject of more or less precise descriptions. It was first recognized as a wild species on the island at the end of the 19th century and early 20th century, but it is only now that it has been officially determined so.

A genetic study has indicated that the mystery wild cat known to locals on the French Mediterranean island of Corsica as the "ghjattu volpe" ("fox-cat") is a distinct sub-species within Felix silvestris. Researchers from the French Office for Biodiversity



(OFB) and Claude Bernard University Lyon 1 conducted the study, published in the journal *Molecular Ecology*. The lab conducted a genetic study comparing the genetic profiles of cats living in the wild of the French island and in metropolitan France and domestic cats.

The scientists started a research program in 2008 when a wild cat fox was first caught. Together with the Office of the Environment of Corsica and supported by the Laboratory of Biometry and Evolutionary Biology (LBBE), OFB started the research. The research program's objective was to confirm its existence in the agro-pastoral mythology of Corsica and to clarify its status. They established camera traps for the wild cats between 2011 and 2014 that helped them identify eight individuals with a particular homogeneous phenotype, which they refer to as the wild Corsican phenotype.

The cat fox has unique stripes on its front legs, as well as very dark hind legs, and a russet stomach. The cat also has a dense silky coat that acts as a natural repellant for fleas, ticks, and lice. The inconspicuous feline has long been part of local folklore. Carlu-Antone Cecchini, head of the forest cat mission at the National Hunting and Wildlife Office and a member of OFB, said in 2019 that the cat fox is part of the shepherd mythology that was passed from generation to generation. These stories said that forest cats would attack the udders of their ewes and goats. The discovery of the genetic lineage of cat fox is an essential step towards ensuring proper protection and conservation for the endangered species.

https://www.sciencetimes.com/articles/42872/20230318/meet-corsican-cat-fox-mysterious-feline-prowling-remote-areas-french.htm

THANK YOU TO Mr J RICHMOND FOR SPOTTING THIS.....

ASTRONOMY - The forgotten maths genius who laid the foundations for Isaac Newton

On a cloudy afternoon in England in 1639, 20-year-old Jeremiah Horrocks became the first person to accurately predict the transit of Venus and measure the distance from the Earth to the Sun. Yet today Horrocks has been "almost forgotten" and few are aware of the important contributions he made to the field of astronomy. Due to his untimely death at the age of 22 in 1641, his work was never published in his lifetime and he never gained widespread recognition for his dazzling mathematical achievements.



Although the astronomical observations published by the Italian, Galileo Galilei, in 1809 had proposed that the Earth was not at the centre of the Universe but merely in orbit around the Sun (as Nicolaus Copernicus had also proposed earlier), Galileo could provide no mathematical proof. It was therefore the work of Jeremiah Horrocks that proved, for the first time, that Galileo was right all along. More than that, Horrocks's work also paved the way for Isaac Newton's ground-breaking work on gravity.

Horrocks's work proved that the Earth is not at the centre of the Universe, but orbits around the Sun, refuting contemporary beliefs and laying the foundations for Isaac Newton's ground-breaking work on gravity. Ironically, Newton was born in 1642, the year after Horrocks died.

"Without Horrocks, all the pieces wouldn't have been in place for Newton," said Dr Matt Bothwell, public astronomer at the University of Cambridge. "Yet he has been almost forgotten, except among history of astronomy buffs." Horrocks's great treatise on the transit of Venus was nearly lost for ever. Only a Latin manuscript survived the ravages of the English civil war and the Great Fire of London. Passed from one astronomer to another for 20 years after Horrocks's death, it would not be published until 1662, in an appendage to a Polish astronomer's work. Importantly it came to the notice of Isaac Newton.

In 1687, Newton acknowledged the importance of Horrocks's observations in his *Principia*: Newton wouldn't have been able to complete his work on gravity, if Horrocks hadn't done these observations at the time that he did.

https://www.msn.com/en-gb/news/world/the-forgotten-maths-genius-who-laid-the-foundations-for-isaacnewton/ar-AA180eAx?ocid=msedgdhp&pc=U531&cvid=2aca157f58d44f0fbf9ca21f8765ccaf&ei=15

PHYSICS - Yes, everything in physics is completely made up - but that's the whole point!

A physicist's task is to constantly create equations that keep up with our observations of physical phenomena. There is much that we see going on inside and around us, even to the greatest depths of the Universe, that we simply do not understand and cannot explain – **but we can measure it**.

Take **Dark Matter**, for example: it's hard to convince people it's worth studying something that's invisible, untouchable, and apparently made of something entirely unknown. While the



vast majority of physicists find the evidence for dark matter's existence convincing, some continue to examine alternatives, and the views in the press and the public are significantly more divided. The most common response I get when I talk about dark matter is: *"isn't this just something physicists made up to make the math work out?"* So says Dr Katie Mack, a theoretical astrophysicist exploring a range of questions in cosmology, the study of the universe from beginning to end. The answer to that might surprise you: yes! In fact, everything in physics is made up to make the math work out.

In practice, physics isn't built around ultimate truth, but rather the constant production and refinement of mathematical approximations. It's not just because we'll never have perfect precision in our observations. It's that, fundamentally, the entire point of physics is to create a model universe in math - a set of equations that remain true when we plug in numbers from observations of physical phenomena.

For example, Newton's second law of motion, which says that force equals mass times acceleration, is a mathematical model that tells us that if we measure the force exerted on an object, in appropriate units, we should get the same number as the product of the object's mass and the acceleration it experiences when subject to that force. In Einstein's version of gravity, general relativity, the equations get far more complicated, but the goal of the exercise is the same. There's always a level of abstraction built into the effort because what allows us to make predictions or design new technologies is a set of equations that can be written down and calculated, not a philosophical discussion on the nature of reality.

This level of abstraction is especially apparent in particle physics, because the existence or non-existence of a single particle on a subatomic scale is a rather fuzzy notion. The equations describing the motion of an electron through space don't actually include a particle at all, but rather an abstract mathematical object called a wavefunction that can spread out and interfere with itself. Is it ever true, then, to say that an electron is 'real' when it's in motion? If we believe that electrons are real things, have we just made up the wavefunction to make the math work out? Absolutely – that was, in fact, the whole point. We couldn't get the equations to work if the electron was a solid, isolated particle, so we made up something that wasn't, and then the numbers started making sense.

Dark matter, dark energy, cosmic inflation, black hole singularities, and all the other hypothetical denizens of our current cosmology might seem less real than falling apples or electricity or fluid flow because we don't experience them in our everyday life, but from a physicist's perspective, they're all equally good fodder for mathematical abstraction. While the way we observe something determines what kind of data points we can use, in the end, everything we do is to make the math work out. We certainly hope that all this calculating brings us a better description of reality, but the mind of God is best left to the philosophers; we don't have an equation for that.

https://www.sciencefocus.com/news/everything-physics-made-up/

WORD(S) OF THE MONTH:

CALCULUS (noun, "KALK-yoo-luss")

Calculus is a type of mathematics. Specifically, it is maths that deals with change. It was invented in the 17th century by two separate thinkers. One was German mathematician Gottfried Leibniz. The other was the English scientist Isaac Newton.

There are two branches of calculus. The first is **"differential" calculus**. This is used to determine how much something is changing at a given time or place. For example, it can be used to find how much a curved line is pointing up or down at any spot along it.

The second branch is **"integral" calculus**. This is used find quantities based on their rate of change. For example, it can be used to find the area under a line whose curvature is known.

Calculus is a powerful tool that can describe many things. The orbits of planets around the sun. The total pressure behind a dam where water is rising. How fast diseases spread. Calculus can be applied to most anything that is changing over space or time.