THE ECHO

Spring 2023

Scientific Minds of the 20th Century

Special Section
Pg.14-23

Scientific minds of the 20th Century

14

Articles

Contents

Edit

Within the vast tapestry of
rating quest to traverse unc
The Echo, an embodiment
thral its readers with captiv
limits of the mind.

Science in Doon has seen a
both interest and participat
The Echo simply intends t
unique perspectives into th
ence and technology.

This term's issue explores
ities of science whilst she
unexplained phenomenon
exciting prospect of telepo
the taste of Hershey's choc
opportunity to explore scie
curriculums offer. You mig
of superionic hydride ion c
or find yourself relating to t
known as The Mandela effe
in the Matrix both explore
human biology with artifici
ually training neurons in th
potential. Moreover, this iss
of hazardous microplastics
every inch of marine ecosy

The special section pays h
ers behind humanity's gr
the brilliance and the intrica
pelled them towards thei
From the towering intellec
brilliance of Fleming, we
of these visionaries, dissec
world as we know it.

Finally, I extend my deepe
team of writers, editors, a
efforts in presenting this
dedication and passion ha
cles that will captivate and
vacations. I hope this issue
intellectual journey.

Happy Reading,
Hridayam Tusnial.

torial

f understanding, lies the exhila-
charted territories of knowledge.
of intellectual allure, aims to en-
vating narratives that stretch the

a tremendous growth in terms of
tion in events and activities and
o fuel this interest by providing
he rapidly evolving world of sci-

the limitless futuristic capabil-
dding light into some common
.From the exploration of the
rtation to an interesting take on
colate, each article offers you an
nce more deeply than what your
ht be intrigued by the promise
conductors as an energy source
he mind boggling phenomenon
ect. Biomechanics and Neurons
e an interesting combination of
ality in terms of limbs and man-
e brain and have a huge growth
sue also warns about the danger
s in our oceans that are affecting
stems.

omage to the trailblazing think-
eatest innovations, unearthing
ate thought processes that pro-
ir groundbreaking discoveries.
ct of Einstein to the accidental
traverse the inspiring journeys
cting the ideas that shaped the

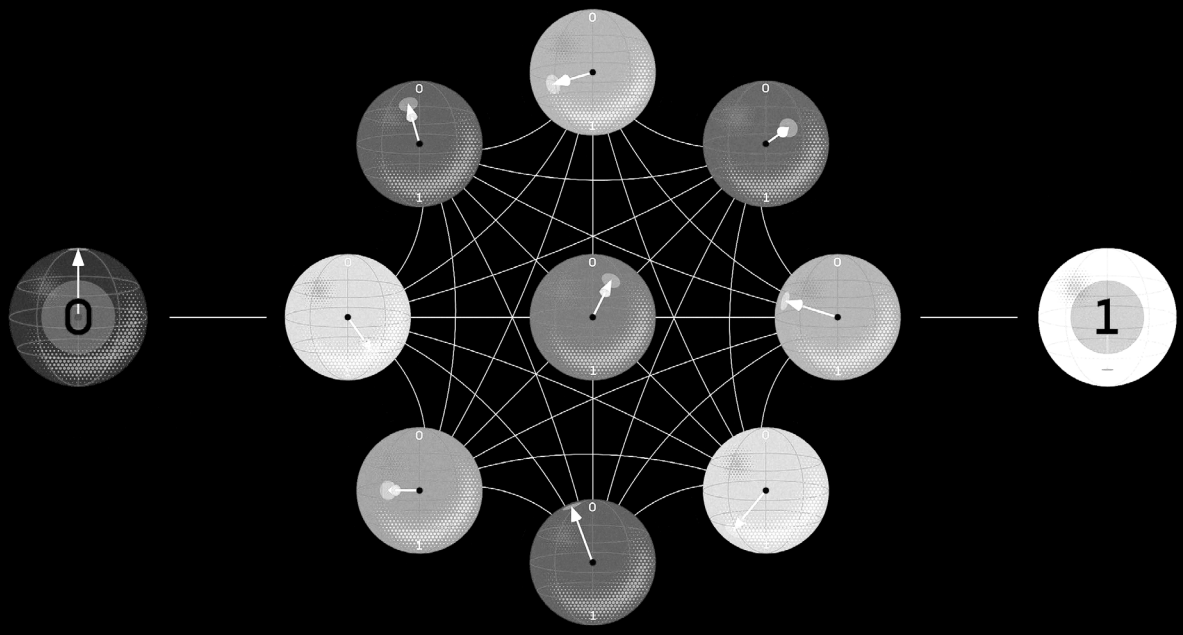
est gratitude to our remarkable
and designers for their tireless
thought-provoking issue. Their
ave shaped a collection of arti-
nourish your mind during these
e acts as a catalyst for your own

Editorial Board

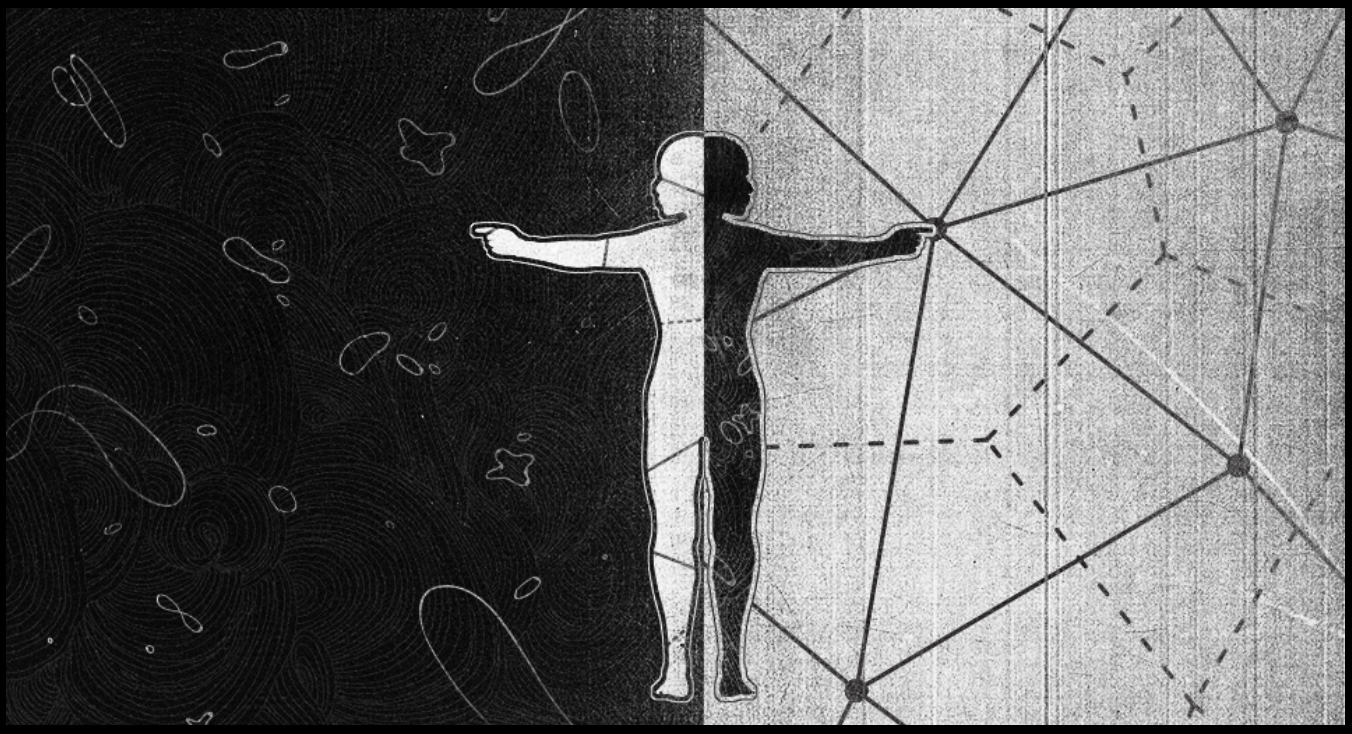
A step closer to teleportation

by Aradhya Jain

You might be thinking, "Hold up, Aradhya. Teleportation isn't real. It's only present in movies and books. What are you talking about?" And you would be right. Humans have not developed teleportation. However, teleportation is something that is possible according to the laws of science. There are essentially two types of teleportation mechanics depicted in movies. The first is "portals" where there exists a hole in space that leads to another place The other type is the teleportation technology shown in star trek, where a person is turned into a beam of light and is reconstructed in another place, through some technology which the movies never explain. I'll provide another example that will be better understood by most people. A portal would be like the giant hole that appeared above New York city in the Chitauri invasion in the first Avengers movie. The other style of teleportation would be similar to what happened to Red Skull at the end of the first Captain America movie. It is quite a coincidence that both of these methods require the opposite ends of the spectrum in science - One involves general relativity, the theory for which Albert Einstein is best known for and the other involves quantum mechanics. Both of these theories are incompatible with each other and yet both give the correct readings. One of the greatest goals of science today is their reconciliation.



The second aforementioned method relies on something called quantum entanglement. In simple terms, quantum entanglement is a form of interaction between two particles and causes their properties (Such as momentum, position, charge, etc) to become linked to each other. The link is not physical, in the same way that two objects attracted to each other via gravity are not physically linked, but the force on them is co-dependant relative to each other. When two particles are entangled with each other, their properties are dependent on each other, regardless of the distance that separates them. This is something that has been experimentally shown for decades but until recently it was thought that this phenomenon was limited to the quantum realm. Now this quantum realm is not the one from sci-fi or marvel. The term quantum realm refers to a scale where



Newton's laws do not produce the correct results when performing calculations. If the particles are at a very big distance from each other, one will only have to observe the properties of one particle to immediately know the properties of the other(Since they are linked together). For example, if there are two electrons, 1 and 2 that are entangled with each other, if 1 is on earth and 2 on pluto, then if we observe a property of 1 known as "spin", we will immediately know the spin of 2, despite the fact that it would take a lot more time for that information to travel from pluto to earth.

To teleport a particle, we have to entangle two particles(A and B) that are at the points where we want to teleport between. Then, we take our particle(C) (We assume all are of the same type, such as all being electrons, or all being protons) and put it inside a detector with A. We then take some measurements of the particles in this box (z) and put the particle B inside the box at the other location. The information from z is then communicated to the other location which chooses an appropriate device based on the information received. The device at the other end causes the properties of particle B to change so that it has the same properties as C. However, due to something known as the pauli exclusion principle, no two objects can have the same quantum state, and thus the properties of C have changed. C now has a different set of properties, and thus for all intents and purposes B is now C since it has the same properties as C.

Even apart from teleporting objects, quantum teleportation is something that can be used for many other things. For example, it can be used in quantum computers, which are the next generation of computers to prevent errors during transmission of information.

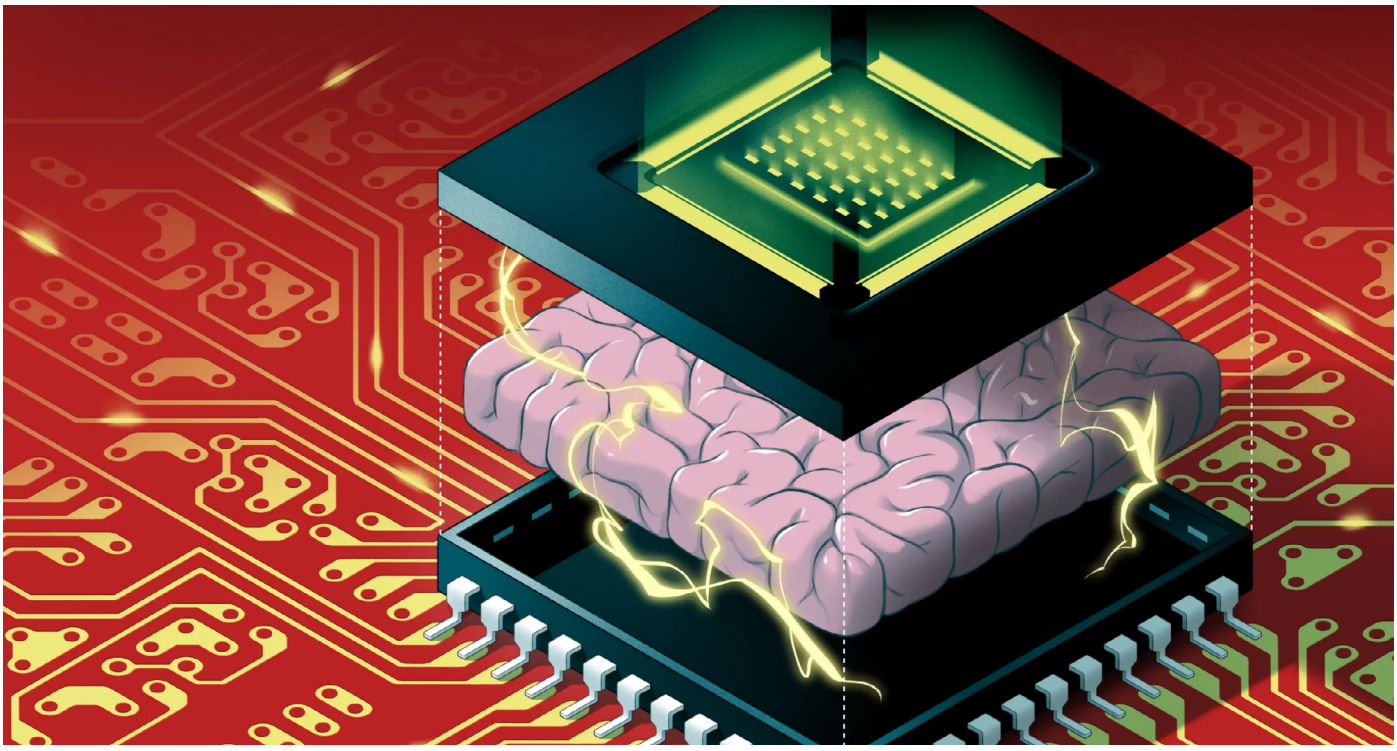
We can thus infer that to teleport an object, three things are required. First is to to entangle a large object(Such as if you want to teleport a laptop, you have to entangle it with lots of other atoms on the other end), then to be able to maintain that entanglement for a long period of time and finally to be able to reconstruct the object from the information. Recently a huge breakthrough has occurred on the first of these three, where scientists managed to have a macroscopic object achieve and maintain quantum entanglement. A team of researchers from the University of Vienna and the Austrian Academy of Sciences have recently managed to entangle a small aluminium drum, which is a macroscopic object that is visible to the naked eye. This achievement is a significant step forward in the field of quantum mechanics, as it demonstrates that entanglement is not limited to the microscopic world. Think of each atom as a coin. When two spinning coins collide with each other, they usually stop spinning and enter defined states as heads or tails. But there is a third option, where the spin frequency of both coins is just right to let them mesh and spin with each other. That is one way to think of how delicate entanglement is. Now imagine doing it for a hundred coins in a grid, a thousand, a million, and so on. If you don't do it correctly, or the frequency is off by just a tiny amount, the whole thing will collapse. While this advancement alone would not lead to teleportation suddenly being developed, it is a significant step forward in the development of teleportation - of the same level as the development of the engine was for a car. Perhaps one day in the future humans will send objects to the moon through teleportation as easily as we today travel to the next town over.

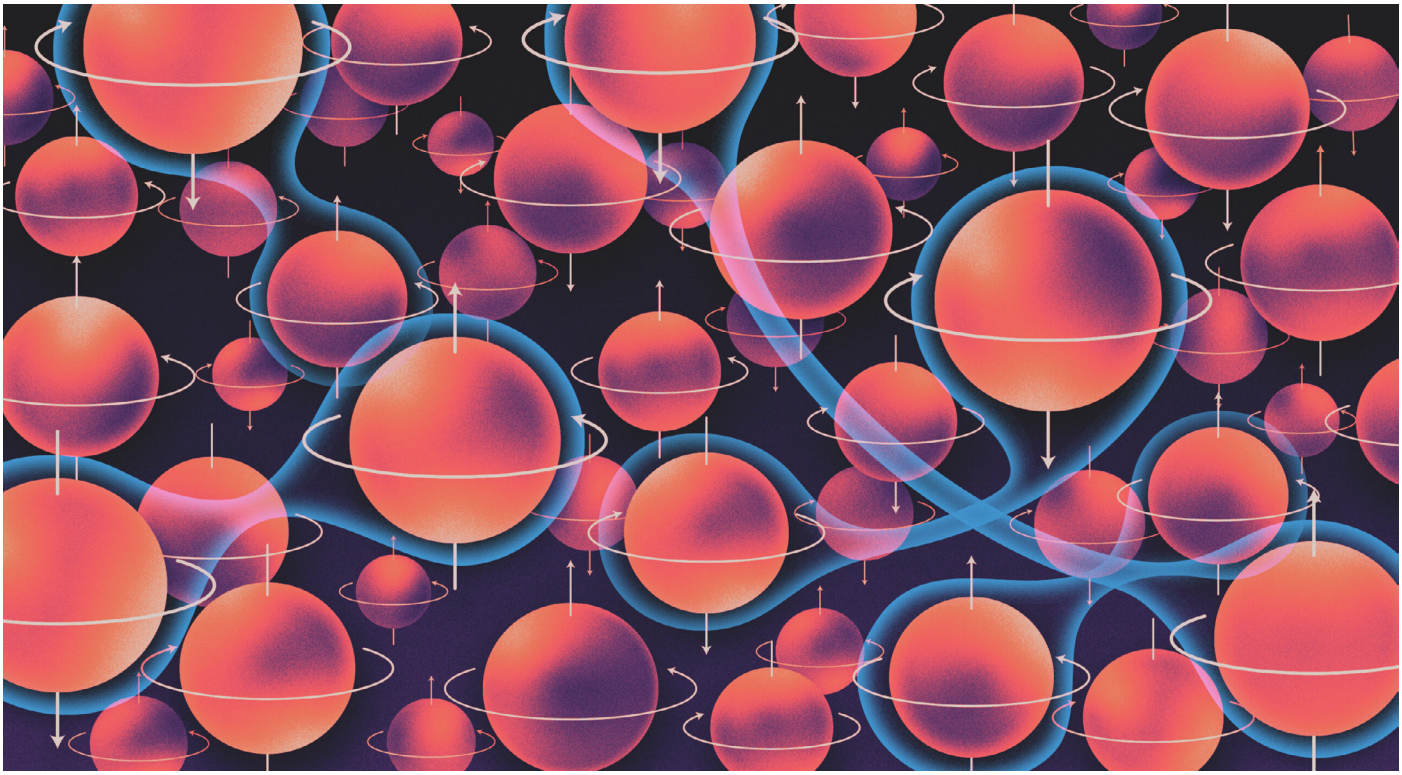
PHOTONIC COMPUTERS

by Shrikritt Jajoo

From vacuum tubes to quantum computers, humanity has certainly come a long way. The humble transistor has been at the forefront of the digital age, facilitating the high-speed computing we experience today. Almost all the things we enjoy today wouldn't have been possible without the transistor, and the major breakthroughs that it facilitated, be it video games or the streaming of quality content. You might have heard of many types of computers, be it electrical, mechanical or quantum but now we are approaching another significant advancement. Merging many of the previous generations' benefits, incorporating great speeds and efficiency, photonic computers is really the future.

First, let me explain the basics of a normal computer. The brain of the computer, the only part we're concerned with, is mainly made up of transistors, in essence, a switch, which operates using electrons (the particle photons are going to replace). These transistors are then grouped together in various ways to form logic gates, and using those logic gates the computer performs several different functions that enable you to control what you do. Right in the brain of the computer, where our normal computers use electrons as their carrier, photonic computers use photons. This leads to a cosmic increase in the speed of signal transfer and all the while uses less energy. Using photons as carriers also helps in incorporating solar energy directly into the working of the computer without having to convert it into electricity, thereby increasing efficiency. These were just some benefits compared to classical computers. In fact, photonic computers are capable of beating even quantum computers because photons are





much more stable and can also hold a variety of positions, using constructive and destructive wave interference to compute multiple strings all at once, making them the computers of the future. Photonic chips of course have many more advantages but this is a simplified overview of how it works.

Many might be familiar with, or have had at least heard of, Moore's Law. It is not really a law per se but actually a trend since the invention of computer chips that the number of transistors in a dense integrated circuit doubles about every two years, and the development of microprocessor technology has followed. From centimetres-long vacuoles we have now progressed to 2-nanometer transistors, the growth has been rapid and our transistors have started to approach the size of atoms. Not to make it more complicated, but here a quantum effect comes into play. Quantum tunnelling is the phenomenon where small particles can sometimes teleport onto the other side of the barrier. This increases as the thickness of the barrier decreases and as we go smaller this will heavily hinder the way our computers process signals. Photonic computers provide the solution to this, offering increased speed and parallel processing capabilities to boost the level of processing we experience today. We have finally beaten Moore's law.

It's great that Moore's law and microchips are here, but what can these progeny of our humble electronic computers achieve in the future? Although in their development phase, these computers still hold huge potential to break into almost every market, be it supercomputing, particle simulation, or just our daily use. The future of these new computers is hard to predict. They have a lot of potential but, again, so did quantum computers. I believe the key to becoming big lies in being small and simple. People are able to better work with something if they understand it or at least if they think they can understand it. Photonic chips are far easier to produce than the supercooled chambers required for quantum computing, and they also have increased capacities and benefits compared to classical computers. I believe that all of these factors combined give it the edge it needs to survive today's rapidly changing world.

Photonic, Electronic, Mechanical, Quantum, computers can be made using almost anything that physics can describe from the simplest substances like water to randomly jumping qubits. These machines are the backbone of today's world and the the foundation on which everything today is built, but the sheer amount of change in the computing industry might be overwhelming given the number of new forms of computing that are introduced every few years. Nonetheless, photonic computers might just be the biggest thing since transistors, and they're definitely here to stay.

MICROPLASTICS

by Aaron Fareed

"Marine plastic pollution has impacted at least 267 species worldwide, including 86% of all sea turtle species, 44% of all seabird species and 43% of all marine mammal species. The impacts include fatalities as a result of ingestion, starvation, suffocation, infection, drowning, and entanglement." (Source: Cleanwater.org)

Microplastics, tiny pieces of plastic less than 5 millimeters in size, have unleashed a chain of devastation on marine life and ecosystems around the world. According to a report published by UNESCO, there are between 50 to 75 Trillion pieces of microplastics in the world's oceans. These microplastics are not only found in deep ocean trenches, but are also present in the seafood served at restaurants and at home.

Microplastics have been affecting marine life for over half a century. Earliest reports date back to the 1960s, where researchers at Plymouth University observed the presence of "plastic" particles and debris in the bodies of marine life - from the smallest plankton to the largest whales.

While the finger-pointing exercise continues at diplomatic levels, we must step up and take responsibility for this catastrophe. Activities such as indiscriminate littering, poor waste disposal methods, uncontrolled plastic production and usage of microbeads in personal care products like gels, scrubs and toothpaste have engendered the plastic ocean dilemma.

World Wildlife Fund (WWF) predicts that by 2050, there will be more microplastic than fish in the sea. Concentration levels of microplastic in some parts of the ocean are actually greater than the concentration of plankton, which is a critical food source for many marine animals.

This also impacts the ingestion mechanism of marine life. Marine animals mistake microplastics for food and ingest them. They are unsuspecting victims feeding on slow poison called plastic, which leads to their eventual destruction. On entering their bodies, microplastics cause blockages in the digestive system and reduce growth and reproduction rates. Marine animals are also exposed to toxic chemicals that are present in the plastic, such as Phthalates and Bisphenol A (BPA). These chemicals are "endocrine disruptors," which means they can interfere with the body's hormonal system resulting in a range of health issues, such as reduced fertility.

In the bulkier and larger animals, microplastics accumulate in the tissues causing inflammation and bio-accumulation. Plastic collects in the tissues of marine animals over a long period of time leading to a build-up of chemicals which ends up causing long-term health problems like Malnutrition and Reduced Lifespan. This poses a danger to a large number of species, leading to their eventual extinction. Sooner than later, instead of fish, plastic bags would be hooked onto fishing lines, and, instead of coral reefs, we will see the formation of plastic islands.

However, a slew of measures have been taken in recent times to mitigate the harmful impact of microplastics. We are also witnessing improved waste management techniques and a shift to biodegradable materials such as paper and wood. There is also a widespread adoption of paper plates, straws and bags instead of plastic.

"Proper" disposal of plastic waste will help prevent microplastics from entering the sea. Recycling will reduce the increasing amount of plastic waste in landfills or in the environment. This will help lower the demand for new plastic products. Educating the public about the hazards of microplastics in the ocean will encourage behavioral changes. This will reduce plastic consumption and will make people more mindful of their surroundings.

Social media has also taken the initiative to spread awareness of this predicament. Famous content creators such as Mr.Beast, National Geographic, Boyan Slat, Lauren Singer, and others have maximized the use of their platforms by creating documentaries like 'Plastic Ocean,' environmental campaigns like Green Space and World Wide Fund have too launched campaigns educating and encouraging the community to put their best foot forward in alleviating the situation. Technology has had a heavy contribution in clearing of microplastic from the oceans. Famous inventions like Mr.Trash Wheel, The Trash Skimmer, The SeaBin 5, and Autonomous underwater vehicles(AUVs) have effectively cleaned approximately 200,000 kilograms of ocean plastic. Drones can be used to monitor and map plastic waste in the ocean, while at the same time helping in identifying areas with dense concentrations of plastic waste.

AUVs assist in collecting samples for analysis for researchers to examine the magnitude of the situation. They are extremely flexible as they have the ability to operate in a variety of ocean conditions and are capable of covering large areas of the ocean quickly and productively. They are able to operate for a long period of time, which makes them ideal for long-term ocean-up efforts.

Inventions of biodegradable products like, biodegradable plastic bags, food packaging, fishing gear, and products are small steps to a huge change. These products are made of a variety of plant-based materials, such as seaweed, cornstarch, cellulose, vegetable oils, and fats. When decomposing these products break down into natural components such as carbon dioxide, water, and biomass when exposed to natural environmental conditions, such as sunlight, heat, or moisture.

We don't need one person doing the job perfectly, we need millions doing it imperfectly. By uniting together, and religiously following the procedure, we all can confidently live in a future where the future generation gets to row the boat on smooth waters, and where the bummock of the iceberg is submerged in ice and not plastic.

BIOMECHANICS

by Shaurya Luthra

Source: Cambridge

During the past 2 decades, exciting new developments have occurred in neurology understanding of human neurons responsible for the control of movements.

Before venturing further about the situation around biomechanics, let's first overview our understanding of the subject. Firstly, an example of biomechanics in the computing sense is bionic limbs. When a person loses a limb, the brain's map of the body (known as the "body schema") can become distorted, causing the person to experience sensations in the missing limb or even feel as though the limb is still there. This phenomenon is also known as the 'phantom limb', and itcan be problematic for people who use prosthetic limbs, as the brain may not immediately recognize the prosthetic as a part of the body.

However, with advances in technology and neuroscience, it's now possible to develop prosthetic limbs that can communicate with the brain and be controlled using neural signals. These devices use sensors to detect signals from the remaining nerves in what is left of the limb.. These signalsare then interpreted by a computer and used to control the movements of the prosthetic limb. These work by interpreting the signals which have been detected and using a chip inside them to understand what is is that needs to be moved.

Over time, with repeated use and training, the brain can learn to incorporate the prosthetic limb into the body schema, effectively treating it as if it were a natural part of the body. This process is known as neuroplasticity, and it allows people with prosthetic limbs to perform

“

By analysing factors such as joint angles, muscle forces, and energy expenditure during various activities, engineers can design prosthetic limbs that optimise performance and reduce the risk of injur

complex tasks such as grasping objects and walking with relative ease. In some cases, researchers have even been able to create prosthetic limbs that can provide sensory feedback to the brain, allowing the user to feel sensations such as pressure, temperature, and texture. This can further enhance the user's ability to control the prosthetic limb and improve their overall quality of life. These signals are first created in the cell, particularly in the cell membrane. These signals contain messages which travel in the body distributing the messages to other limbs for the area to function. Secondly, the signals are then converted to chemicals but only when passed through a neuron. In prosthetic limbs the essential component without which these limbs won't work is the control of electric signals sent from the brain to the prosthetic limbs. The robotic neuroprosthetic system works by implanting 2D arrays of electrodes in the area of the brain that control/process the movement and the sense of feel or touch from a natural limb. For context, arrays are storage areas that contain information for later usage. They are similar to the memory chips in laptops, but much simpler. and 2D arrays store data in both rows and columns which allows them to simultaneously execute various pieces of information.

The way biomechanics links to prosthetic limbs is by playing an important role in the design and development of prosthetic limbs. As shown before through examples, Biomechanics is the study of the mechanical properties of biological systems, including the human body, and how they interact with their environment. By applying principles of biomechanics to the design of prosthetic limbs, engineers can create devices that are more efficient, comfortable, and functional, since Prosthetic limbs aim to mimic the natural movement and function of the missing limb as closely as possible. This requires an understanding of the biomechanics of the limb being replaced, as well as the biomechanics of the remaining limb and the body as a whole.

By analysing factors such as joint angles, muscle forces, and energy expenditure during various activities, engineers can design prosthetic limbs that optimise performance and reduce the risk of injury. For example, in lower-limb prosthetics, the design of the prosthetic foot must take into account factors such as the angle of the ankle and the amount of force required to push off during walking or running. By using materials that mimic the properties of natural muscle and bone, prosthetic limbs can also be made more comfortable and durable.

Our body works with prosthetic limbs through a process called neural integration. This process involves the interaction between the prosthetic limb and the nervous system, which includes the brain, spinal cord, and peripheral nerves. When a person uses a prosthetic limb, sensors in the device detect signals from the remaining nerves in the residual limb, which are then transmitted to a computer that interprets the signals and uses them to control the movements of the prosthetic limb. This process is called myoelectric control, and it allows the user to perform a variety of tasks, such as grasping objects, walking, or running. As mentioned earlier, with repeated use, the body can integrate the limb into the body schema. This allows the user to perceive the prosthetic limb as part of their body and control it more intuitively. In addition to myoelectric control, some advanced prosthetic limbs also provide sensory feedback to the user. This is achieved through the use of sensors that detect pressure, temperature, and other sensations in the prosthetic limb, which are then transmitted to the brain via nerve stimulation. This can help the user to feel more connected to the prosthetic limb and perform tasks with greater accuracy and precision. It is truly spectacular how a human body is capable of incredibly fast communication.

At the moment, the advancements made in the field of biomechanics used in prosthetic limbs are spectacular and it's really amazing how far humanity has reached. However, there is always scope for improvement such as improved control - which can be done by better connection from the brain and durability. Affordability is also a major concern since these limbs are quite expensive and not accessible by all. The safe and speedy development of these limbs is a ray of hope for disabled people.

Neurons in the Matrix

by Kai Kubo

Moravec's Paradox states that it is easy for computers to do things that humans find challenging while on the other hand, it is much more difficult to train computers to do things humans find easy. From the dawn of human technology, the concept of AI (artificial intelligence) has fascinated us to innovative extents. From 3D printing to Alexa, to even DALL-E, the industry of mechanizing AI has seen a gradual increase in its usage and popularity in our modern world. Yet, although AI may have a higher capability of calculating and comprehending better than a human, it still does not have the instincts and flexibility of a human. You see, we as contemporary beings have neurological senses of vision, smell, physical contact, and more, all connected to what we experience, and how we express our emotions. While machines are nothing more than a product of trained data fed to them. A recent discovery in Australia might just have changed that. A small firm, by the name of Cortical Labs, has produced lab-grown brain cells to master pong in just minutes, compared to what might have been days for conventional AI. Inevitably, the question arises, how did they fabricate an entirely new species of these apparently, "sentient" beings?

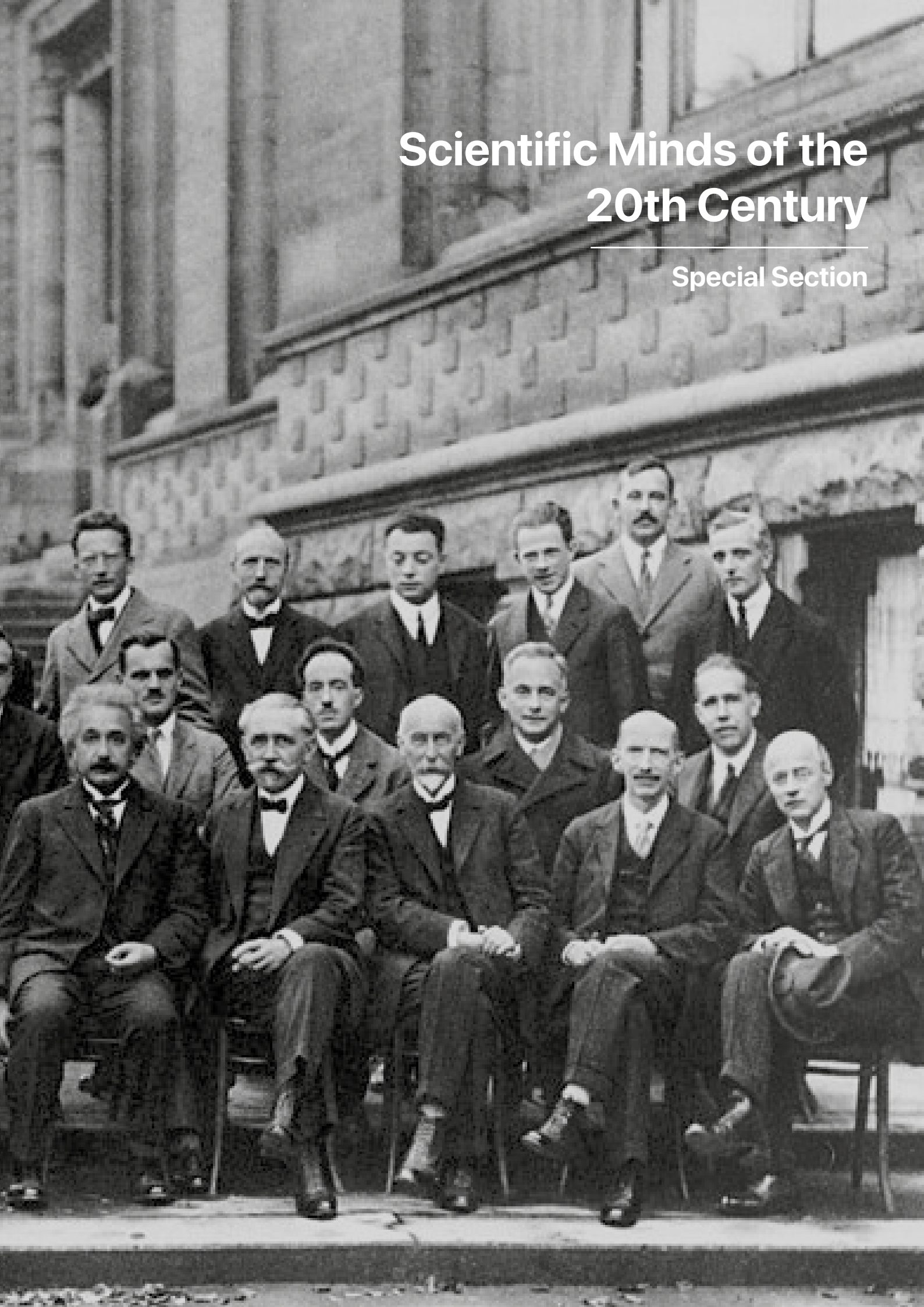
For most of these brain cells, life first begins at circumcision. Baby foreskin cells are cryogenically frozen in liquid nitrogen and commonly sold to labs. At the labs, the foreskin cells are infected with a virus that transforms them into stem cells. If these stem cells are placed in a regulated environment, they can grow into mature neuron cells in just a couple of weeks, interacting with each other through chemical signals, much like a grossly simplified version of our brain. They were then connected to the electrodes on an electric chip, that simulated the classic 70s game, Pong, on a computer. They called their creation "DishBrain". The idea of the scientific team was to examine the behavior of neurons gaining sensory inputs from their environment, and processing it spontaneously to figure out their outputs. It's similar to how the human body uses electrical impulses as messages sent throughout the body.

With this hypothesis, DishBrain was able to gain information on the game through electrical stimulations. Stimulations sent out were used to recognize the game's conditions, and stimulations that came back were used to perform the actions that made the paddle move in accordance with the ball's direction. But how do we know if it is aware of its mistakes, even though it hasn't been taught the rules? The simple solution was discipline. In terms of conditioning, punishment makes the behavior less likely to happen again. You see, DishBrain likes to search for patterns just like our brains. It is always trying to draw patterns from its surroundings. Therefore, if DishBrain is able to return the ball, it provides full stimulation that allows the neurons to obtain authority over the game. But, if DishBrain does not hit the ball back, then it gets discerned by a random stimulation that it can't make sense of. This sort of reward & punishment system works by allowing DishBrain to adapt to its conditions, by reducing the "undesirable" behavior of missing the ball and the more desirable situation of being provided with predictable stimulations when hitting the ball. Through this disciplinary course of measures as somewhat of a live feedback loop, DishBrain was able to improve its gameplay and get significantly better at its performance, allowing it to conduct more rallies and get aced less often.

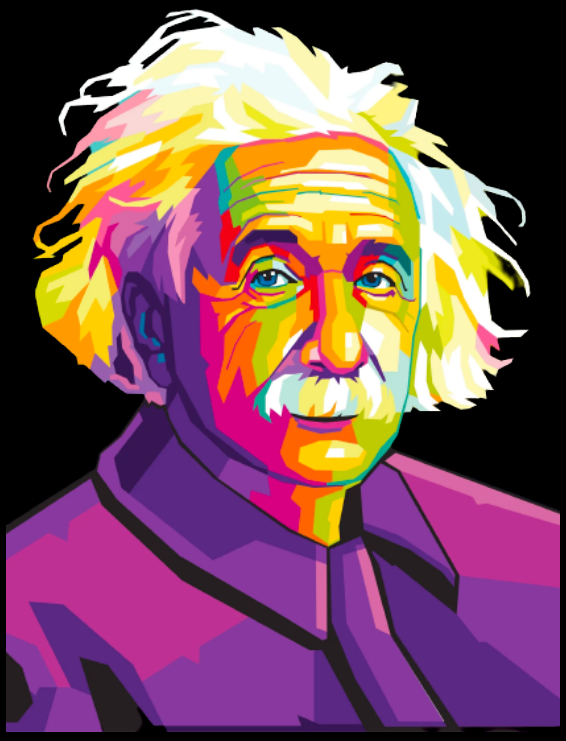
Nonetheless, why are these scientists making brain cells play video games in the first place? From the research, one of the most impressive pieces of information the scientists gathered was that it took an AI 5000 rallies to learn what the DishBrain could do in 10 to 15 rallies. By highlighting this comparison, scientists were able to foresee the major potential this new development could provide for the future. Currently, the only issue that the company is facing to work with is the conflict of engagement within bioethics. One of the leading members Dr. Kagan stated that they are trying to prevent a conscious brain from being created. Moreover, the company also states that with its advancements, it hopes to support test treatments for conditions like epilepsy and dementia while also possibly evolving the DishBrain onto the internet for people to program their own tasks.

Scientific Minds of the 20th Century

Special Section



The Theory of Relativity

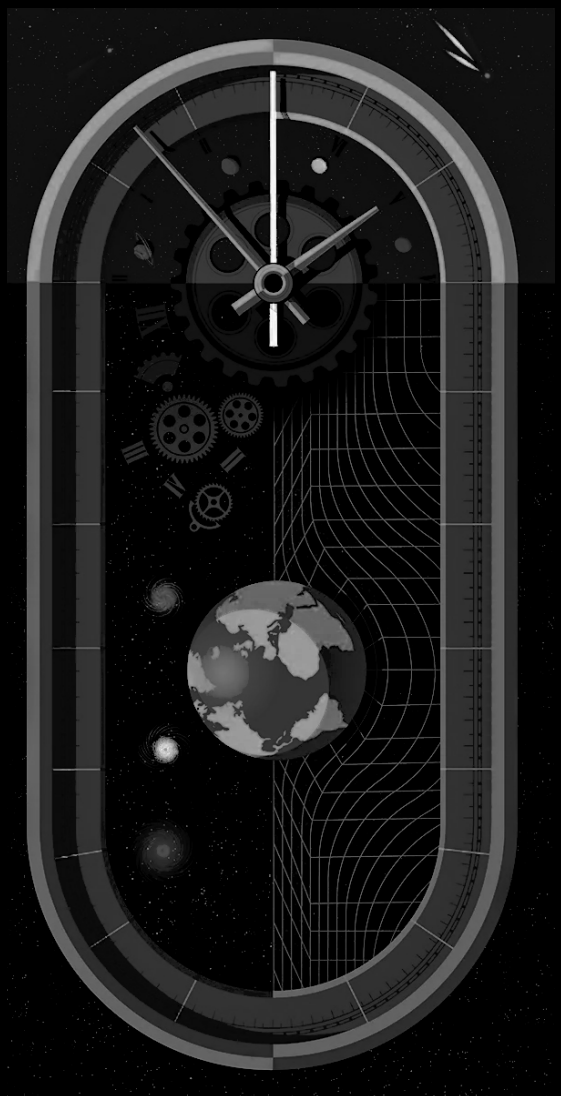


Albert Einstein

The premise that Einstein used to build his theory of relativity was that the rules of physics are the same for all observers moving at the same constant speed relative to each other. This contradicted the widely held belief at the time that there was an absolute frame of reference against which all motion could be measured.

Key points:

- Einstein's thought of man falling down a roof, he referred as "The happiest thought of life"
- He raced to discover the correct mathematical formulas for his theory before a rival, mathematician David Hilbert, could do so first.
- Einstein simultaneously struggled during this theory's development, as he went through a divorce from his first wife and a separation from his sons while he courted a cousin whom he would later marry



A man falling down the roof, that was the inception of Einstein's most ground-breaking theory of relativity. Most of you must have heard of it and many of you might also be studying it, but have you ever thought about how it came to be? How might you have stumbled across it? If we really even need it?

Well before the theory of relativity, it was believed that there existed an absolute quantity of motion called absolute rest. Its notion was against the method in which we measured how fast anything travelled compared to absolute rest. So how would you define this foreign phenomena? Einstein soon refined his thought experiment so that the falling man was in an enclosed chamber, such as an elevator, in free fall. In the chamber, he would feel weightless. Any objects he dropped would float alongside him. There would be no way for him to tell if the chamber was falling at an accelerated rate. There was no way to make a distinction between the effects of gravity and the effects of being accelerated. Here is where a major paradigm shift occurred due to the thought experiment of Einstein. He talked about some reference point that is itself stationary and at rest could be thought of as absolute rest, perhaps the vast emptiness of space. Einstein then imagined that the man was in the same chamber way out in space, where there was no perceptible gravity, and a constant force was pulling the chamber up at an accelerated rate. He would feel his feet pressed to the floor. If he dropped an object, it would fall to the floor at an accelerated rate, just as if he stood on Earth. Nothing can be at rest because to define something being at absolute rest we would have to compare it against another quantity of motion inducing ambiguity of which quantity is at rest. Essentially, he reasoned, for anyone to define absolute rest they must first define another absolute quantity of motion for which they must first define absolute rest, it was an endless loop of no absolute quantity and thus he concluded, no absolute quantity of motion exists.

Combustion

Key points:

- Phlogiston theory was first proposed by Johann Joachim
- Antoine Lavoisier's experiment failed to agree with the same
- Scientists opposed the findings, continuing to believe the Phlogiston theory.
- Further worked on proof for his discovery.
- Invited all to witness the same experiment through which he backed his theory.

Hydrocarbon + Oxygen ->
Heat & Energy + Water + Carbon Dioxide

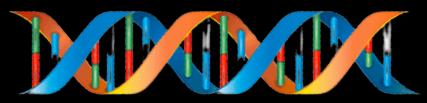
From disproving the existence of phlogiston, to getting executed for tax fraud, Antoine Lavoisier was a very unique individual that contributed a lot to our current knowledge of chemistry, with his most prominent one being the discovery of oxygen. In the early 17th century, the Phlogiston Theory was first proposed by Johann Joachim Becher, later worked on by Antoine lavoisier. The theory stated that all flammable objects contained a substance called phlogiston, which was released when the object underwent combustion. Despite this, an experiment conducted by Lavoisier where he burned phosphorus and sulphur, showed that they gained weight by combining with air. Intrigued by this finding, he set up yet another experiment. Lavoisier filled a glass dome called a bell jar with oxygen and introduced hydrogen and a spark simultaneously appeared. This formed water droplets on the inside of the bell jar.

He was even able to reasonably predict the amount of water that would be produced from the reaction. However, scientists continued to doubt Lavoisier's conclusions that the elements were combining to create water, and instead said that water was part of the phlogiston combustion process that was occurring when the air ignited. In order to further prove his point, Lavoisier came up with the decision to separate water without combustion or fire. By flowing water through an iron tube that was red hot, the oxygen in the water combined with the iron to make iron oxide, and hydrogen gas was produced and escaped out the other end of the tube.

Now he had proof that water could be broken down into more components. Although many still doubted his results, he began to invite chemists, scientists, and opponents alike into his lab to conduct the experiments for them, consistently breaking down and synthesising water as the final product in two separate, unrelated reactions.

Antoine Lavoisier

DNA: Double Helix Structure



Key Points

- Around 1943 Oswald Avery discovered what he had already suspected: the DNA molecule carried the blueprint of life yet no one knew how.
- Chargaff investigates further about the structure of the DNA molecule and finds out the purines and pyramidines are equal in amount(now known as chargaff's rule)
- James watson and Francis Crick were close to finally discovering it

During the years of his boyhood interest in bird-watching had matured into a serious desire to learn genetics, later he made a significant impact in the field with the help from various scientists such as Rosalind Franklin who, using a technique called X-ray crystallography, revealed the helical shape of the DNA molecule. Discovered on the basis of Franklin's unpublished experimental evidence, which had reached them through irregular routes. Watson and Crick realised that DNA was made up of two chains of nucleotide pairs that encode the genetic information for all living things. The stunning find made possible the era of "new biology" that led to the biotechnology industry and, most recently, the deciphering of the human genetic blueprint.
Around 1943 Oswald Avery proved what had been suspected: that DNA, a nucleic acid, carries genetic information, but yet no one knew how it worked. By the early 1950s, at least two groups were hot on the trail. Crick, a British graduate student, and Watson, an American research fellow, were in the hunt at Cambridge University. The discovery in 1953 of the double helix, the twisted-ladder structure of deoxyribonucleic acid (DNA), by James Watson and Francis Crick marked a milestone in the history of science and gave rise to modern molecular biology, which is largely concerned with understanding how genes control the chemical processes within cells. In short order, their discovery yielded ground-breaking insights into the genetic code and protein synthesis.Watson and Crick were not the discoverers of DNA, but rather the first scientists to formulate an accurate description of this molecule's complex, double-helical structure. Moreover, Watson and Crick's work was directly dependent on the research of numerous scientists before them.

James Watson

James Clerk Maxwell: T

Most of us have studied about light being a part of electr
waves in our physics class, and while we do know the
between them now, have we ever noticed that how this o
came into being? How did a scientist even fathom, dec
that light could be a part of the electromagnetic spect
included X rays, Gamma rays etc...

James Maxwell pondered on this topic and his
were based on a theory on electricity and magnetism
formulated himself and were known as Maxwell's equat
lecturing about electricity and magnetism, at the King
London, he came across the relation and worked on it
considering it as a mere coincidence, calculating that
of propagation of an electromagnetic field is approxima
the speed of light. He proposed that the phenomenon
therefore an electromagnetic phenomenon.

Maxwell had studied and commented on electricity and
as early as 1855 when his paper "On Faraday's lines of
read to the Cambridge Philosophical Society. The paper

Wilson Greatbatch

Artificial cardiac pacemaker

Key Points

- Wilson worked for the next two years to refine a design of a unit that could be implanted in the body to maintain a pulse rhythm for long periods.
- At first, Greatbatch realised that he could innovate a creation that replaced the at-the-time bulky, painful pacemaker machines hospitals were using at the time.
- Patients with so-called "heart block" were suffering blackouts, dizziness, and often death because their hearts' electrical impulses could not properly function.

By running electrodes directly from his new machine into the muscle tissue of a heart sample, Greatbatch discovered that his artificial pacemaker could keep a patient's heart on track using an electrocardiogram indefinitely.. First, the device was tested on dogs, which after some design improvements, was made ready for human testing. In 1960, they implanted a pacemaker into a 77-year-old man, who lived for 10 months after the surgery. In that year, they implanted pacemakers into nine other patients, several of whom lived for more than 20 years after the implant. In the 1970s, he went on to develop a corrosion-free lithium battery so that pacemakers could run for a continuous 10 years instead of the previous 2-year lifespan. Chardack and Greatbatch's design was the first implanted pacemaker to be commercially produced. The pacemaker utilises small electrical impulses that are sent via electrodes to jump-start a bradycardia affected heart. It achieves this by using electrodes implanted on the thin muscled lining of the heart.

Their are also wireless pacemakers that are available, which are situated inside the right ventricle of the heart and do not use any cords. The fundamental benefit of a leadless pacemaker is that it eliminates various issues associated with transvenous pacemakers and leads, including pocket infections, hematoma, lead dislodgment, and lead fracture. Because there is no chest incision or visible pacemaker pocket, the leadless pacemaker is very appealing cosmetically.

The Spectrum

romagnetic
similarities
bservation
ades back,
trum which

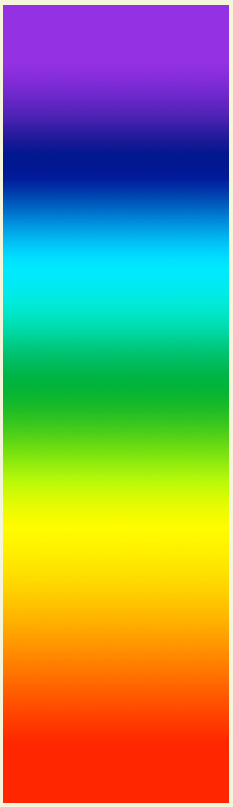
predictions
n which he
ions. While
g's college,
instead of
the speed
tely that of
n of light is

magnetism
force" was
presented

a simplified model of Faraday's work and how electricity and magnetism are related. He reduced all of the current knowledge into a linked set of differential equations with 20 equations in 20 variables. This work was later published as "On Physical Lines of Force" in March 1861.

In 1862 on discovering that the speed of propagation of an electromagnetic field is approximately that of the speed of light, he worked on the problem further, Maxwell showed that the equations predict the existence of waves of oscillating electric and magnetic fields that travel through empty space at a speed that could be predicted from simple electrical experiments; using the data available at the time, Maxwell obtained a velocity of 310,740,000 metres per second (1.0195×109 ft/s).In his 1865 paper "A Dynamical Theory of the Electromagnetic Field"

The fact is still disputable as to why Maxwell never demonstrated his research in order to provide evidence, although it was later proved by Heinrich Hertz, 8 years after his death.



The Spectrum

Penicillin

Alexander Fleming

Often described as a careless lab technician, Fleming returned from a two-week vacation to find that a mould had developed on an accidentally contaminated staphylococcus culture plate. Upon analysis of the mould, he observed that the culture hindered the growth of staphylococci. He quickly realised that the mould was producing a chemical that could kill bacteria as a form of self-defence. He named the substance penicillin.

Disadvan

1.Allergic reactions: One of the major disadvantages of penicillin is the potential for allergic reactions. Some individuals may develop an allergic response to penicillin, ranging from mild skin rashes to severe allergic reactions such as anaphylaxis, a life-threatening condition. Allergic reactions to penicillin are relatively common, occurring in about 1-10% of individuals. This can pose a challenge in clinical practice as it restricts the use of penicillin in patients with known or suspected penicillin allergies. In such cases, alternative antibiotics or desensitization protocols may be necessary, leading to increased costs and potentially suboptimal treatment outcomes.

2.**Res**
teria
terac
emer
wides
use c
opme
resist
acqui
teria.
effec
requi

Development

Long before the development of penicillin, several disinfectants prepared with metal ions poisonous to bacteria, such as mercury or copper, as well as arsenicals and sulphonamides, medications created by chemical tinkering with synthetic colours, were in use.These were neither as effective as penicillin and did more harm than good leading for there to be a need for a new anti-bacteria. Even though this was made by accident it changed the course of medicine altogether. Fleming was intrigued by the accidental observation and investigated the mould further, discovering that it was a strain of Penicillium notatum. He then began experimenting with the mould, discovering that it produced a material with strong antibacterial qualities. This chemical was given the name penicillin by him. However for it to be made available for the betterment of the common man, further testing was required,which was carried out by other scientists. Ten years later, in 1937, Howard Florey and Ernst Chain discovered Fleming's research while studying microbes and the compounds they created. They then put together a group of scientists to focus completely on the "Penicillin Project." The project's complexity, disagreements, and scientific difficulties made it extremely difficult for the researchers to separate penicillin from its original mould. However, their process was inadequate as it required an unnecessarily large amount of resources and time. Later through further testing, the recycling of penicillin was discovered and then mass production was possible and the medicine could move onto further stages of distribution.

tages

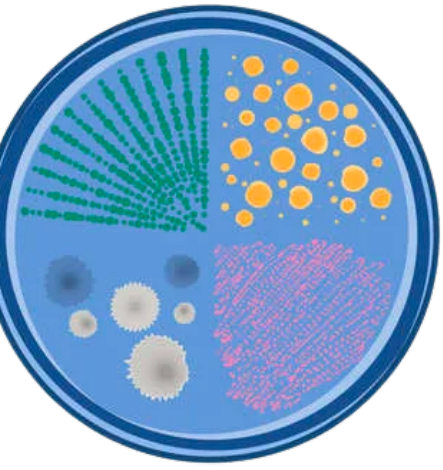
sistance development: Over time, bac- have developed mechanisms to coun- t the effects of penicillin, leading to the gence of antibiotic-resistant strains. The spread and sometimes inappropriate of penicillin has contributed to the devel- ent of resistance. Bacteria can acquire tance through genetic mutations or by iring resistance genes from other bac- This resistance can render penicillin in- tive against certain bacterial infections, ring the use of alternative antibiotics.

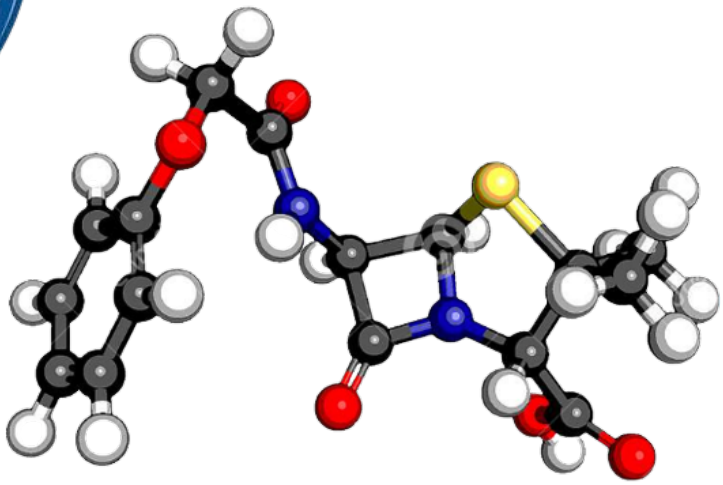
Advantages

1.Broad-spectrum activity: Penicillin demonstrates effectiveness against a wide range of bacteria, including gram-positive cocci, streptococci, and pneumococci. It is particularly effective against infections caused by organisms such as Staphylococcus and Streptococcus, which are common pathogens responsible for various infections, including respiratory tract infections, skin and soft tissue infections, and urinary tract infections.

2.High efficacy: Penicillin is known for its potent bactericidal activity, meaning it kills bacteria rather than simply inhibiting their growth. This mechanism of action makes penicillin highly effective in eradicating bacterial infections. It works by interfering with the formation of the bacterial cell wall, leading to the rupture and death of the bacterial cells.

3.Low toxicity and minimal side effects: Penicillin is generally well-tolerated and has a low toxicity profile. It has been extensively used for decades, and its safety record is well-established. Penicillin rarely causes severe adverse effects when used appropriately and under medical supervision. While some individuals may experience mild side effects like gastrointestinal disturbances or allergic reactions, such reactions are relatively infrequent. This favorable safety profile allows for the administration of penicillin to a broad range of patients, including children, pregnant women, and the elderly, with minimal concern for major complications.

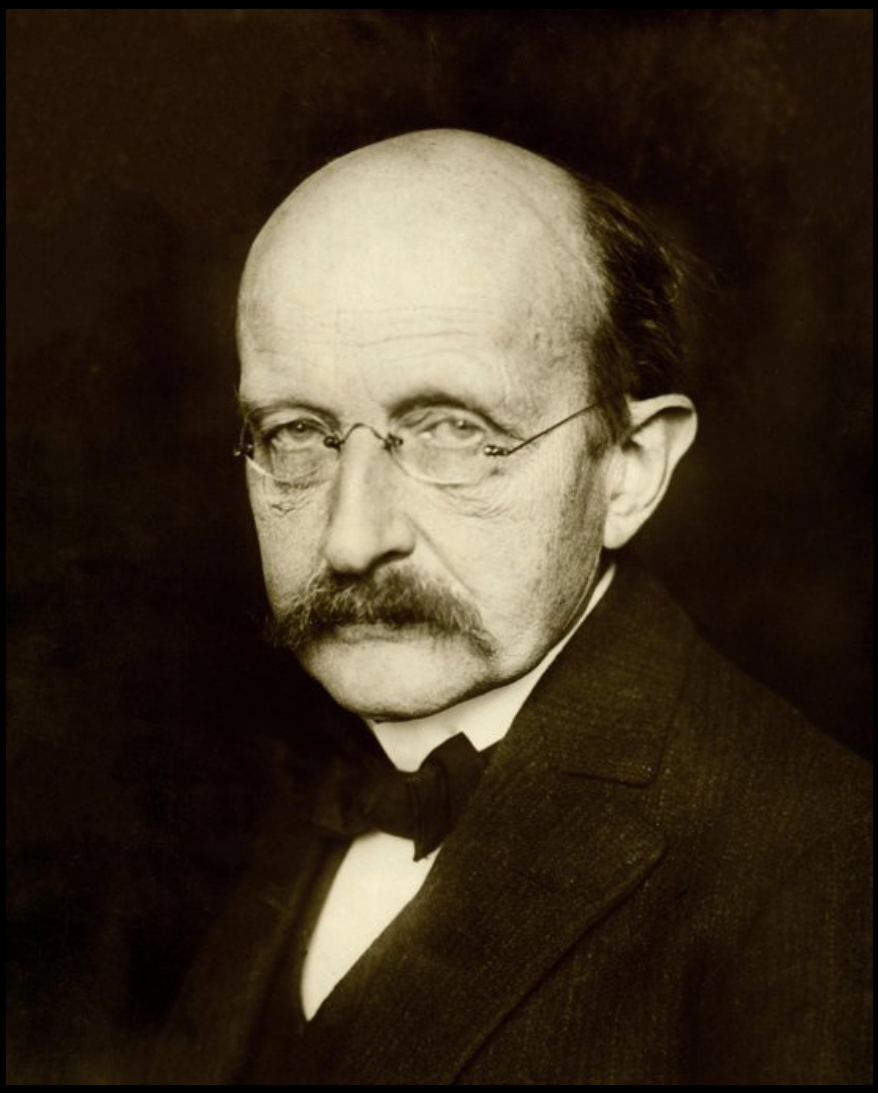




Brief

Before the emergence of Quantum Theory, an encompassing theory within the realm of quantum mechanics that explains the fundamental nature of matter and energy, the explanation of specific facets of the natural world relied upon classical physics. However, this account applied solely to the conventional scale of observations, namely the macroscopic realm, and failed to address the intricacies inherent in the microscopic domain surrounding atoms and subatomic particles. The situation precipitated significant discord and divergence of opinion among physicists, such as Niels Bohr, Marie Curie, and Ernest Rutherford. However, in 1900, Max Planck's groundbreaking research on the impact of radiation on a Blackbody substance marked a pivotal moment when the prevailing chaos of ideas fused into the developing field of Modern Quantum Mechanics within the realm of physics.

This emerging discipline of physics stimulated the transformative potential to revolutionise our comprehension of space and time entirely. By delving into the realm of higher dimensions, it presented a myriad of fresh ideas for other scientists to explore and expand upon. Notably, Albert Einstein would later accomplish this by making advancements in the field.



Max Planck

Contribution

Remarkable developments associated by Einstein were -

1. Photoelectric Effect
2. Light Quanta
3. Wave-Particle Duality
4. EPR Paradox
5. Quantum Entanglement.

Max Planck also polished equations established by Wilhelm Wien and John Rayleigh, engendering what is now known as "Planck's radiation formula."

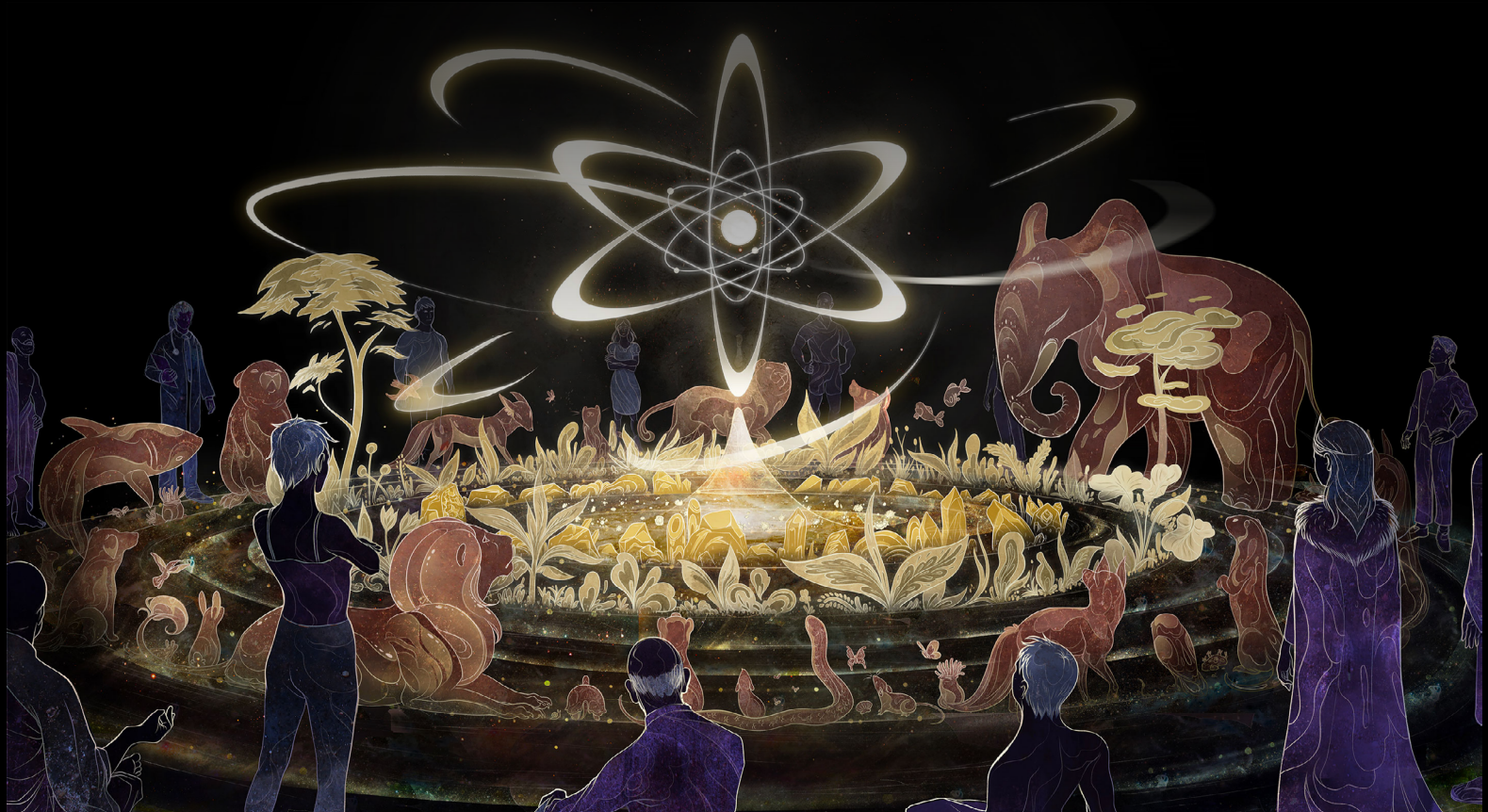
Planck's work found support both empirically and theoretically, as he substantiated his ideas through various instances. His experimental approach involved employing a simple apparatus to measure how discrete atoms and molecules release amounts of energy. The Blackbody Radiation experiment involved a blackbody radiator heated to a high temperature, and the radiation emitted by the radiator was examined. A blackbody is an object that absorbs all incident radiation and emits radiation across comprehensive frequencies.

Quantum Physics

Experiment

- The radiator was placed in a controlled environment, inside a vacuum chamber to eliminate background radiation. The radiator was built out of material with high emissivity, such as graphite.
- Then the radiator was heated to a high temperature using an electric current passing through a filament.
- The radiation spectrum was measured using a spectrometer, which split the radiation into its frequencies and measured its intensities.
- The observed spectrum was compared with Planck's formula, which describes the intensity of radiation at different frequencies as a function of temperature. It incorporated a constant called Planck's constant (h) to account for the quantization of energy.
- Lastly, the results were analysed by observing the comparison between the observed spectrum and the predicted spectrum allowing scientists to assess the accuracy of Planck's formula.

Based on the results, Planck formulated a concept that energy exists in distinct units, known as quantum energy, which can only be emitted or absorbed in the form of electromagnetic radiation. During his investigations, he observed that light was emitted and absorbed in packets, rather than behaving solely as waves. These discrete packets of energy were named "quanta," signifying infinitesimally small quantities of electromagnetic energy. This groundbreaking field of physics enabled scientists to investigate the intricate relationship between energy and matter at the subatomic level. As mentioned earlier, it established a foundation upon which subsequent scientists could build and advance, ultimately evolving into the comprehensive framework known today as Quantum Mechanics.



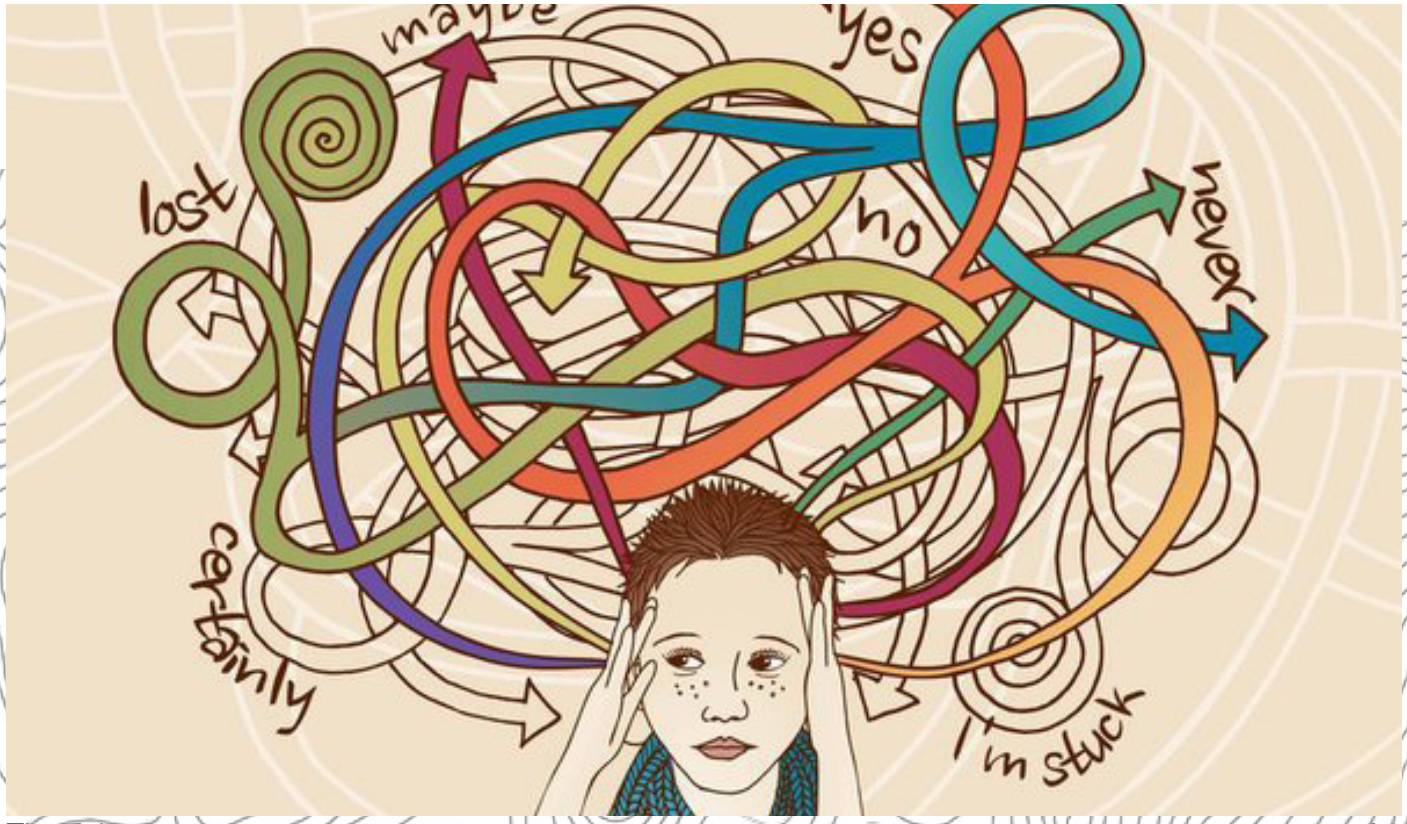
The Mandela effect

by Harshil Makin

Imagine sitting at your friend's place, having the time of your life, when you decide to open up the Monopoly board and enjoy a game with the people around you. You eagerly await the bright and charming monocled man's face, but to your dismay, you find something completely different. You see your friends around you with the same puzzled expressions as yours when the conversation about the missing monocle arises. All of you begin to question the fundamental principles of everything you've known until now. The above example is an uncanny phenomenon, presently known as the Mandela Effect, while people might dismiss it as a conspiracy theory. Due to the inquisitive nature of the human brain, many scientists have come up with scientific reasoning behind this peculiar phenomenon.

As the above paragraph suggests, the Mandela Effect is a phenomenon where people recall something that never occurred. The most prominent example of this effect is in the name itself. People believed that Nelson Mandela, the former president of South Africa, died in prison in the 1990s. However, confusion arose when people realized that he died in 2013 and saw rallies in mourning for his loss. Further investigation concluded that this was not the only example. Looney Tunes, Monopoly, Berenstain Bears, numerous quotes, and many more instances proved our memories incorrect. Due to the sheer number of times this occurred, it was not a coincidence, leading to the belief that there had to be a reason behind it.

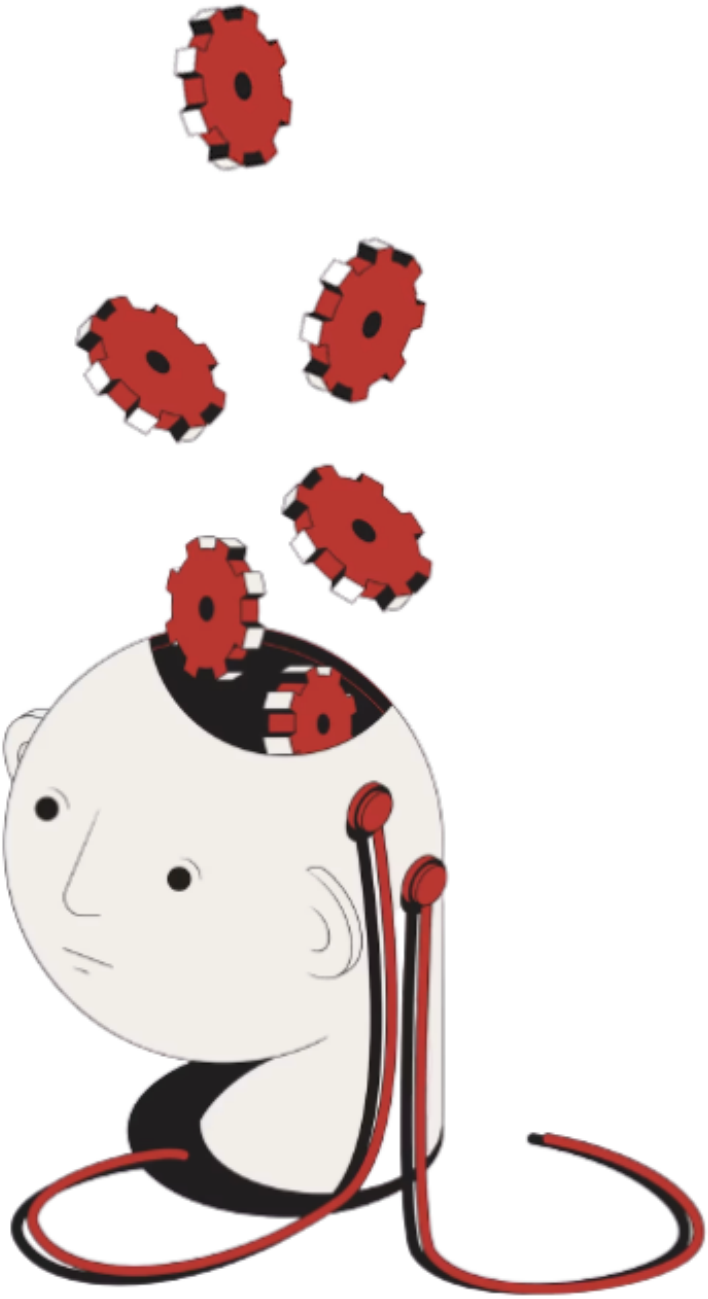
Most of the causes of this effect have to do with memory and how it functions in the brain. Memory is quite versatile, and people's recollections can be influenced simply by what others say, leading them to remember fabricated instances that never occurred. The first cause of this effect is the concept of false memories. As the name suggests, these are false recollections of an event. While some may be related to the truth, they don't need to be authentic. When these false memories occur on a large scale, the Mandela effect takes its place. It cannot be identified as insignificant since everyone remembers the event distinctly and shares the same confusion.



Another possible reason behind this is confabulation. Confabulations are false recollections that people create out of the blue, often to fill in gaps in their memory. For instance, someone who cannot remember what happened to Nelson Mandela may assume that he passed away in the past and then claim to remember this "truth." They are not lying but believe what they are saying because that is what their mind tells them. These are also notifications for a typical sign of memory-related diseases such as dementia or Alzheimer's. These diseases develop due to a lack of information. If we do not have enough information to prove a fact, we make up evidence to prove it to ourselves.

The most dangerous cause of the Mandela effect is internet influence. The causes of the Mandela effect can be broken down into two parts: misinformation and problems with memory. Internet influence may sound strange in an article about the Mandela effect, but it is solely responsible for the misinformation aspect of the cause. It is transparent that people are easy to influence online. Some people believe the most absurd things, and this misinformation spreads like wildfire from one person to another. This also causes the Mandela effect to be sporadic, since people believe it and consider it a memory malfunction rather than their fault. This effect is not something to be afraid of; it is the conspiracy theories and false facts that arise from this misinformation that needs to be ceased.

Apart from what we know, we still can't determine any other significant reasons for the Mandela Effect or explain how it happens due to a lack of evidence. Nowadays, it has become a frequent event that most of us dismiss after being puzzled for a few minutes. While we currently understand its negative causes and effects, I hope that in the future, we can discover more and gain a better understanding of this phenomenon.



Decoding Hershey's and Vomit

by Arjun Mitra

Hershey's chocolate has gained worldwide recognition, yet some individuals find its flavour rather unpalatable, likening it to the taste of vomit. This curious taste has sparked much debate, with a multitude of theories circulating regarding the chocolate's processing methods or the inclusion of artificial flavourings. Nevertheless, the most compelling explanation for Hershey's "vomit-like" flavour can be attributed to the presence of a compound known as butyric acid.

Butyric acid is a type of short-chain fatty acid that is derived from the process of fermentation in the large intestine of animals, including humans, where dietary fibres are broken down by specialised bacteria known as butyrate-producing bacteria. However, this versatile compound can also be produced synthetically through various chemical processes. The presence of butyric acid in natural food sources such as dairy products, specifically butter and cheese, has made it a quintessential component in various industrial applications. For instance, companies like Hershey's rely on this acid to produce the desired flavour profile in their products.

Despite its pungent and sour taste, butyric acid is highly valued for its distinctive flavour and aroma, which make it a vital ingredient in many fermented foods, such as sourdough bread and sauerkraut. Its broad range of applications in both food and non-food industries underscores the importance of this organic compound in modern society.

Hershey's chocolate owes its signature flavour in part to the presence of butyric acid, which is generated as a byproduct of the chocolate-making process. The

production of milk chocolate, a key ingredient in Hershey's chocolate, involves the fermentation of milk. In this process, bacteria in the milk consume lactose, breaking it down into lactic acid. Subsequently, the lactic acid undergoes further breakdown, producing butyric acid, which infuses the chocolate with its characteristic taste. This intricate process, culminating in the formation of butyric acid, is a testament to the nuanced and complex chemistry that underlines the creation of Hershey's chocolate.

Although Hershey's chocolate contains butyric acid in minuscule quantities, even the slightest concentration can be detected by the human olfactory and gustatory systems. The "vomit-like" taste that some people ascribe to Hershey's chocolate is actually a result of the tangy and acidic flavour of butyric acid. The degree of sensitivity to butyric acid's taste may vary from person to person, accounting for why some people may find Hershey's chocolate more unappealing than others.

Furthermore, while butyric acid is a natural product of many fermentation processes, including those used to create dairy products such as cheese and butter, its presence in Hershey's chocolate has raised concerns regarding potential health risks. Butyric acid is known to be corrosive and can irritate the skin and eyes upon contact. If ingested in large amounts, it may lead to nausea, vomiting, and diarrhoea. Additionally, butyric acid has been linked to the development of certain types of cancer. As such, some experts caution against consuming large amounts of butyric acid-containing foods, including Hershey's chocolate, in order to minimise potential health risks. However, the amount of butyric acid present in Hershey's chocolate is typically not significant enough to cause adverse health effects in most individuals, and the Food and Drug Administration Federal Agency has deemed it safe for consumption in the amounts found in food products. Nonetheless, individuals with a history of digestive issues or sensitivity to acidic substances may want to exercise caution when consuming Hershey's chocolate or other butyric acid-containing foods.

It is important to note that not everyone perceives Hershey's chocolate as having a "vomit-like" taste. In fact, many people enjoy the unique flavour of Hershey's chocolate and find it to be one of the brand's defining features. Taste preferences are highly individual and can be influenced by a variety of factors, including genetics, culture, and personal experience, hence this fact doesn't apply to every individual.

From Lab to Grid:

The Revolutionary Superionic Hydride Ion Conductor Poised to Power the Future

by Yashvardhan Verma

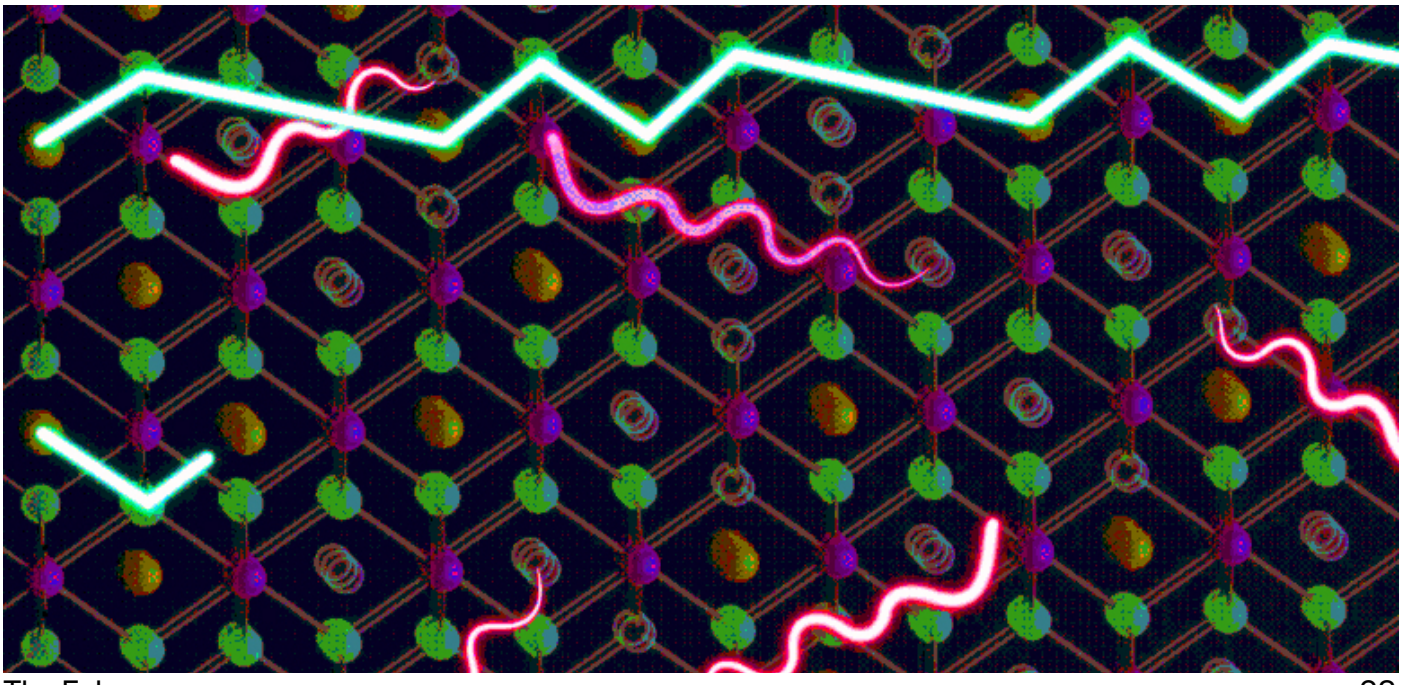
Efficient, dependable, and successful energy sources are absolutely necessary to meet the expanding energy requirements of the world. Superionic hydride ion conductor is a promising technology that has the potential to alter energy storage and transportation whilst being used to provide environmentally friendly options for powering electric cars and entire metropolitan areas.

At high temperatures, superionic hydride ion conductors (SHICs) are a class of materials with excellent ionic conductivity. These materials have become very intriguing for they could be used in robust applications like solid-state batteries. On the other hand, strong electrolytes outperform standard fluid electrolytes in a number of ways, including increased prosperity and extended energy thickness. SHICs have superionic conductivity because hydride particles (H-) grow through the material's gem cross-section, and due to their remarkable adaptability at high temperatures, the hydride particles are able to travel through the material and can conduct power. In the crystal lattice, the hydride ions travel through interstitial sites, which are spaces between the material's atoms or ions.

New developments in materials science and computational systems have drawn in analysts to plan and organise SHICs with extra properties. Lithium hydride (LiH), which has been demonstrated to have high ionic conductivity at temperatures above 600°C, is one promising SHIC material. Sodium hydride (NaH), potassium hydride (KH), and magnesium hydride (MgH2) are additional SHIC materials under the scanner.

The development of SHICs may have the potential to transform the energy collection industry as a whole by working with the creation of secure, high-energy-thickness, strong-state batteries.

The School of Alberta and Hydro-Québec, a Canadian energy association, have teamed up to accomplish this objective, as due to the efficiency of SHICs, they will be beneficial for the entire population. For guaranteed applications, this affiliation is fundamental for supporting creation and execution.



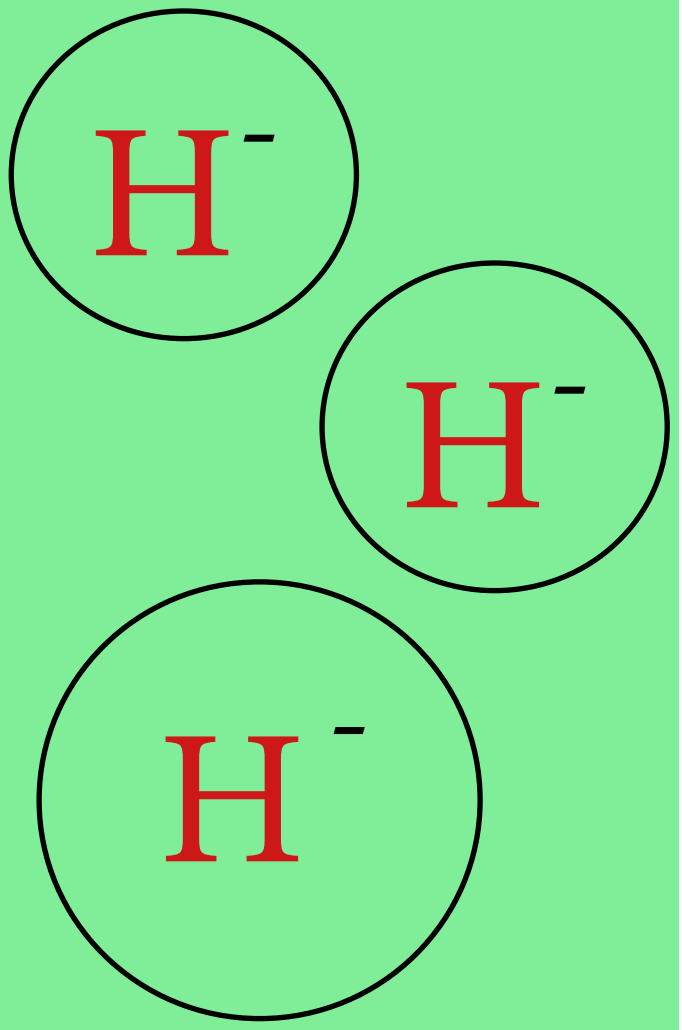
There are different applications for atom guides made of superionic hydride that might perhaps change the energy scene. Technology for electric vehicles is a promising area - they can possibly substitute standard lithium-molecule batteries, increasing the amount of charge a vehicle can hold, extending vehicles' range, and decreasing charging times. Electric vehicles can possibly become a more useful and feasible method of transportation with the help of SHICs.

Superionic hydride particle guides can likewise be utilised for energy capacity of sustainable power sources like wind and solar power, in order to minimise wastage. Superionic hydride molecule guides can help reduce the need for oil-based power plants by transporting excess energy during times of high demand and managing excess energy during times of low demand. Superionic hydride-based particle guides can also be used to improve urban communities as a whole. They could help settle the system and reduce the need for oil-based power plants by managing excess energy during times of low interest and moving it during times of high interest. As a result, substances that harm the atmosphere and the ozone layer have less of an impact.

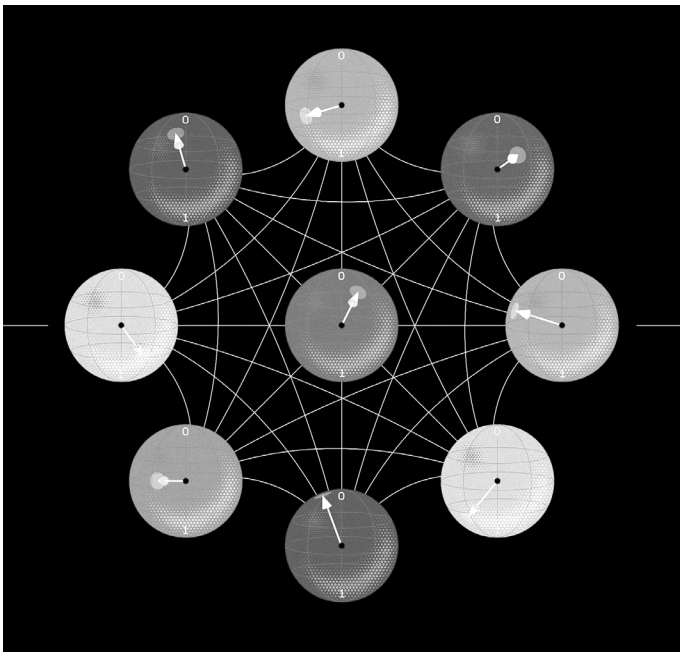
However, there are a few issues that need to be resolved before superionic hydride particle guides become a common innovation. The persistently high cost of production may limit adoption in some applications, particularly those where cost is a major factor. In addition, it is anticipated that standardisation and rules will be necessary to ensure safe and efficient usage of this product.

Overall, superionic hydride particle guides have a lot of potential to change the energy industry by reducing environmental change and providing eco-friendly ways to meet the growing demand for energy. A significant step toward identifying this potential is the brand-new approach that scientists at the University of Alberta have developed. This creation in particular is being further developed and adapted for real world applications.

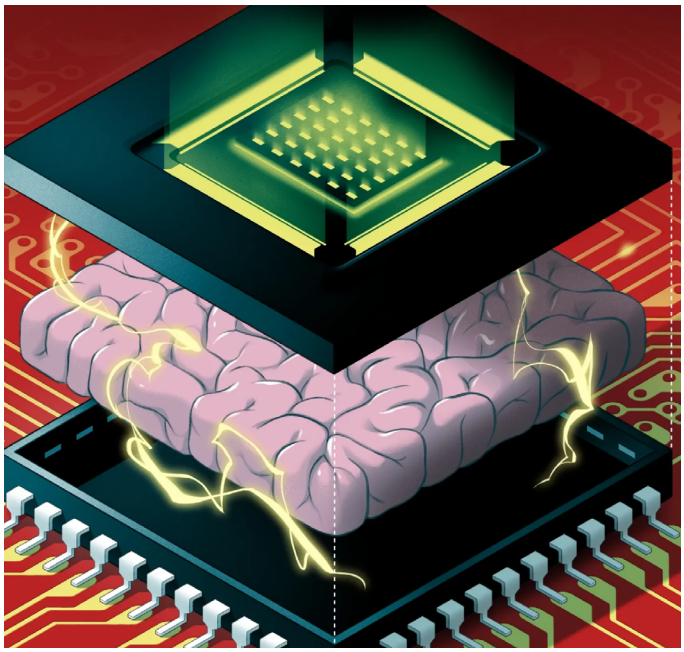
Superionic hydride molecule guides may contribute to the improvement of a cleaner and simpler-to-maintain future for all of us. However, in order to make this development a comprehensive solution to energy shortage and transportation, it is essential to address the steps and obstacles. By doing this, we can meet the sincere need for clean, long-lasting energy and help the world and its people have a better future.



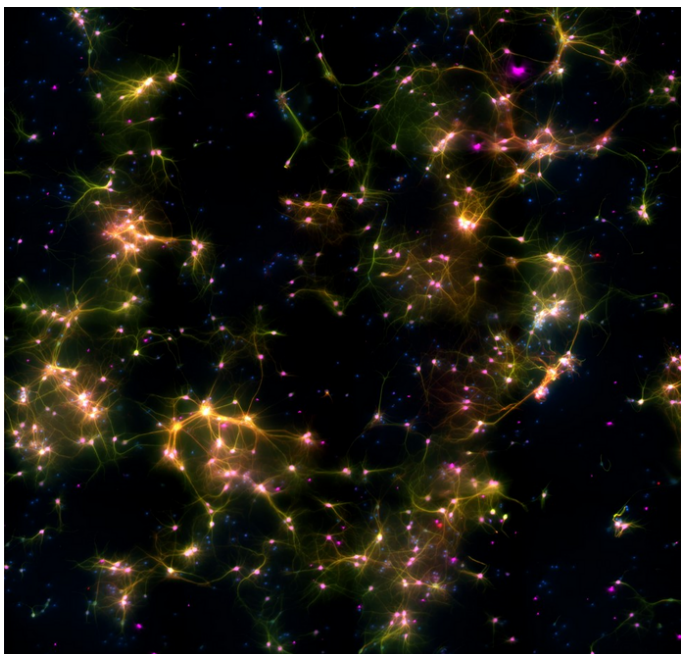
Refer



A Step Closer to Teleportation



Photonic Computers

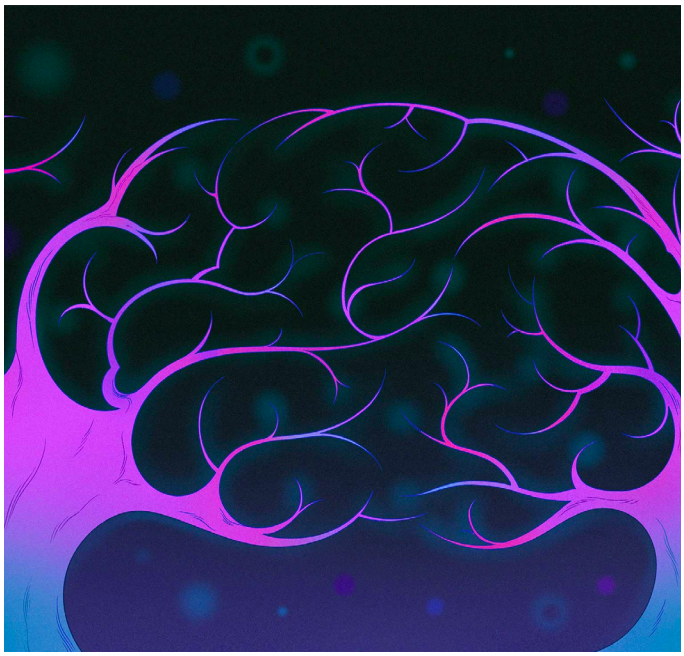


Neurons in the Matrix

The Mandela Effect

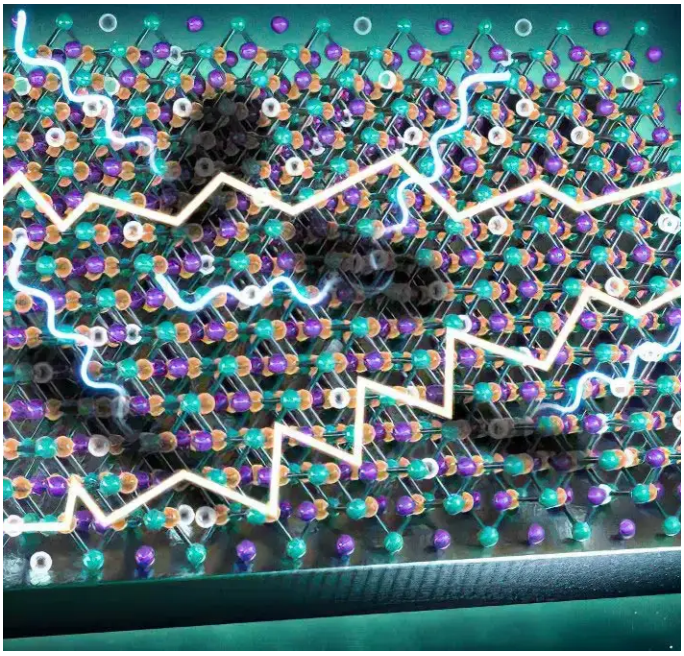
ences

Microplastics



Biomechanics

Decoding Hershey's and Vomit



From:Lab to Grid

The echo

The Doon School
Mall Road
Dehradun
India
Pin: 248001