THE GEEKLY

The Perfect Magazine for Science Lovers.

HICKORY DICKORY

Akhilesh Balaji

What is time? Is time real, or is it an illusion? Akhilesh Balaji answers these mystifying question the best that we can do right now.

Issue 4


THEGEEKLY

EDITOR'S NOTE

Hello, there! This is our fourth issue, as you may know. But, what you may not know is that 4 is rather a special number. For instance, 4 is the first non-prime even number, the smallest composite number, and the smallest squared prime. In Buddhism, there are 4 noble truths, and Aristotle came up with the 4 great element: Water, Fire, Earth, and Wind. In politics, Franklin D. Roosevelt came up with 4 freedoms: Freedom of Speech, Freedom of Religion, Freedom from Want and Freedom from Fear. So, 4 is rather a special number. In the 4th issue of The Geekly, we are delighted to announce that Roopa Pai, bestselling author of "From Leeches to Slug Glue" has agreed to write an article for us! Keep learning!

Happy Reading,

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THE GEEKLY

FEATURED

HICKORY DICKORY

Time is something, that, in our eyes cannot be stopped: It is eternal, and has never been non-existent. But, is that really true? Is time an illusion. If so, that leads to a bigger question: What is reality? Akhilesh Balaji explores these concepts in detail.


XI
XII

Time is something that we take for granted. After all, time just seems spontaneous. It cannot be stopped, and it is eternal, in our eyes. There was never a time, so to speak when time was non-existent. But is that really the case. Since we perceive time as reality, let us first look at the concept of reality itself.

What is reality? Reality is “the state of things as they actually exist, as opposed to an idealistic or notional idea of them”, according to the Oxford dictionary. But this is extremely subjective. You can let your imagination run wild at this point: Why not a world which has been programmed by machines, as depicted in the 1999 film, “The Matrix”. Or a universe where you are the only person, ▶

“Our perception of time's flow depends entirely on our inability to see the world in all its detail.”

other humans just being other entities, as believed by solipsists. The possibilities are endless! There is no way of proving what reality is, in reality. That last statement was smothered with irony and is a paradox in itself. How can we prove what’s real, in reality, without knowing what reality is? A tricky question.

But, aside from the idea of reality not being what we perceive it as, is it possible that the whole idea of reality is non-existent, and exists in only our minds, nothing more than a figment of the imagination? In other words, is reality an illusion? Perhaps. But if it was, there would be no way to prove it.

Now, let us move on to the second big question, the main idea of this article: If reality is an illusion, is time real? If time was real, then would time also be an illusion? “Our perception of time's flow depends entirely on our inability to see the world in all its detail.”, argues physicist Carlo Rovelli. It is impossible to answer these questions without bias. For example, if all of what we have discovered in the field of science is, in reality, merely our own perceptions? But, nevertheless, let us try answering this question, from the perspective of science. So to speak, the science that humans have discovered in our perception of reality.

To do so, let us unravel the concept of Quantum Uncertainty. The principles of quantum uncertainty revolve around probability and chance. In other words, nothing about the universe is ever predefined, what happens in the future depends entirely on chance. The plethora of possibilities for the near future ▶

is infinite. Even as you are reading this article, you don't know what could happen in the next second. You might suddenly rip it apart in a sudden fit of fury as a mosquito bites you, or you might put it down to go get some fresh air outside. We also need to know what entropy is. Entropy is commonly regarded as disorder or chaos but is actually a gradual decline into disorder. For example, a block of ice has a lower entropy than a glass of water. The disorder in the universe gradually keeps increasing. That's the reason why glass shatters into shards and not vice versa. It's the reason why air shoots out of a punctured tyre and not vice versa.

So what do these two concepts have to do with reality? Quantum uncertainty states that you cannot know the position and speed of all the particles that we have in the universe. Therefore, if we could know them, then that would mean that there would be no entropy or disorder. That would also mean that there would be no unravelling of time, as the passing of time is because of entropy. Therefore, we can argue that the passing of time or our perception of its flow is because of the fact that we are not able to know the position and speed of all the particles. This is also what Rovelli argues. Remember, "Our perception of time's flow depends entirely on our inability to see the world in all its detail."

But, this is, as I mentioned earlier, an unfair argument, as it has a bias towards our perception of time's flow. Regardless, in our eyes, time is real, and cannot be stopped with what little technology we have today. So until then, remember that you are living in an uncertain world.

Carlo Rovelli (Shown Above) is a physicist, and the best selling author of "The Order of Time"

"The two most powerful warriors are patience and time."

Must See

Dhruv Ramu

Stopping disease with disease

Vaccines

'Vaccine' is probably a word you may have heard multiple times in conversations. Influenza vaccine, H1N1 vaccine, and so on. What is a vaccine? In short, vaccines are biological preparations that provide immunity to a particular infectious disease. However, vaccines typically contain a resemblance of a disease-causing microorganism but are weakened so that the body can fight it.

The immune system contains billions of cells who are soldiers to factories. The immune system is the body's defense against foreign organisms, such as bacteria. The immune system is exposed to bacteria and viruses every day. However, the body can usually stem any infection without the external help of antibiotics. As a result, it is not felt. However, in the case of a serious infection, intelligence cells collect data about the foreign organism and 'remember' it in order to be prepared in case it attacks again. The memory cells in the body are produced in the case of a serious infection, and its purpose is to simply remember information. If it attacks again, the memory cells in the body respond by ordering coordinated attacks against the microorganism, producing special antibodies as it already knows the structure of the invader. This is a very effective process, therefore many infections that have already occurred usually do not cause much trouble if they re-enter the body. This natural mechanism if the body is the foundation for the idea of vaccination.

As useful as memory cells are when they are obtained during the infection against a serious virus, it is a process that reduces the immunity temporarily and is a generally harmful process as it can sometimes even be fatal. Vaccines are methods of causing memory cell units to produce, but not harming the body much in the process, causing immunity to diseases. Some vaccines include almost dead or extremely weak micro-organisms. However, sometimes, there is a need for a stronger vaccine, as if the immune system works harder, more memory cells will be produced for better immunity.

A question arises that if a vaccine is so potentially harmful, what if the germs win? Therefore, scientists and doctors produce and breed a weaker version of the germ in a laboratory. To summarise, vaccines weaken germs, inject them into the immune system, cause the production of memory cells and results in the immunity of a person.

However, there are side effects to vaccines, as useful as they may be. Let's get to some statistics. The measles vaccine was distributed in 1963. In the 1950s, there were an estimated 135, 000, 000 cases of measles. However, now if we have so much better medical technology, why do we need a measles vaccine? Well, even though most children would be able to fight it using antibiotics, it will damage the immune system unnecessarily for those who survived it, and some may suffer bad side effects of measles such as pneumonia, diarrhoea, encephalitis, SSPE and ear infections.

So, vaccines are indeed important. Let us attempt this thought experiment to understand the side effects of vaccines. If 10 million people are vaccinated with the measles vaccine(MMR), 10% or 1 million people will get a fever. 5% or 500,000 people will end up getting a mild rash. 0.001% of people(100 people) might get a serious allergic reaction which must be treated. Only 0.0001% of 10 million, in this case, 10 kids,

will get the most serious side effect of this vaccine: Encephalitis.

Parents must also realise that getting the measles infection is more dangerous than a side effect of the vaccine. In 2017 alone 110,000 people died of the measles infection. Therefore, it is a similar scenario to the number of people dying from not wearing seatbelts in a car compared to being killed by it.

Herd immunity is a concept that is the only way a child can be protected from a case of measles if they cannot be vaccinated due to allergic reactions.
Herd immunity is when a disease like measles cannot spread when there are many people around that are already vaccinated, immune and not susceptible. As it cannot spread, it dies before actually reaching its victims. However, there is got to be a number so that herd immunity is possible. 95% of people around the unvaccinated person need to be immune to measles so that it cannot spread further.

Vaccines are one of the most powerful tools we have to combat and eradicate infections and diseases. The anti-vaccine conspiracies influence parents' decisions, sometimes causing death and pain as the child cannot be immune to some foreign infections. More vaccinated children have a direct relationship with fewer dead children.


AKHILESH
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D DEATH

Oxygen is the 8th element in the periodic table and is commonly regarded as the elixir of life. And rightly so. Indeed, without Oxygen, there would be close to no life on this planet. But, that statement has a few loopholes. First, when we say "oxygen", we commonly refer to O_2, the most stable form of oxygen. For the rest of this article, when I say oxygen, I will refer to this stable form of it, unless I indicate otherwise.

Now, is it possible that oxygen is also responsible for the death of species? Though oxygen has been regarded by most people as the elixir of life, could oxygen also be the cause of natural death, organ failure? To understand these questions better, let us first delve into how our current views about "the elixir of life" began in the first place. Oxygen, as I mentioned earlier, is responsible for nearly all the life on this planet. This is because oxygen is used in ATP-ADP exchange. First, when you inhale the oxygen, it travels to small sacs called alveoli. Through a process called diffusion, the red blood cells exchange the oxygen for carbon dioxide, which is breathed out. But what use does the body have for oxygen?

Oxygen helps the body burn food molecules into glucose. This glucose is important to supply energy to the cell, through the process of cellular respiration, or ATP-ADP exchange. Without oxygen, our cells wouldn't have enough energy to survive, let alone function appropriately, and succumb.

In prehistoric times, there was a lot more oxygen in the air than there is now. Thus, organisms on earth grew to Brobdingnagian proportions. Dragonflies, for example, spanned over one meter in length, and there existed a snake straight out of your nightmares: The Titanoboa. It spanned over 10 meters in length and was twice as thick as a man. It crushed with a force of 4 Eiffel towers per square inch. But, giant though these big brutes maybe, they didn't live for long. One of today's dragonflies, for example, lived for nearly twice as long as a prehistoric dragonfly would have lived. Why is this? The answer lies in the atmosphere at the time.

As I mentioned earlier, there was a higher concentration of oxygen in the air, at the time. This was the cause of those animal's short lives. The reason for this lies in oxidation. Oxidation is the same process that turns iron into iron oxide, or rust. Oxidation also plays a role in combustion or the burning of fire. Fire needs oxygen to burn. This can be seen when steel wool is set on fire. As the fire burns its way through, all the burnt steel turns into rust.

Joseph Priestly once described inhaling oxygen as: "The feeling of it to my lungs was not sensibly different from that of common air; but I fancied that my breast felt peculiarly light and easy for some time afterwards. Who can tell but that, in time, this pure air may become a fashionable article in luxury.... From the greater

strength and vivacity of the flame of a candle, in this pure air, it may be conjectured, that it might be peculiarly salutary to the lungs in certain morbid cases when the common air would not be sufficient to carry off the putrid effluvium fast enough. But, perhaps, we may also infer from these experiments, that though pure dephlogisticated air [oxygen] might be beneficial as a medicine, it might not be so proper for us in the usual healthy state of the body; for, as a candle burns out much faster in dephlogisticated than in common air, so we might, as may be said, live out too fast [Priestley's italics], and the animal powers be too soon exhausted in this pure kind of air. A moralist, at least, may say, that the air which nature has provided for us is as good as we deserve.."

Priestly's record of his experiments [see above] contains the first suggestion that oxygen may accelerate ageing. He conducted an experiment on a mouse where he locked it in a chamber full of pure oxygen, and it died faster than another mouse which he locked in a chamber full of normal air. But, it could not be proven that oxygen was toxic until a full hundred years later.

The toxic effects of oxygen become more and more pronounced as the concentration increases. The first effects were observed by scuba divers towards the end of the 19th century. They usually carried pure oxygen with them, and as there was greater pressure underwater, the oxygen concentration was "increased". What scuba divers experienced were seizures similar to an epileptic grand-mal. These were called oxygen convulsions and would be a disaster if the diver lost consciousness underwater. These convulsions were sometimes fatal - even above water.

These toxic effects of oxygen were soon recognized and divers were told to watch out for the symptoms of "oxygen poisoning" (think about how ironic that sounds). "Tingling of the gingers and toes, and twitching of the muscles" were just two items in a navy handbook about oxygen poisoning.

In conclusion, Oxygen was the molecule that made the world. It was responsible for all life on earth but is also responsible for their death. Who knows? Maybe, scientists will one day invent a gas that supplies energy to our cells but doesn't cause oxidation, and accelerate ageing. But until then, the circle of life continues.

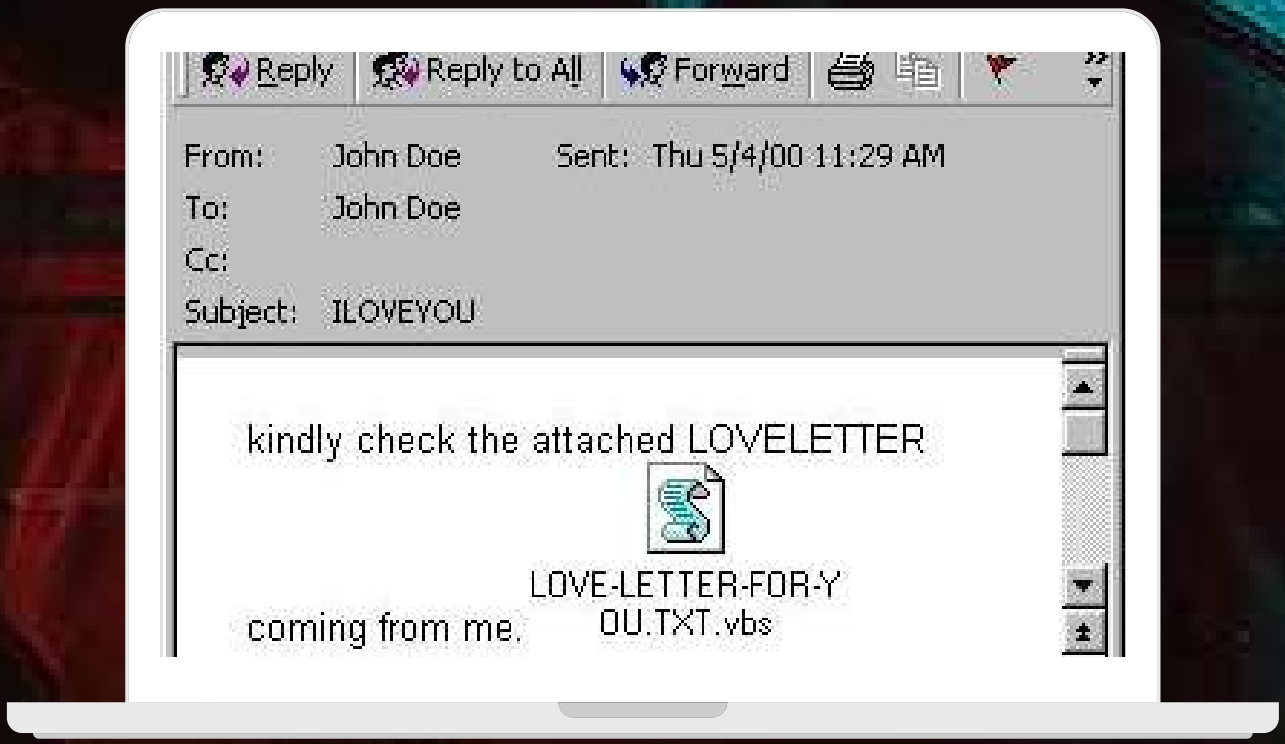
TOP 5 COMPUTER VIR

Akhilesh Balaji

5 ILOVEYOU

The ILOVEYOU virus, also known as the Lovebug, was a computer virus that infected over 10 million computers in the year 2000. The virus spread through e-mail, with the subject line "ILOVEYOU", and the attachment "LOVE-LETTER-FOR-YOU.txt.vbs". On Outlook, users would only be able to view the name of the file, which was "LOVE-LETTER-FOR-YOU.txt". Users would think it was a simple text file, and open it. The worm would then replace all common file types in their computers with a folder called "ILOVEYOU", and send a copy of itself to everyone in your contacts. This made it spread faster than any previous email worm.

RUSES


Reply
Reply to All
Forward
From: John Doe
Sent: Thu 5/4/00 11:29 AM
To: John Doe
Cc:
Subject: ILOVEYOU
kindly check the attached LOVELETTER
LOVE-LETTER-FOR-YOU.TXT.vbs
coming from me.

4 CRYPTOLOCKER

CryptoLocker was a cyberattack that used the CryptoLocker ransomware. Essentially, the attack utilized a Trojan that targeted Microsoft Windows users. It spread through infected E-Mail attachments, and via a botnet called Gameover ZeuS. The virus encrypted certain file types with RSA encryption, which is an extremely strong encryption. In order to unlock your files, you would have to find the key, which was an extremely large prime number. In fact, RSA encryption is so powerful that it would take a modern-day computer over 200 years to find the key. But, CryptoLocker offered another way out: It would give you the key to unlock your files if you paid 400 USD, or 2 BTC within 100 hours.

3 STORM WORM

Storm worm was a Trojan that spread mainly through E-Mail. The Storm Worm began attacking thousands of (mostly private) computers in Europe and the United States on Friday, January 19, 2007, using an e-mail message with a subject line about a recent weather disaster, "230 dead as storm batters Europe". During There is evidence, according to PCWorld, that the Storm Worm was of Russian origin, possibly traceable to the Russian Business Network. "During our tests we saw an infected machine sending a burst of almost 1,800 emails in a five-minute period and then it just stopped.", said a researcher with Symantec's security response group.

❷CONFICKER

Conficker was a worm that appeared in November 2008. It also goes by the aliases Downup, Downadup and Kido. The virus would disable numerous of Microsoft Windows' services, including as Automatic Updates, Windows Defender and Windows Error Reporting, as well as making antivirus websites inaccessible and often locking users out of their accounts. Apart from this, the virus then made the computer part of a botnet. A botnet is a connected network of computers. Thus, the virus could spread through the botnet as well. Conficker can spread by several means, copying itself to shared folders, for example, or exploiting the AutoRun utility for removable media.

❶SHAMOON

Shamoon was discovered in 2012, and was called the "biggest hack in history". It was mainly active in Saudi Arabia, as it targeted the Oil and energy sector. It struck over 30,000 computers in Saudi Arabia. Once a computer was infected, it compiled a list of files on the victim's system, and sent thins information to the hacker. All the affected files were then erased by a program called a "wiper". Finally, the virus overwrites the master boot record, meaning the computer can no longer be rebooted and is therefore unusable. Shamoon also managed to hit the Saudi Government.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PROPERTIES

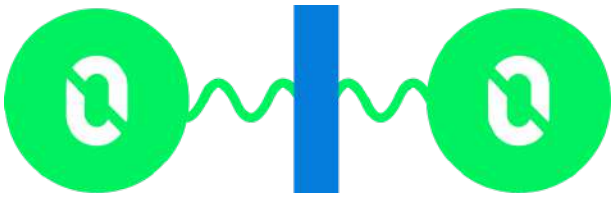
SUPERPOSITION

Quantum superposition occurs when quanta, or quantum particles, are in a mixture of states until measured. That is, they are neither 0, nor 1, both at the same time. But, when they are measured, they become either a zero or a one, almost as if they know we are watching. When we say 0 an 1, they can mean anything from up and down to wave and particle.

ENTANGLEMENT

Quantum entanglement is a process where two quanta are linked together using a complex process. The result of this is that both the quanta are "entangled". The other responds to a change in the first, at the same time, even if they are separated by a universe! Imagine a pair of coins. If you tossed the first and it became heads, you would immediately know that the other one was tails. And, this change would take place instentaneously. Cool, right? But that's not all...

S OF QUANTA



TUNNELING

Quantum Tunneling is the basis for transistors. Essentially, in classical physics, a particle would simply bounce of a barrier. But, in quantum physics, the particle somehow "senses" that a barrier is coming out, and turns into a wave. So, this wave then passes right through the barrier, without leaving any probability flow inside the well! Mystifying!

TELEPORTATION

Teleportation only occurs between two entangled quanta. In fact, scientists have managed to teleport quanta as much as 140 kilometers from where they started out. How this works is that these two particles exchange places, therefore moving the other particle to where it was, while this particle itself moves to where the other particle was. But, in order to teleport humans, they would need to be teleported atom by atom - and with the technology we have, it would take1 million years. Even then, we would not have the technology to manipulate over a trillion atoms so accurately. For all you know, you could be missing a toe!

ENIGMA: THE CODE UNBREAKABLE

Dhruv Ramu explores this code, taking you on a fascinating journey.

Alan Turing was a brilliant mathematician born in London in 1912. He studied in prestigious universities, and then worked part-time for the British Government Code and Cypher school even before World War II broke out. In 1939, when Germany used codes to transfer messages, Turing took up a full-time job at Bletchley Park in Buckinghamshire, the location where top secret work was underway to decipher military codes used by Germany and its allies.

The Enigma was a type of enciphering machine used by German Armed Forces to send messages securely. Polish mathematicians had already found how to read enigma messages and shared this information with the British, however increased German security such as changing the cypher system daily caused the task of understanding this complex code very difficult. ▶

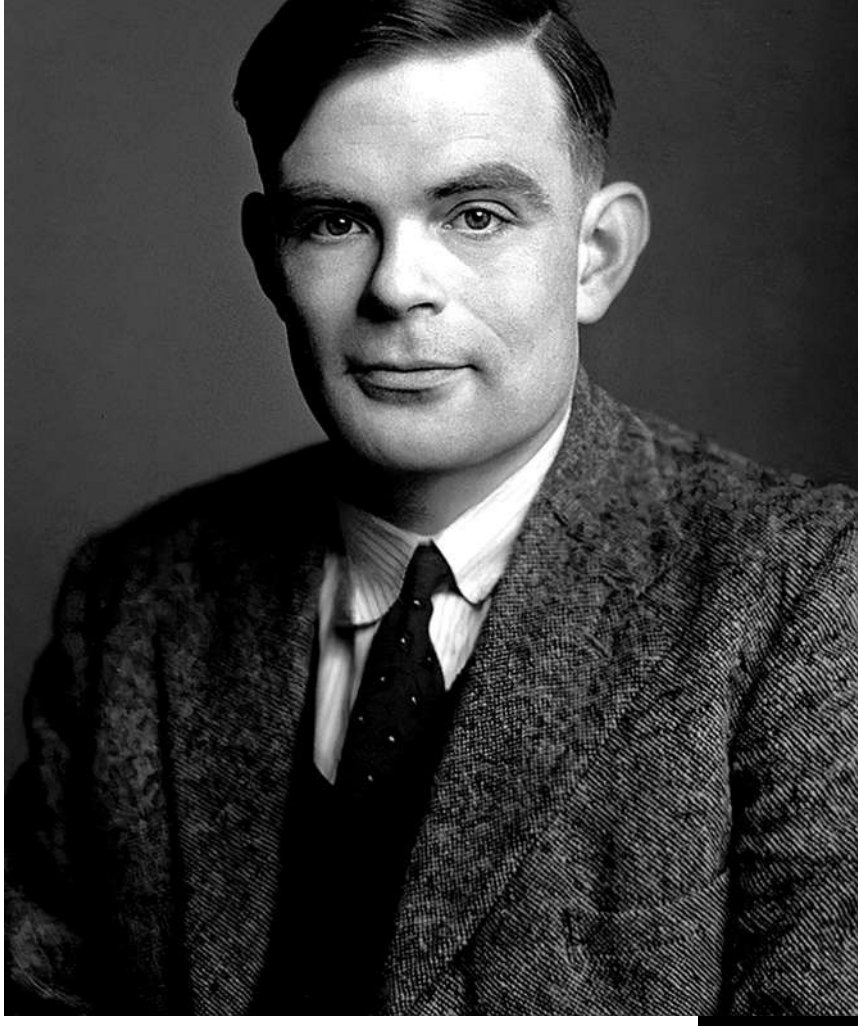
Alan Turing along with Gordon Welchman, another code-breaker played key roles in the process of inventing a machine known as The Bombe. This device was created to reduce the work of code-breakers during the war. This was after mid-1940, and after this invention, the intelligence gained greatly helped the war effort.

After the success with the enigma to decode messages from the German Air Force, Turing then focused on decrypting more complex German naval communication. German U-boats were causing issues to Allied ships which carried supplies and shipments. Turing created a technique called Banburismus which helped the naval messages from the Germans readable by the Allies in 1941. Alan Turing led a team of code-breakers called “Hut 8” at Bletchley which carried out detailed and structured cryptanalysis of all German navy and air force signals. Turing’s role here was a pivoting point in the Battle of the Atlantic against the Axis, especially since it was a massive naval war.

In the month of July 1942 Turing then developed a complex code-deciphering technique called Turingery. This method was especially useful in cracking the ‘Lorenz’ cypher machine. This cypher machine included the communication of high-level strategic messages.

In December 1942, Alan Turing travelled to the United States. The purpose of this visit was to advise the US military in the use of Bombe machines and to share his knowledge of the Enigma. He also observed progress on a top secret speech enciphering system. Turing returned to Bletchley in March 1943. He continued work on cryptanalysis and also developed a scrambling device for speech. The Order of the British Empire, also known as the OBE is a prestigious award and was awarded to Alan Turing because of his vital wartime work.

Turing had developed a hypothetical computing device in 1936 and then post-wartime he delved deeper into this, building▶



Alan Turing, a great mathematician

on earlier work. He also worked at the National Physical Laboratory in Great Britain. He also published a design which can be viewed as a forerunner to the Computers we have now called Artificial Computing Engine but was not taken forward. Unfortunately, he passed away in 1952 due to a case of cyanide poisoning.

Alan Turing was arguably one of the best code-breakers in the 20th century and his contributions to the Allies in the decryption of the Enigma and the invention of the Bombe were phenomenal. His work in Bletchley Park was kept strictly confidential until the 1970, and even then all details were released only towards the end of the 20th century. It is possible that the work of Alan Turing and his colleagues at Bletchley Park reduced the length of the war, but it is definite that it saved countless lives and impacted the outcome of the war as well.

Dhruv Ramu

CONTEST

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PLASMA THER

Roopa Pai talks about a 19th century treatment for a 21st century virus


RAPY
Must See

Bet you thought 'plasma therapy' – the new treatment being tried out against the scary-as-heck Covid-19 virus – was some cool, cutting-edge therapy that had just been invented. Far from it. In truth, the concept is over 130 years old!

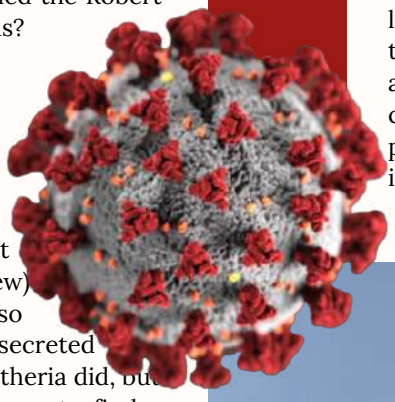
Here's the fascinating story of the discovery of plasma therapy, and the killer children's disease it was first used effectively against.

Before we go there, some context-setting is essential. In the past few years, with wave upon wave of new and deadly micro-organisms unleashing serious guerilla warfare against our immune systems, we have become paranoid about germs of all kinds (which is a little silly, actually, because our insides – specifically, our digestive systems – are literally crawling with germs, a majority of which are essential for our well-being). But get this – until the 1880s, when French chemist Louis Pasteur first proved that certain germs could cause certain diseases in humans, NO ONE had figured out that one of the reasons people got sick was because of germs! Everyone thought that it was inhaling smelly, foggy, 'bad air' – what they called 'miasma' – was made people ill. So while they avoided such places, no one, not even surgeons, bothered to regularly wash their hands (not even before they did their surgeries – oh dear, you've fainted!).

A VACCINE CAN PREVENT A VIRUS – BUT WHAT CURES IT?

The thing was, even though microbes had been identified as the causes of some diseases by the last decade of the nineteenth century, there were not many effective cures for them. Sure, some vaccines had been developed, but they were meant to prevent disease, not treat it. As you can imagine, finding ways to treat and cure diseases was the big spur for researchers, doctors and microbiologists at the time. And the place where it was all happening was the Institute for Infectious Diseases in Berlin, which is today called the Robert Koch Institute. (Don't know who Robert Koch was? Look him up on the Net!)

In 1883, German bacteriologist Edwin Klebs identified the bacterium that caused the dreaded disease diphtheria, a disease that caused the respiratory passages to swell up and choked thousands of children to death each year. The very next year, Friedrich Loeffler, a bacteriologist working at the Koch Institute, cultivated (i.e., grew) the same bacterium in the laboratory. Loeffler also suggested it was a soluble poison the bacterium secreted that actually caused the tissue damage that diphtheria did, but did not pursue it further. Now the search was on to find a vaccine for the disease, as well as a cure for children who had already caught it.



In 1888, two French scientists called Emile Roux (who had also helped Louis Pasteur develop the rabies vaccine) and Alexandre Yersin (after whom the bacterium that causes bubonic plague— *Yersinia pestis* —which he co-discovered, is named), who were working together at the Pasteur Institute ▶ discovered, to their surprise, that even after they had filtered the diphtheria bacterium out of infected blood, the filtrate still had the power to infect animals like guinea pigs, rabbits and pigeons with the disease. Loeffler had been right, and now they had proof—it wasn't the bacterium itself, but some kind of poison that it released into the bloodstream that caused the disease! Roux and Yersin referred to this bacterial poison as a 'toxin'.

NOT EVERYONE WHO GETS IT DIES FROM IT – HOW COME?

Researchers now began to wonder how it was that some of the children and animals infected with diphtheria survived. Could it be that animal and human immune systems — our in-built disease-fighting armies—were capable of producing a corresponding 'antitoxin'? Perhaps the antitoxins were able to neutralize (or 'cancel out') the toxins when the bacteria producing them were weak! There was only one way to find out if the hypothesis was true: start deliberately infecting animals with small doses of weak diphtheria bacterium, examine samples of their blood and see what came up.Among the scientists working feverishly on this project was a German military doctor called Emil Behring, also part of the Koch Institute. Behring first started infecting guinea pigs with small doses of the diphtheria toxin, taken from the blood of a diphtheria survivor, and discovered that guinea pigs did indeed produce antitoxins. When he drew a sample of antitoxin-laden blood and put a chemical in the sample to coagulate it, i.e., to make the blood cells clump together, a clear liquid called blood serum, which contained the antitoxins (and antitoxins are nothing but a kind of antibody), separated from the coagulated cells. When this serum, suitably processed and cleared of all microbes, was injected into a healthy ▶

guinea pig, the animal developed passive immunity, or temporary immunity, to diphtheria. What was even more exciting was that the guinea pigs that had diphtheria were cured when they received the 'antiserum' (antitoxin-laden serum).

In 1890, Behring went public with his discovery of the diphtheria antiserum. The very next year, he treated a girl already suffering from diphtheria with antiserum from guinea pigs. She recovered! Clearly, while vaccines could only prevent disease, antiserums could help your body fight the disease after you had got it!

The 'miracle' threw the whole medical and non-medical universe into a huge celebratory tizzy—for the very first time in human history, an effective way to treat a life-threatening infectious disease had been discovered.

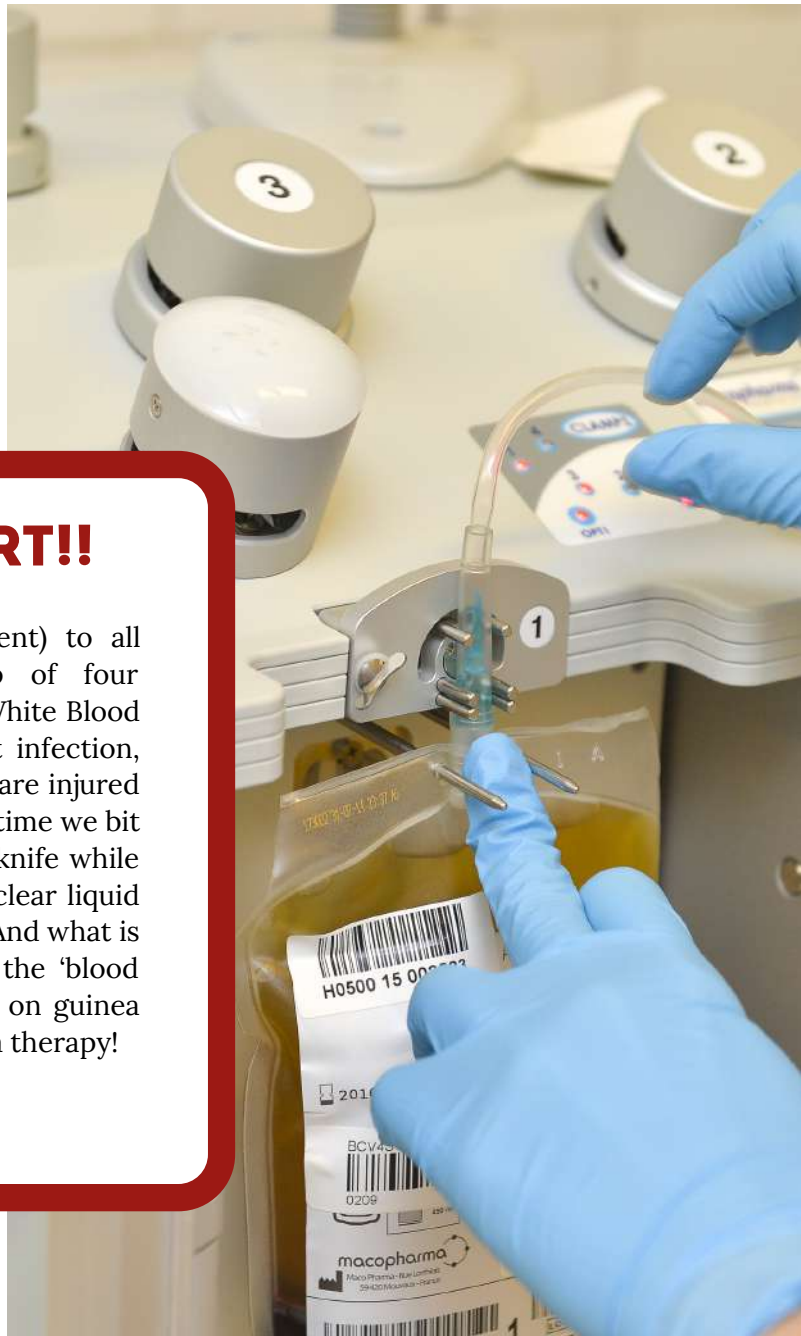
BUT GUINEA PIGS ARE TINY, AND WE NEED LOTS OF ANTISERUM!

Now to produce tons of antiserum to treat everyone with diphtheria! That was easier said than done, though, for guinea pigs simply would not be able to produce the amount of serum required for clinical trials, first on animals and then on humans. Behring decided to infect larger animals with diphtheria toxin , to see if they could produce more antiserum, and began trying it on dogs and goats. It was then that another German physician called Paul Ehrlich, who had recently joined the Koch Institute, suggested that Behring try horses. Ehrlich's hunch turned out to be a mega-winner. Horses were not only able to produce loads of antiserum, but their antiserum also contained more antitoxins per milliliter than others! And since horses were also believed to carry no diseases that could be transferred to humans, they were the ideal antiserum factories. ▶

It took a while to work out the correct dosage and formulation that would be most effective and safe for humans, and trials began in right earnest only in 1894. They were an unqualified success! Alongside, the historical human love for horses got an unqualified boost – horses were no longer just dependable and loving companions, they also produced stuff in their bodies that made human children well. Which other friend could do that for you?

Soon, antiserums were developed against rabies, tetanus and even snake venom. The German pharmaceutical company Hoechst took on the responsibility of maintaining the 'antiserum horses' and mass-producing and marketing the world's first plasma therapy treatment – the diphtheria remedy. In 1901, Behring was awarded the very first Nobel Prize in Physiology or Medicine for his discovery of the diphtheria antitoxin, and hailed as the 'saviour of children'.

You see why it is ill-advised to feel superior about 'new' ways of being and doing without first examining them in closer detail?



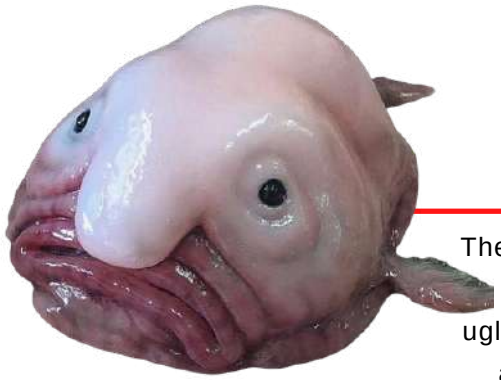
A-HA MOMENT ALERT!!

Important PSA (Public Service Announcement) to all readers: Our blood is mainly made up of four components – Red Blood Corpuscles (RBC), White Blood Corpuscles (WBC or leucocytes) which fight infection, Platelets, which help our blood clot when we are injured (if not for platelets, we'd bleed to death every time we bit our tongues or cut ourselves with a kitchen knife while chopping veggies), and Plasma (which is the clear liquid in which all these other cells are suspended). And what is another word for plasma? Blood serum! So the 'blood serum therapy' that Emil Behring was trying on guinea pigs was what we know today as... yup! Plasma therapy!

Gadget
Microsoft Hololens

Microsoft Hololens is a product that helps you see in mixed reality. You can slip on these glasses, and be taken to a virtual operating system where you can do all of your work. It is portable, and is widely regarded the new future.

OF THE MONTH



Species
Psychrolutes marcidus

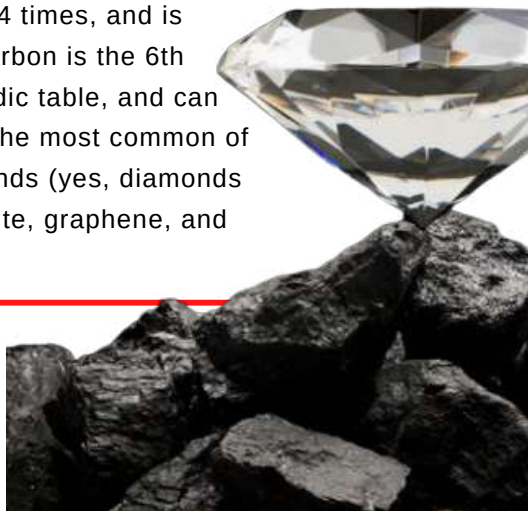
The *Psychrolutes marcidus*, or the blobfish is widely regarded the ugliest animal in the world. It lives at the bottom of the ocean, and uses as little energy as possible to catch its prey. The fish primarily hunts by just floating along and letting creatures wander into its mouth, rather than expending any energy. It also has a density only slightly above that of water.

Material
Hydrogel

Hydrogel is a material that can absorb over 50 times its weight in water, as the name suggests. It is a kind of polymer that is hydro elastic. It is used in the popular toy, Orbeez, and is also used in agriculture to feed plants water. It also has medical applications, but that field is still in development.

Element
Carbon

Carbon is one of the most abundant elements on the earth. It is responsible for all the life on earth. What makes it so special: It can bond 4 times, and is extremely stable. Carbon is the 6th element in the periodic table, and can take various forms: the most common of these include diamonds (yes, diamonds are common), graphite, graphene, and fullerenes.



Compound
Raspite

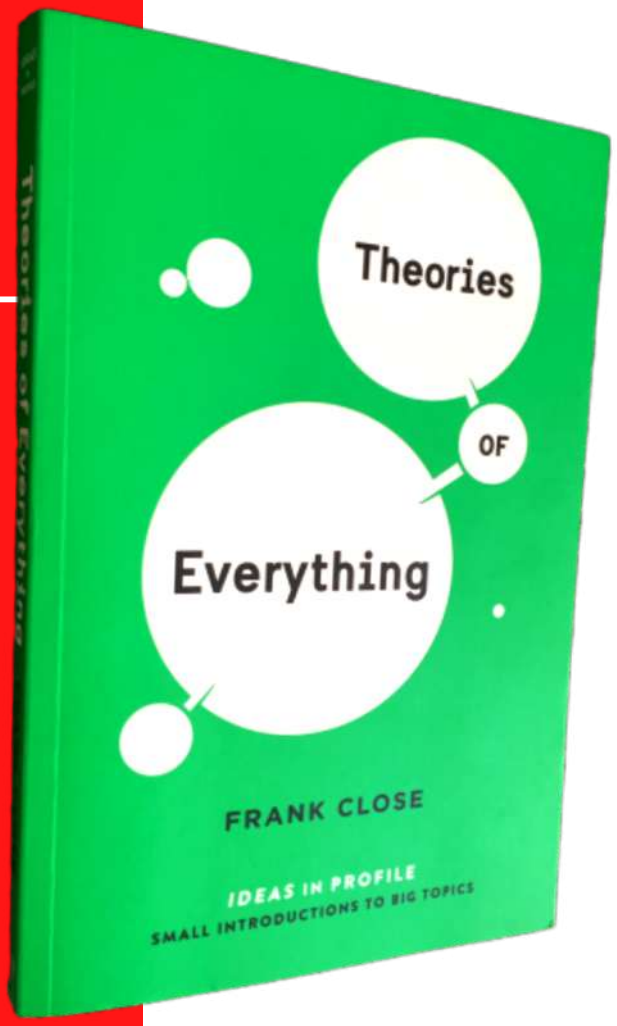
Raspite is a mineral, a lead tungstate; with the formula $PbWO_4$. It forms yellow to yellowish brown mono clinic crystals. It is the low temperature mono clinic dimorph of the tetragonal stolzite. Heating of raspite to 395(5)°C leads to a transformation into stolzite.

Scientist
Yuval Noah Harari

Yuval Noah Harari is an Israeli historian and a professor in the Department of History at the Hebrew University of Jerusalem. He is the author of the popular science bestsellers *Sapiens*, and *Homo Deus*.

Book
Theories of Everything

Physicist Frank Close takes the reader to the frontiers of science in a vividly told investigation of revolutionary science and enterprise from the seventeenth century to the present. He looks at what has been meant by theories of everything, explores the scientific breakthroughs they have allowed, and shows the far-reaching effects they have had on crucial aspects of life and belief. Theories of everything, he argues, can be described as those which draw on all relevant branches of knowledge to explain everything known about the universe. Such accounts may reign supreme for centuries. Then, often as a result of the advances they themselves have enabled, a new discovery is made which the current theory cannot explain. A new theory is needed which inspiration, sometimes, supplies.




WHAT IF?
The Earth was shaped like a doughnut?

An earth in the shape of a donut may not be as different from a round earth as you think. For instance, life would still be possible. The gravitational pull of the earth would be much lesser, though. In the round earth, the gravity is around 1g. Whereas, on the donut earth, the equator's gravitational pull would be just 0.3g, and the pull on the poles would be around 0.65 g, a little more. This is because a donut earth would have to resist the forces trying to crush it into a spherical shape. It would have to spin much faster, and centrifugal forces would kick in. So, if you wanted to break free of the gravitational pull of the earth, the equator would be the best place to do it. Would we still have a moon? Probably.

It would most likely be attracted toward the hole at the center of the earth, and bob up and down. Otherwise, it would be attracted toward the equator, and to a figure 8 around earth. But both of these orbits would have disastrous consequences. The tides would rise high, over 50 feet (0.02 km) in height, so coastal cities might never become a possibility. Thus, human life may evolve separately, on separate continents.

-Akhilesh Balaji


POI

RTFOLIO

GEYSERS

◀ This is a geyser erupting in Iceland. A geyser is nothing but a release of a buildup of geothermal energy underground. That is why Iceland has lots of geothermal power.

▶ This Geyser can be found at Guy W. Talbot State Park, in Oregon, United States.

▲ At Yellowstone National Park, various geysers can be found. This Geyser is one of the biggest in the part. Many other hot springs and other cool natural phenomena can be found.

◀ This is a hot spring at Yellowstone National Park. The difference between a geyser and a hot spring is that a hot spring is a pool of mineral water heated by geothermal energy, whereas a geyser is a buildup and release of geothermal energy.

▲ These two were also found at iceland.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ANIMAL

CORRECT C

TESTING

OR WRONG?

DEBATE

Various different animals, right from mice to flies are widely used in scientific and medical research. These living beings are critical in order for scientists to develop and learn more about human biology and health in the process of developing new medicine. The use of animals for research purposes has long since been furiously debated, from the moral side if it is following moral principles solely for human benefit, or that without animals in laboratories, research and development would be impeded.

Definitely, when we stop testing medicines and other chemicals on animals, it would affect the development of cures and vaccinations, possibly stopping research into the creation of vital treatments. There are principles to be followed in laboratories around the world such as: **Replace** when possible the use of animals with alternatives such as computer modelling and cell culture. **Reduce** the number of animals used in laboratories and improve communication between researchers so that similar experiments are not repeated. **Refining** animal experimentation by caring for animals better by minimizing pain and also improving medical care for them.

Dhruv Ramu

DEBATE

Akhilesh Balaji

Developing medicines is an extensive field. There are various steps one must take to publish a medicine. But, before it is available to people as a cure, scientists need to know how the human body will react to this. To know this, or rather, get a good impression of this, scientists test it out on organisms that have a genome similar to that of a human. Mice and humans are much more closely related than you may think. The animals that they test on include monkeys, apes, mice, dogs, and rabbits.

But, these tests do not always go correctly. Sometimes, the animal may suffer lots of pain, or even die in agony. It is not ethically or morally correct to test the effects of a drug on any living being without knowing the effects of it. A better alternative to this would be computer simulations. Computers have evolved greatly both in appearance and efficiency. A well-designed computer simulation could save millions of animal lives.

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