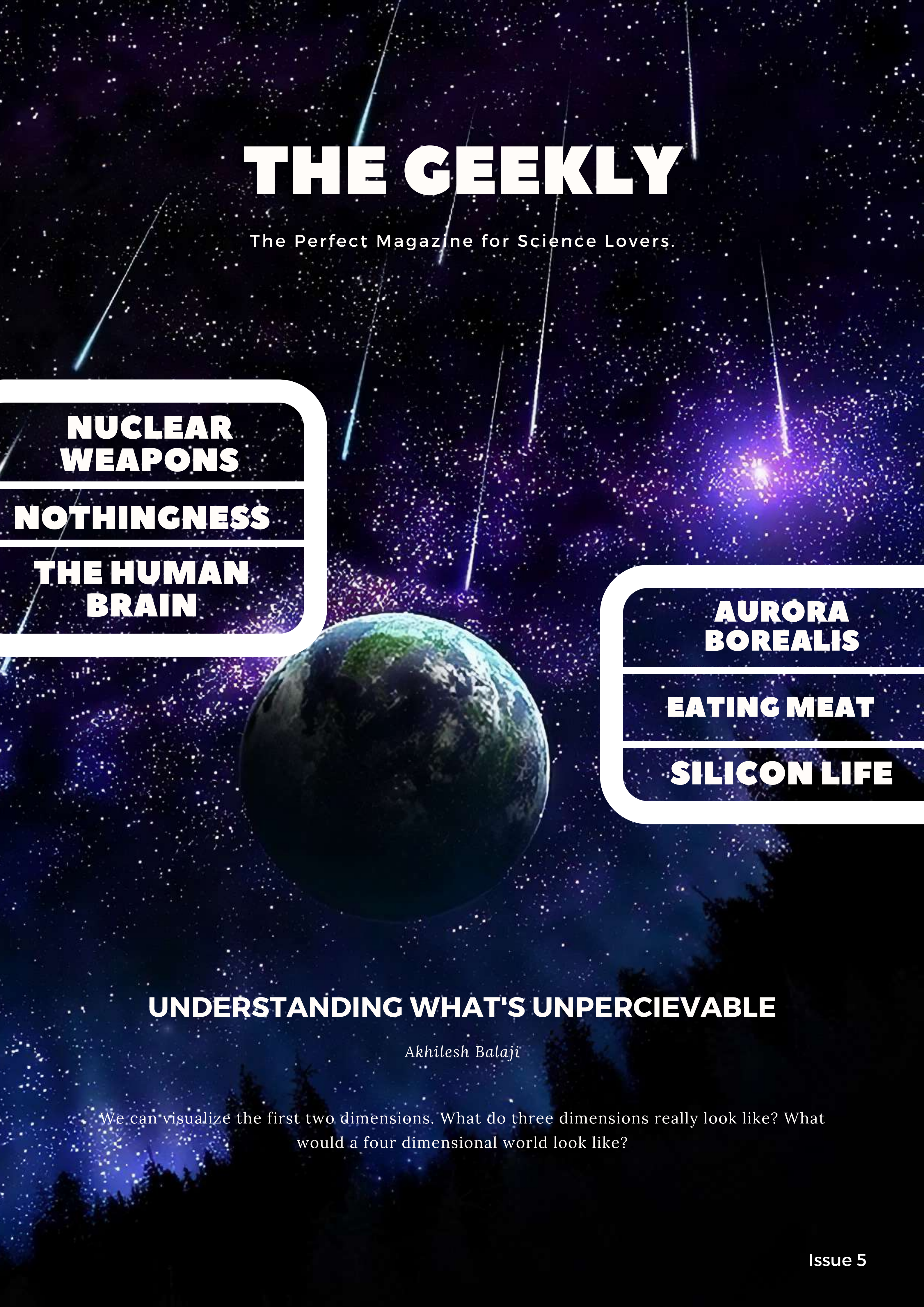

THE GEEKLY

The Perfect Magazine for Science Lovers.

NUCLEAR WEAPONS

NOTHINGNESS

THE HUMAN BRAIN

AURORA BOREALIS

EATING MEAT

SILICON LIFE

UNDERSTANDING WHAT'S UNPERCIEVABLE

Akhilesh Balaji

We can visualize the first two dimensions. What do three dimensions really look like? What would a four dimensional world look like?

Issue 5

THEGEEKLY

EDITOR'S NOTE

The month of October holds a great many surprises for us. Of course, there are all the obvious things: 31st October is Halloween, 2nd October is Gandhi Jayanti, etc. But, did you know that a pride of Asiatic lions from Gir are supposed to be relocated to Kuno-Palpur soon, to create a second home for the species? Or that a SpaceX Falcon 9 rocket will launch a Dragon cargo resupply mission (CRS-21) to the International Space Station on 30 October? The Geekly *is* a science magazine. But, sometimes, don't you feel that science is magical, too? In this issue of The Geekly, join us on an enthralling journey through higher dimensions, much ado about nothing, the intricacies of the human brain, and much, much more. Keep learning!!

Happy Reading,

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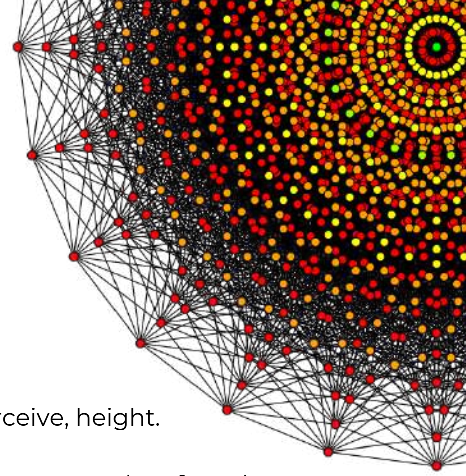


A 2D cross-section of a Dodekeract, a 12D cube. This is purely theoretical, as we don't know if the 12th dimension even exists ▶

What is a dimension? You may have heard this word being thrown at you in various different contexts: From Einstein's theory of relativity, to measuring the amount of carpet needed to cover the floor of a room. Simply put, a dimension is an aspect, or perspective of looking at things. There are many dimensions, almost an infinite number of them.

But, when we observe these dimensions from a mathematical perspective, we like to organize them based on how many ways you can measure an object in that dimension. We will start from the beginning, the zeroth dimension. As the name implies, this dimension does not have any way to measure an object in it. Thus, the only object that can exist in the zeroth dimension is a point that takes up no space at all, and therefore has no mass. This point has no shape either. Now, imagine these points stacked up on top of each other, infinitely. What do you get? You get a line. A line has only a length, and 0 thickness. What we have here is the first dimension.

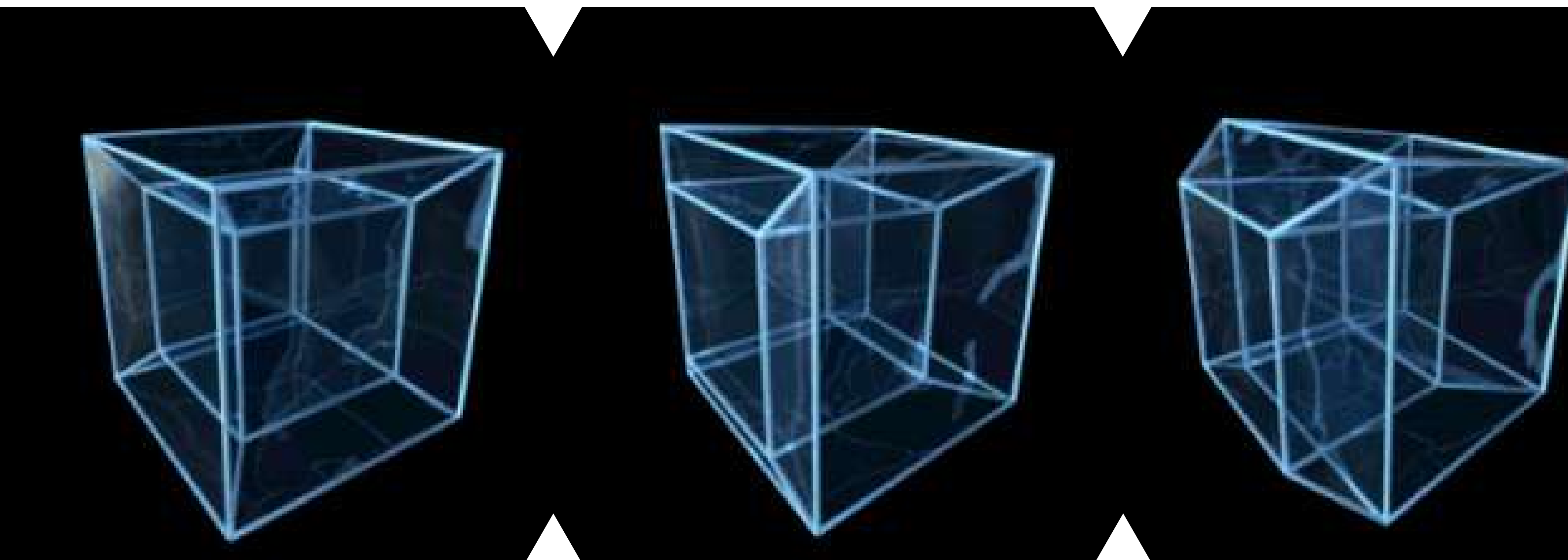
Further, imagine these lines stacked together on one axis, infinitely. You get a two-dimensional object. For simplicity's sake, let us assume that we get a square. This square has length and width, but no thickness. From a scientific perspective, it is impossible for a two-dimensional object to exist in a three-dimensional world, because everything, from a piece of paper to aluminum foil has thickness, however negligible. Three dimensions, on the other hand, are essentially many two-dimensional objects stacked up to create the last ▸ dimension that we can perceive, height.

These three dimensions are commonly referred to as x, y, and z. It seems almost paradoxical how an object of zero thickness can be stacked up, however infinitely, to create an object with one extra dimension.

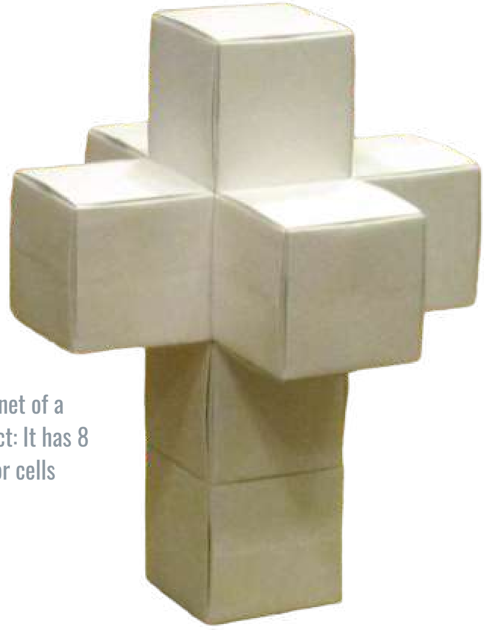
Though we are three-dimensional creatures, have you ever noticed that we cannot perceive the third dimension in its entirety? Even when we look at a three-dimensional object, we are only able to perceive its two-dimensional projection on a flat plane, the same way a wall captures our shadows. The same way, a two-dimensional creature would only be able to perceive a cross-section of a two-dimensional object, which, in this case, is a line. As the object moved closer to the creature, the line would appear to get longer and longer. If this line was growing proportional to the speed it went backwards, then the object would appear stationary. This is an illusion which can occur in the three-dimensional realm as well. Thus, a one-dimensional being would be able to see - nothing, because there would be nothing to see in the Zeroth dimension.

By the same logic, a four dimensional being would be able to see in three dimensions, which means that it would be able to see through things, above things, into things, and outside things, at the same time. Scientists also argue that three-dimensional objects are actually 4 dimensional shadows. But, what would you see if you managed to get into a four dimensional world? For the first few paragraphs, I navigated from a point to a line to a square to a cube. All of these are called "hypercubes". For instance, a line is a one-dimensional hypercube, and a cube is a three-dimensional hypercube. ▸

The first stage is the tesseract in 3D, and the rest show how rotating it in 4D affects the 3D projection.

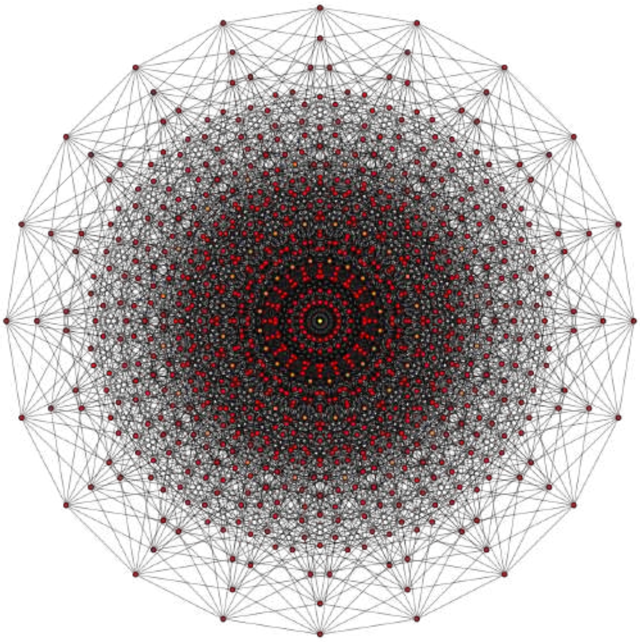


A four dimensional hypercube would be something called a tesseract. The tesseract would essentially be a cube at right angles with another cube. Explaining it in three-dimensional terms, a tesseract would be a cube with its corners connected to another cube. The tesseract you see on this page, then is a two-dimensional drawing of a three-dimensional projection of a four dimensional cube. The tesseract can essentially be broken up of subfacets, or lower-dimensional components: 16 vertices, or points, 32 edges, or line segments, 24 squares, or facets, 8 cubes, or cells, and 1 tesseract, or terra. The cube is the center is actually the same size as the cube on the outside, but it is further behind in four-dimensional space, making it appear smaller in its three-dimensional shadow.



▶ The net of a tesseract: It has 8 cubes, or cells

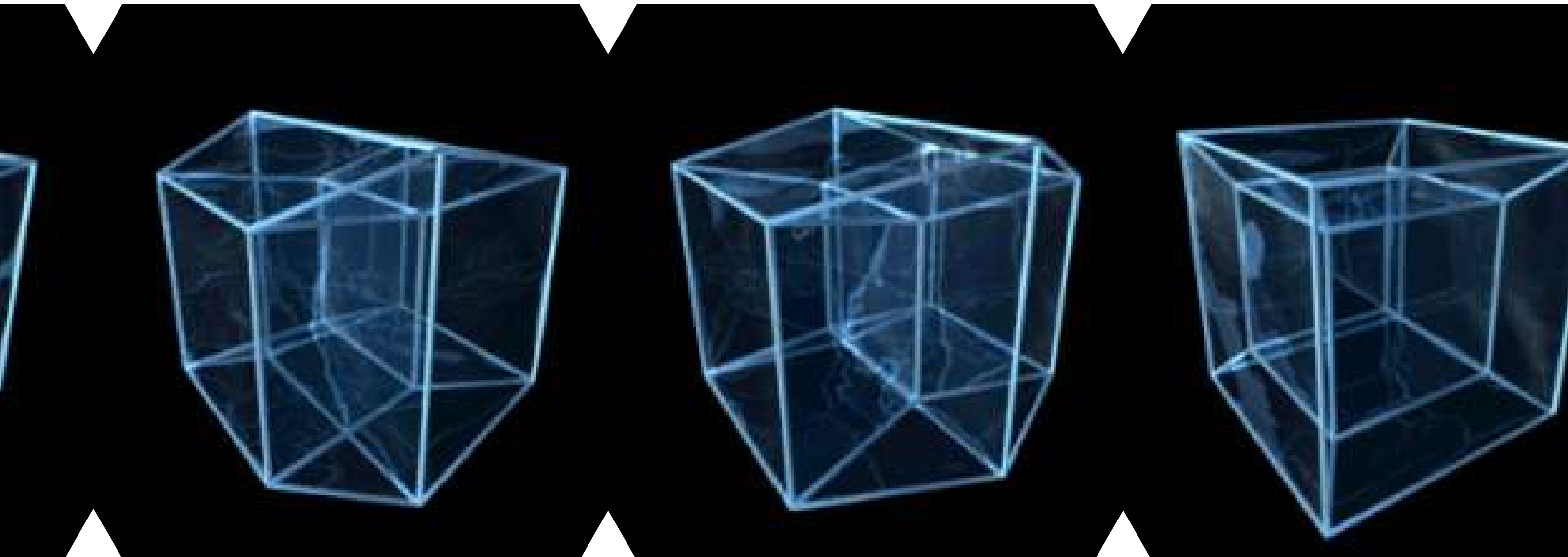
The image of a rotating tesseract (below) looks weird, right? This is because its rotation looks deformed, or distorted to us, because we, puny three-dimensional beings are unable to ▸ perceive the magnitude of the four-dimensional realm. And remember: the four-dimensional can only be perceived by beings from the fifth dimension or higher. The penteract would only be visible to six, or higher dimensional beings, the sexteract would only be perceivable to seven, or higher dimensional beings, and the dekeract would only be perceivable to eleven, or higher dimensional beings.



▲ A 2D cross-section of the 10D dekeract! Whoah!!

But that's not all! A hypercube is just one of the many types of higher-dimensional geometries. For example, the hypersphere is a generalization of the circle and sphere to higher dimensions. So, in the fourth dimension, a hypersphere would be a "glome", and in the fifth dimension, a "hyperglome". On top of those, there are simplexes (Triangle, Tetrahedron, Pentachron, etc) and cross polytypes (Octahedron, Hexadecachoron, Pentarss, etc).

Just imagine how much more intellectually capable higher-dimensional beings might be! They have extra dimensions to make neuron connections. Why, our own brains may be wired through the fourth dimension! Overall, higher-dimensional mathematics is a promising new field, and why might never be able to completely unravel it, judging by the sheer effort of trying to imagine three-dimensional projections of higher-dimensional objects. Who knows? Higher dimensions may be the true nature of reality.



Silicon Life

Akhilesh Balaji

Planet earth supports over 8.7 million species, and maybe a few hundred trillion that we haven't even discovered. These life-forms are quite varied, ranging from the one-celled amoeba to the gargantuan Blue Whale. But, all of these species have one thing in common: they are all carbon-based. Every single organism that we consider alive, on earth is called organic, meaning the base structure of their compounds are all carbon. But, what makes carbon so special? Before answering the question of silicon-based life, we must first answer the question of carbon-based life.

Carbon is the sixth element of the periodic table, falling under group 14, making it a polyatomic nonmetal. This also means that carbon has 4 valence electrons, so it can form 4 bonds. This is one of the reasons why all life on earth is carbon-based. The ability to form four bonds gives it a property called "catenation". Catenation is a property which means that carbon can form ring and chain compounds with other carbon atoms, and other elements, too. This is a very useful property.

Take, for example, a simple alkane chain called Icosane ($C_{20}H_{42}$). This is composed of 20 carbon atoms linked together with single bonds, and 42 hydrogen atoms attached to these carbon atoms. So, two bonds are used up while connecting to the next and previous carbon atoms, leaving the other two free to bond to two hydrogen atoms. As for the atoms at the beginning and end of the chain, the one extra bond is used up by another hydrogen atom: This is a simple example of linear catenation. The number of carbon atoms can keep on increasing, making the alkane chain extremely long. Scientists have even managed to observe alkane chains over 120 carbon atoms long (icosahectane)!

Then, of course, there are branched chains. The same icosane molecule we saw earlier can also be broken into, for example, 13-Pentyl pentadecane: A 15 carbon atom long chain (pentadecane) with a 5 carbon atom long chain (Pentyl) attached to it at the 13th carbon atom (13-). Icosane could even be written as 4,16-dihexyl octane. This would mean that two 6 carbon atom long chains (dihexyl) were attached respectively at the 4th and 16th (4,16-) carbon atoms of an 8 carbon atom long chain (octane).

Lastly, there are rings: A chain of carbon atoms could simply be joined at the ends to make the compound in the shape of a ring. Examples include Cycloalkanes, such as Cyclobutane (C_4H_8) and Cyclooctanonacontane ($C_{98}H_{196}$). But, there are also a separate class of hydrocarbon rings called Arenes. They are sometimes also called Benzene derivatives, because Benzene is one of the most basic Arenes: It consists of a 6 Carbon atom ring with alternating double bonds (a double bond is when two electrons are shared, instead of one, as with a single bond).

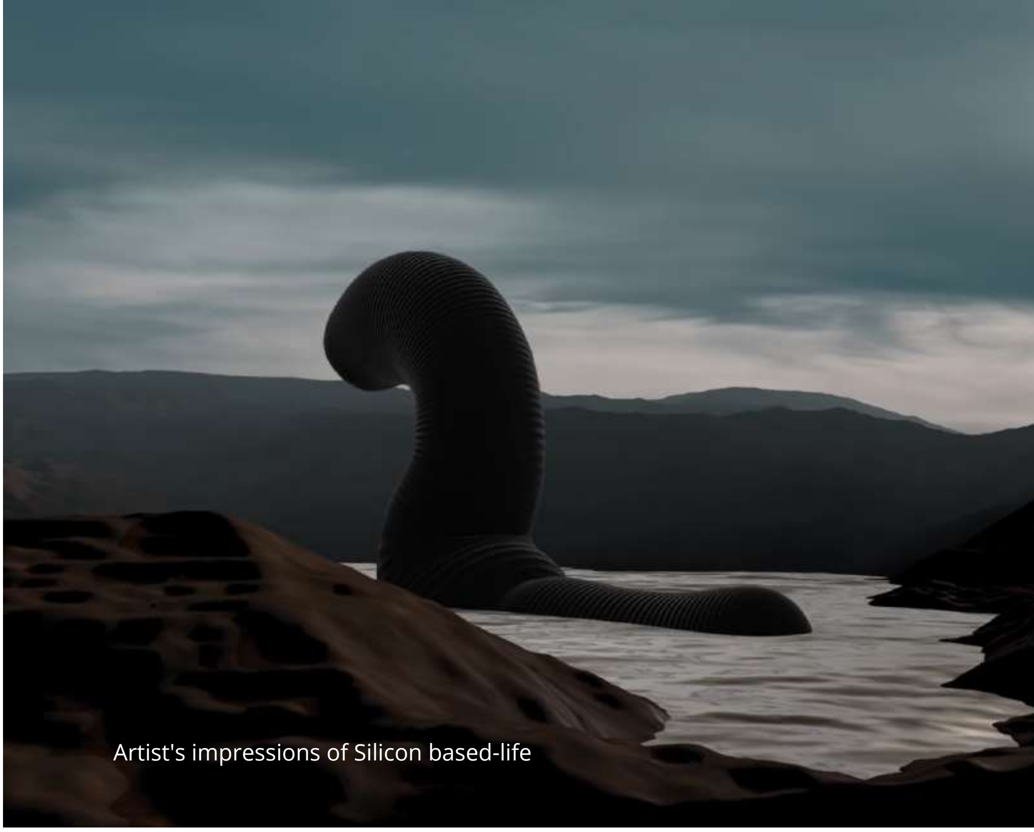
But, what is so interesting is that these double bonds, wherever in the ring they are placed, will remain stable as long as the gap between them is one bond. As a result of this, they are constantly jumping from carbon atom to carbon atom, so in the diagram, these double bonds are represented as a circle in the center of the ring.

Another unique feature of carbon is the number of allotropes it has. Pure carbon can take on various different allotropes, or forms, under different conditions. Some examples are diamond, graphite, lonsdaleite, fullerenes, amorphous carbon and carbon nanotubes.

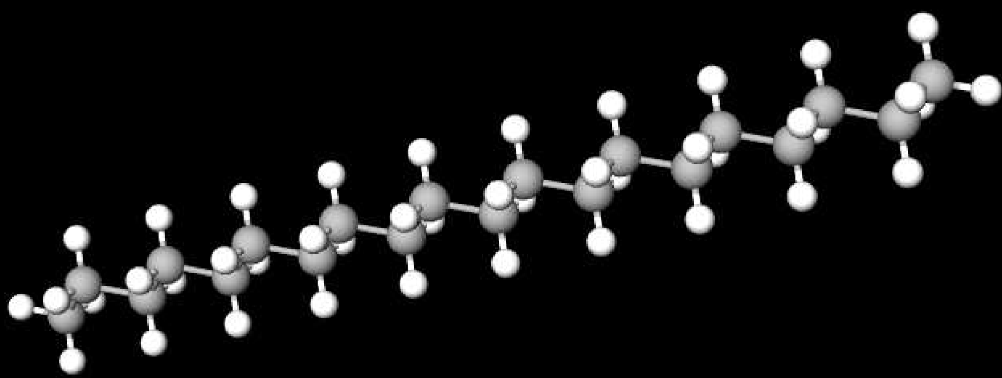
Now, we come to the question of silicon life. If carbon has all these properties, then, why worry about silicon life? The reason is that silicon also falls under group 14 of the periodic table. It also has the atomic number 14. Because these two polyatomic nonmetals have been grouped under the same column, it means both of them have some common properties. The further down from carbon you go, on that same column, the lesser common properties they have. But, luckily for us, silicon also has the property of catenation. But, there's a catch.

Silicon can form chains and rings, but it cannot bond with itself. Instead, it can form alternating bonds with oxygen. This means that there are no "silicon chains" as such. There are "silicon-oxygen chains" - chains of alternating silicon and oxygen. An example of this can be found in Quartz: the chemical composition of quartz is SiO_2. Like carbon, silicon can also form four bonds, but is slightly more heavy. But, this does not mean that silicon life is impossible. Many of its life processes will be completely different from ours. For example, CO_2 is not the same as SiO_2. The environment in which silicon life can be found will also greatly differ.

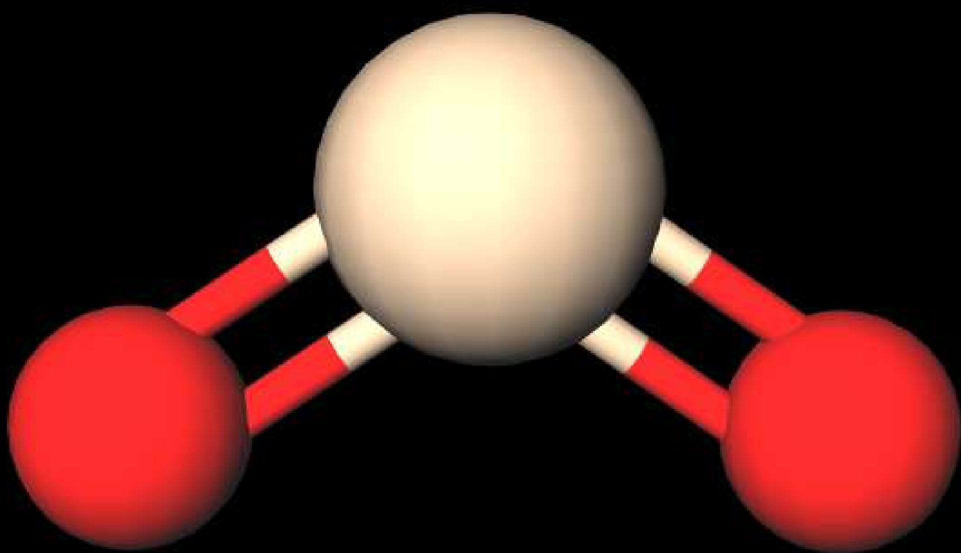
Artist's impressions of Silicon based-life



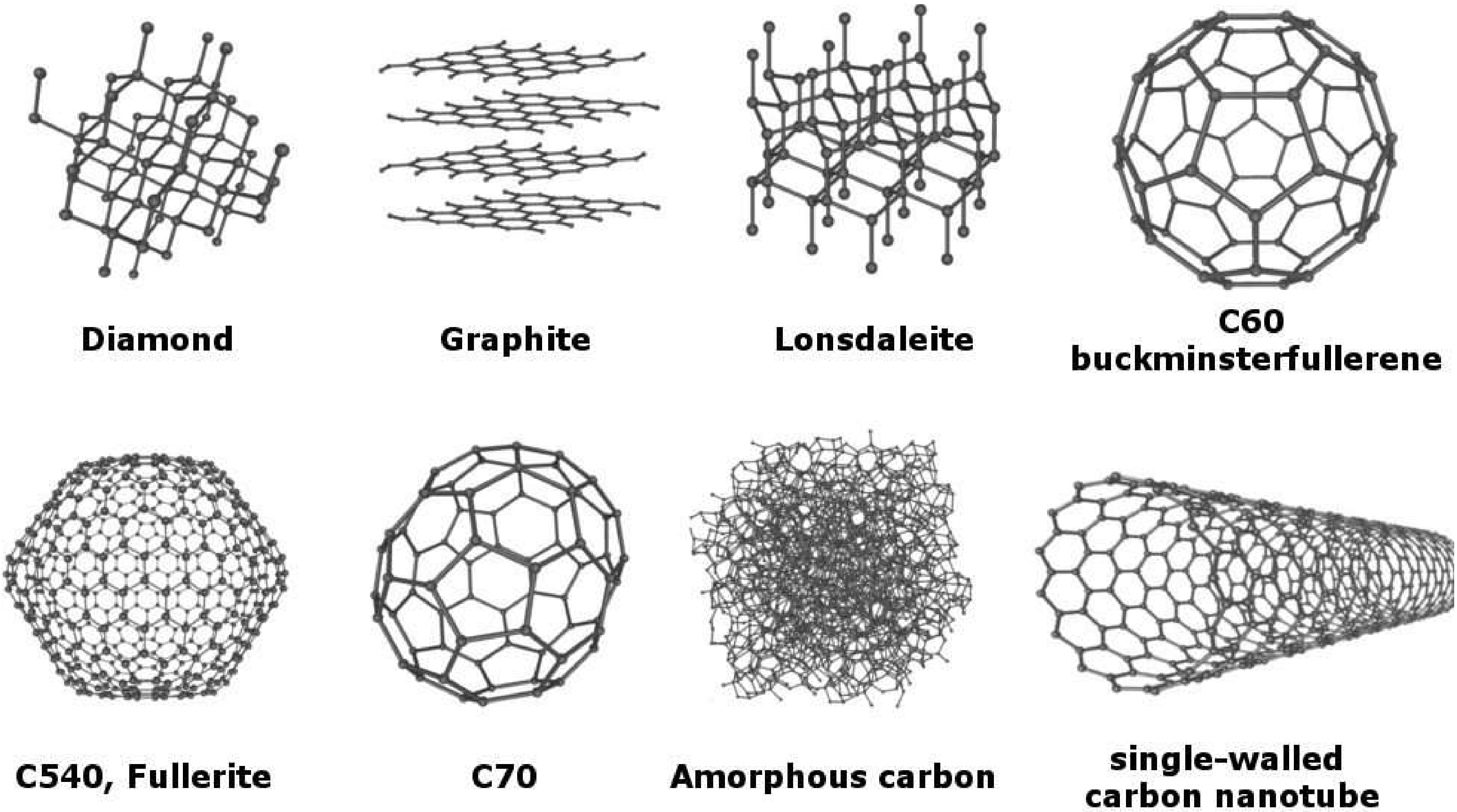
Artist's impressions of Silicon based-life



Icosane, a 20 atom long alkane



Silicon dioxide, or SiO2



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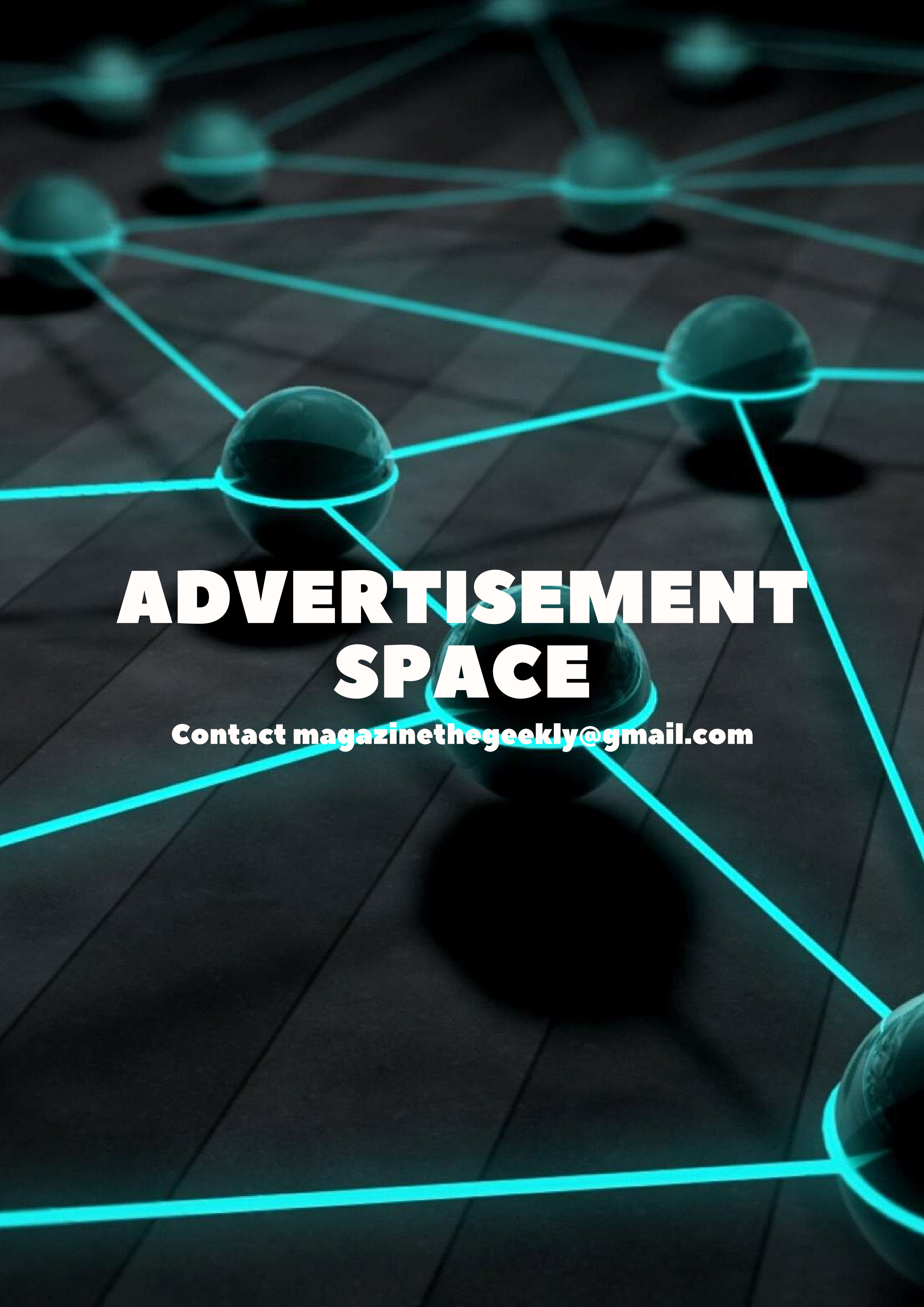
The first requirement for Silicon life to exist would be 0% oxygen in the atmosphere. This is because when silicon oxidizes, it becomes silica, which is a solid and not a gas, like carbon dioxide. Thus, if there was oxygen in the atmosphere, the silicon would turn into rock, providing no scope for the existence of silicon life. Silicon life might also not need water. It would probably use liquid methane as the galactic elixir of life. Also, it is generally agreed that extremely high temperatures would be a requirement for silicon based life to thrive. Even if it did exist, it is likely to be in the form of microbes, and not animal-sized organisms that can be seen with the naked eye.

But, I think that silicon life is highly improbable. For one thing, there is the matter of DNA. It is virtually impossible for DNA to stay stable when the carbon is replaced with silicon. Also, the conditions I mentioned above are extremely hard to find, being extremely difficult to achieve even in the lab. Maybe we just shouldn't apply our earth "science" to alien organisms that we've never encountered before.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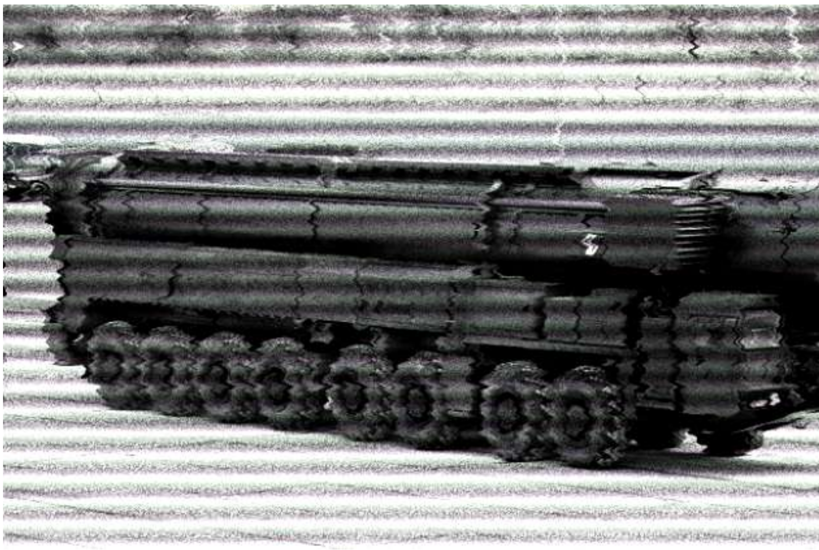
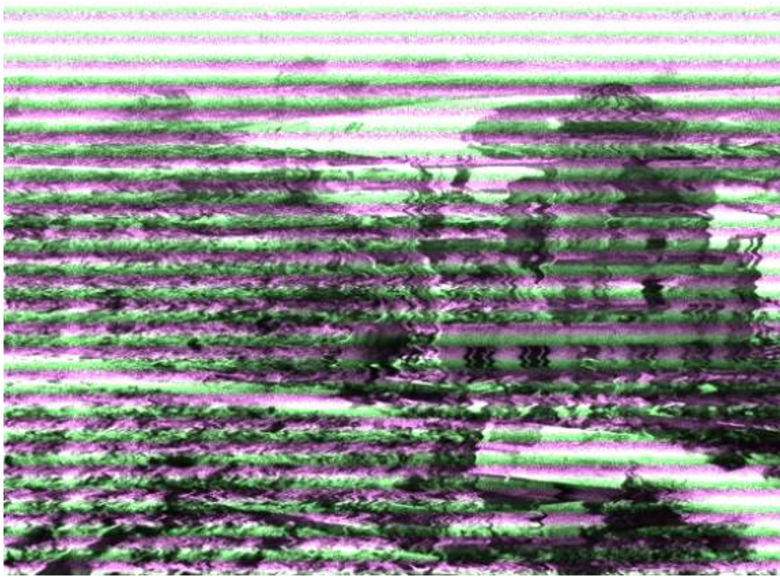
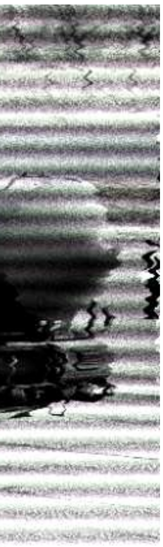
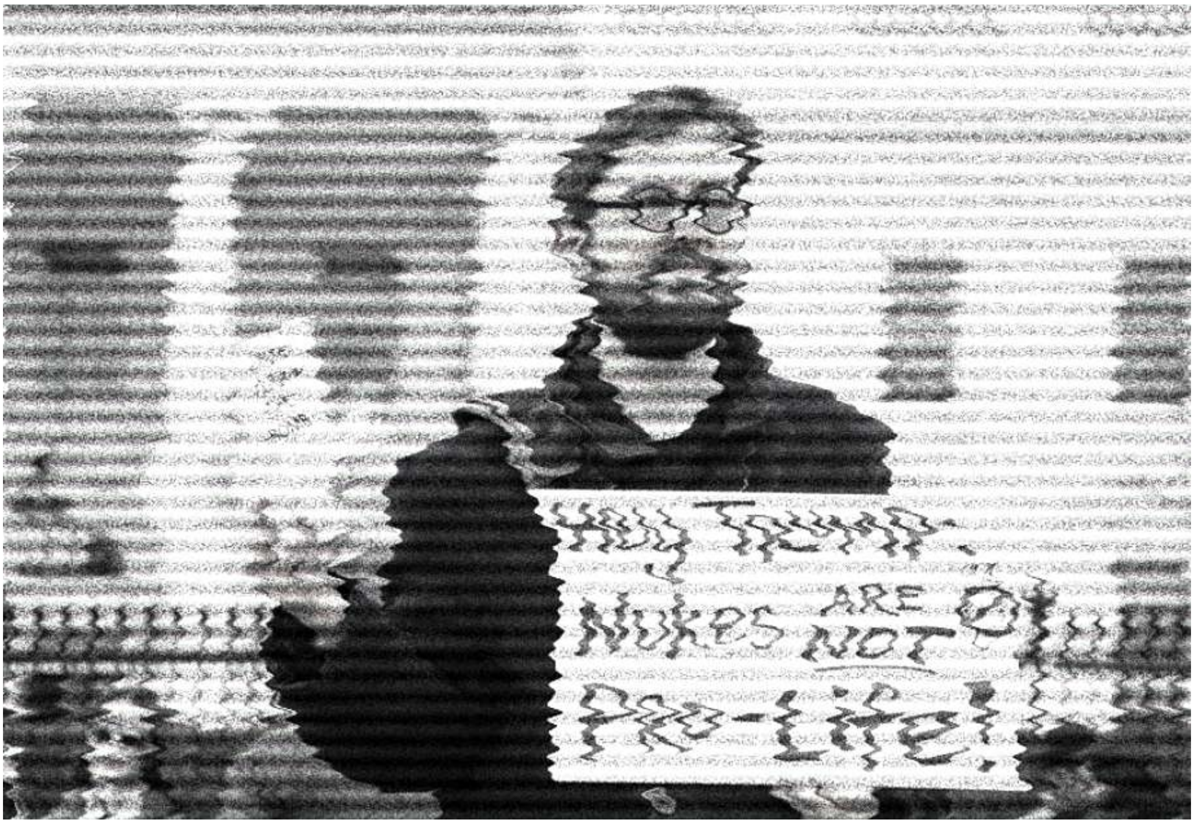
A nuclear weapon is a device that has been designed to release large amounts of energy by way of explosion as a result of either nuclear fission, nuclear fusion or a combination of the two. Fission weapons are referred to as atomic bombs. Fusion-based nuclear weapons are recognized as thermonuclear bombs, or in other words hydrogen bombs. These weapons are categorized as nuclear weapons because a significant portion of the energy is released by nuclear fusion or fission.

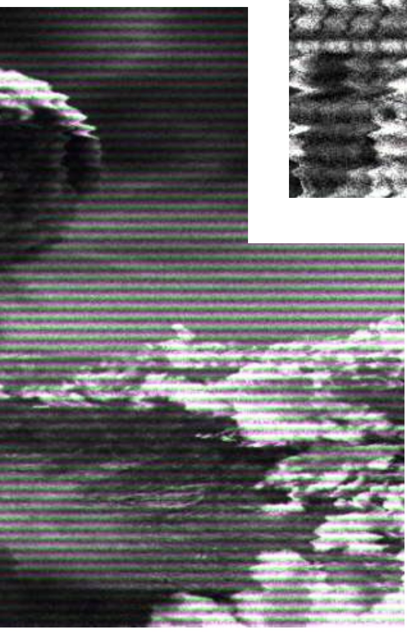
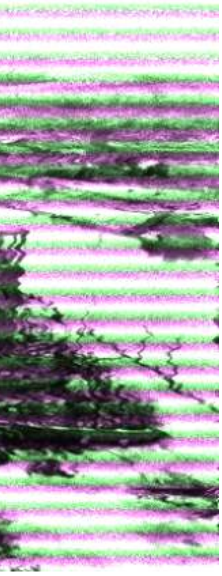


Nuclear weapons compared to chemical weaponry produces simply enormous amounts of energy. The explosive energy led to the terms megaton and kiloton being coined, as a unit to measure their blast energy over conventional TNT (trinitrotoluene). One of the most famous nuclear bombs was the one dropped on Hiroshima, during World War II in 1945.

This bomb contained approximately 64 kilograms of uranium, however the energy released was far more, to be precise 15 kilotons (1,000 tonnes) of chemical energy. The blast was so impactful, that it produced a huge shock wave, along with enormous amounts of heat and lethal radiation. This further led to convection currents being created pushing up particulate matter and debris into the atmosphere, creating the familiar and trademark 'mushroom cloud'. Radioactive debris was carried high into the atmosphere, then falling due to gravity in a radioactive fallout. Bombings like these cause an enormous toll of casualties and deaths, and in this case the attack on Hiroshima was closely followed by a similar nuclear bombing in Nagasaki.



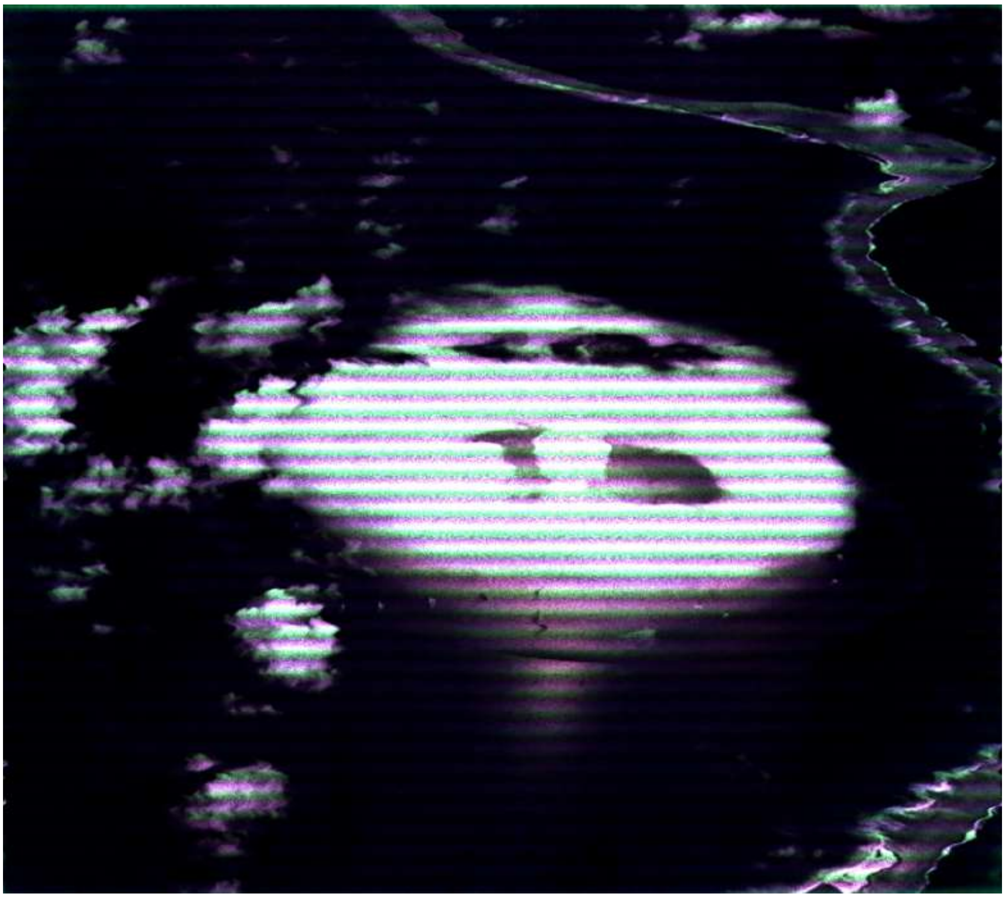



Since decades after the invention and then application of nuclear weaponry, militaries have invested and invented far better technology that can do much more destruction than the bombs dropped in Japan in 1945. This has led to governments worldwide negotiating arms-control deals. These countries that have nuclear weapons have also led to military strategists forming a new discipline called nuclear strategy, pertaining solely to nuclear weapons of unparalleled power. In the pioneering stages of nuclear weaponry, nuclear bombs were only ‘dropped’ by airplanes. Later on, nuclear warheads were developed as ballistic missiles which are arguably the most important nuclear weapons of them all. Currently, smaller tactical nuclear weapons can be ‘delivered’ by the means of artillery, land mines, torpedoes, depth charges and short range cruise missiles.

After the first use of nuclear bombs during World War II, the Cold War between the USA and its allies against the Soviet Union and its satellite states. Roughly between 1945 and 1991 nuclear development drastically increased with the American stockpile of nuclear weapons at 32,000 warheads in 1966.

Nuclear fission is a process in nuclear physics wherein the nucleus of an atom is split apart into two or smaller nuclei, known as the products of fission. The byproducts of fission process include neutrons, photons usually as gamma rays and nuclear fragments. Fission of heavy elements such as Uranium and Plutonium are exothermic reactions and release high amounts of energy as kinetic energy, heating up the substances around it. This energy can be harnessed for nuclear power and nuclear weaponry. Fission was used in the atomic bomb in Hiroshima mentioned above.

Nuclear fusion is another nuclear process, where energy can be produced when light atoms are ‘smashed’ together. It is the opposite reaction of fission, mentioned above. The sun and other stars generate heat by the process of fusion. It is done on Earth by combining two isotopes of the same element, such as hydrogen. Two isotopes of hydrogen are deuterium and tritium. Hydrogen is the lightest element of all with a single proton. However, between the isotopes, the number of neutrons is different. This process is used in thermonuclear weapons. Scientists are currently working on such nuclear bombs which do not require any fission process at all to activate the fusion process. Thermonuclear bombs are more sophisticated than atomic bombs and cause more destruction, and are less compact. The strongest nuclear bomb we know was a thermonuclear bomb.

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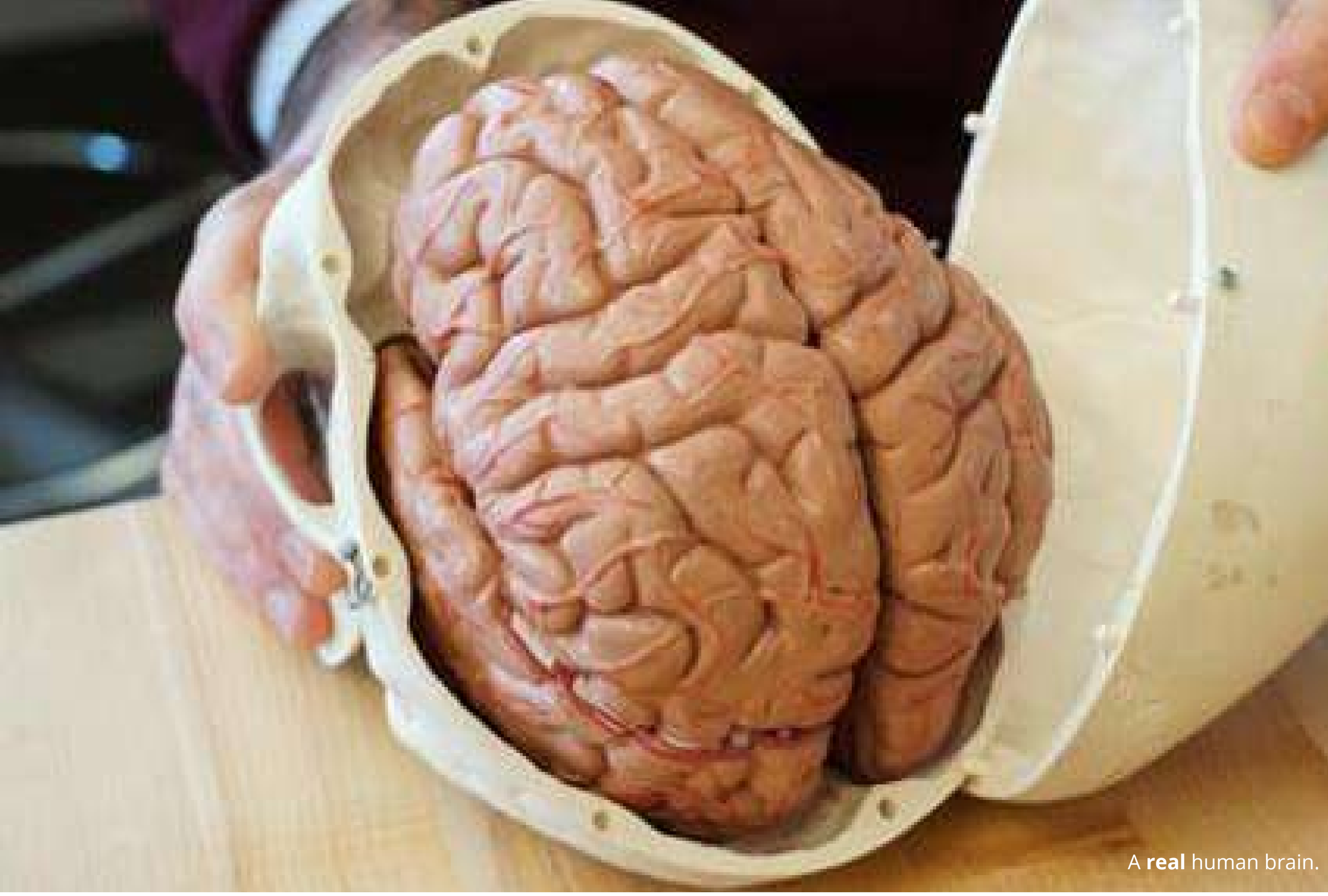
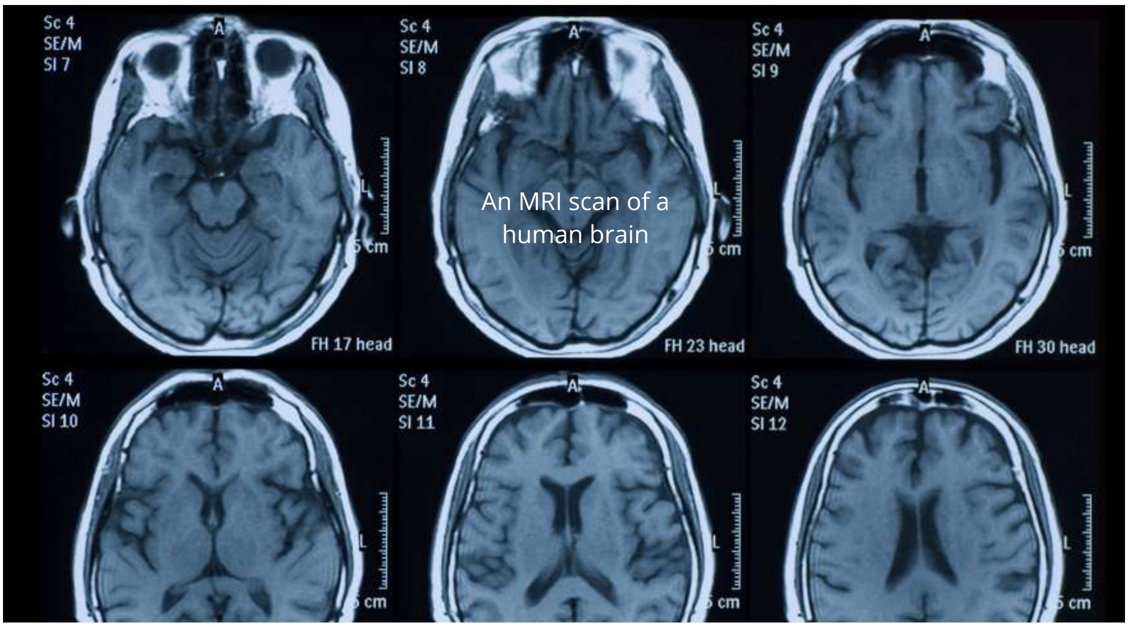


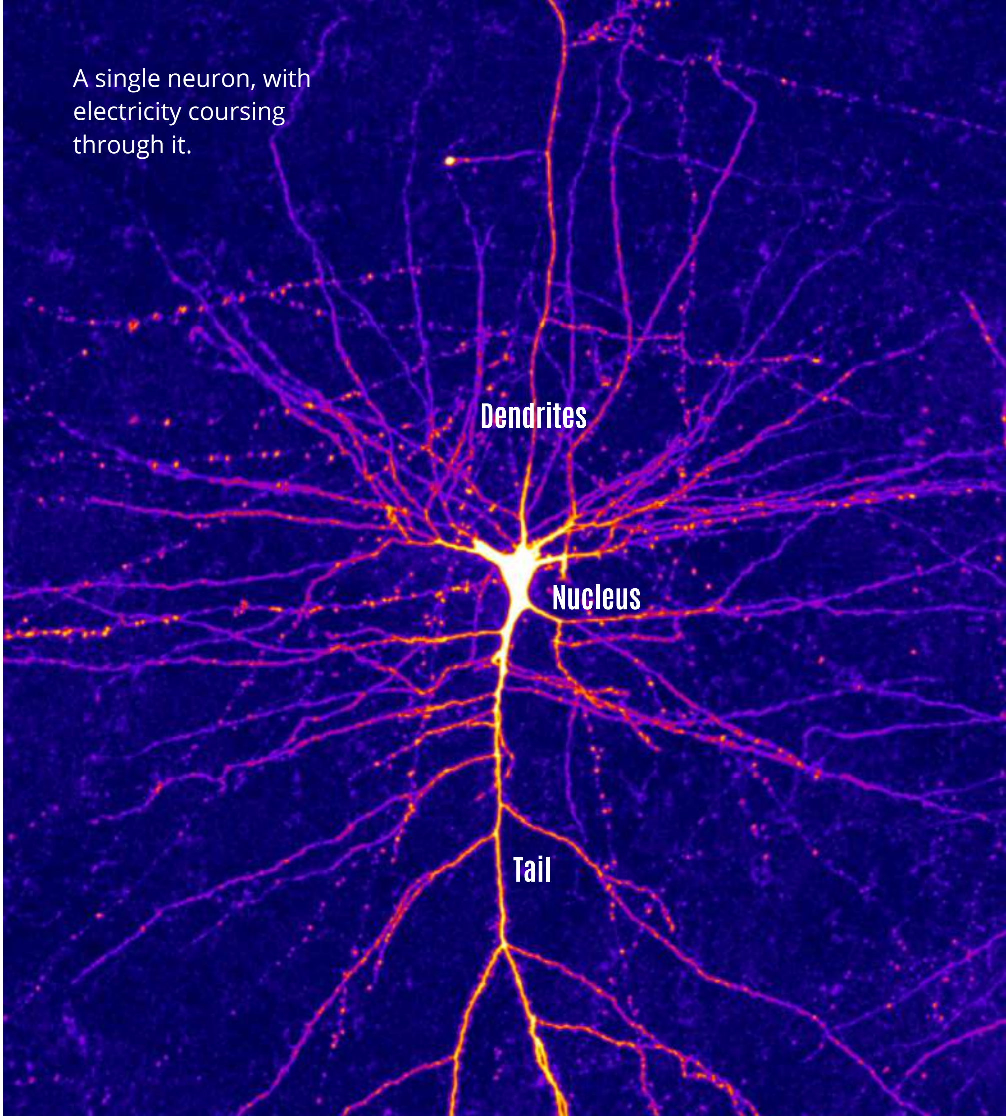
A **real** human brain.

There is one organ that has powered humanity's rise to power on planet earth. That organ is responsible for humanity's invention of one of the most primitive tools: Fire, as well as some cutting edge technology: Rockets. The journey from fire to rockets is one that puzzles a great many anthropologists. What was it that powered humanities rise to power: The humble lump of fat sitting in your head: The human brain.

What is it that makes the brain so important? The brain, for starters, is what powers your existence: It is responsible for the pumping of your muscles every time you decide to burn some calories, the direction of your immune system, and even the steady dub-dub of your heart. Also, the brain is what gives you your



An MRI scan of a human brain



A single neuron, with electricity coursing through it.

This is already quite a lot of things to handle. But, there is something at the root of all of this, something drives the brain to make all these decisions, and perform all of these actions: Consciousness. Consciousness is awareness or sentience of internal or external existence, but this definition has been widely debated, since it is the most puzzling aspect of our lives. An amoeba, for instance, has no knowledge of the fact that it is alive: It simply goes around doing its duty: Engulfing its “food”.

The brain is so powerful that to map the entire human brain, it would require 20,000 terabytes of data. To put that into perspective, the average computer has a capacity of around 64 gigabytes to 3 terabytes. But, what is it that makes the brain capable of so many “features”? How is it so powerful? To understand this, we must delve into the lump of fat itself. As it happens, the brain is not just a lump of fat. Inside the brain, there are billions of little cells called neurons.

Alone, these neurons are useless. But, when the neurons are connected together, the more and more intelligent, or capable you become. For example, a human baby has around 2,500 connections per neuron, and 100 billion neurons. So, a human baby has a total of approximately 2.5e+14 neuron connections, or 250 trillion neuron connections. A middle-aged person, on the other hand has a total of about 500,000,000,000,000 connections.

What do we mean by connections? Well, the neuron has three parts: The dendrites, the body, and the tail. The dendrites are the parts responsible for making connections, or latching on the other neurons, and the tail is the “receptor”. It is the place where the dendrites connect. And, finally, the body is the part that houses the nucleus. The nucleus is the control center of the cell, and houses all the cell’s DNA.

These neurons are conductors of electricity. When one neuron is electrically activated, that electric charge passes through all the other connected neurons, almost like a pathway. This electric charge then travels through the appropriate areas of the nervous system, if needed. To watch all of this in action, through a microscope, is truly a beautiful sight.

The brain is also organized into several parts, which are the cerebrum, cerebellum and brain stem. The cerebrum is responsible for interpreting the senses: touch, vision and hearing, as well as speech, reasoning, emotions, learning, and fine control of movement. The cerebellum coordinates muscle movements, posture, and balance, while the brain stem is a connection between the brain and the spinal cord. It is responsible for the automatic functions such as heartbeat, temperature, breathing, sneezing, coughing, and swallowing.

The two hemispheres are a part of the cerebrum. The left hemisphere and the right hemisphere. As their names suggest, these hemispheres are the left and right sides of the brain respectively. The right side of the brain is believed to be more

Must See

oriented towards creativity, and the left side is believed to be oriented towards facts, and knowledge. But, guess what?? The left side of the brain controls the right side of the body, and the right side of the brain controls the left side of the body. So, people who are left-handed tend to be more artistic or imaginative than right-handed people. It is not that this is always true, it is just true majority of the time. These two hemispheres are connected by the nerve fibers, called corpus callosum.

The four major lobes are also a part of the cerebrum. The frontal lobe focuses on behavior, emotions, judgement, problem-solving, intelligence and concentration. The parietal lobe, on the other hand, focuses mainly on the interpretation of pain, language, words, and spatial, as well as visual perception. The occipital lobe only interprets signals from the eyes, i.e. colors, brightness, etc, and the temporal lobe focuses on memory, hearing, and organization.

The brain is so complex, that even now, we have difficulty understanding it. How is the brain able to be so fast and efficient? These questions have even led to the hypotheses that our neurons are connected through the fourth dimension. But, at the end of the day, it all comes down to one thing: Evolution.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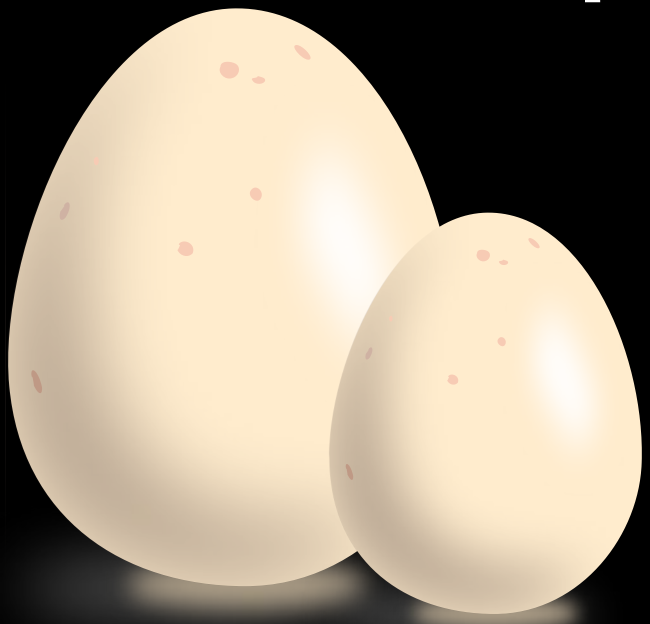
FIND AND JUSTIFY THE ANSWER

Which came first: The pterosaur, or the egg?



THE DOUBLE-SL

LIT EXPERIMENT

Instead of a pattern relative to where the two slits are, the wall instead shows an interference patter based on the wave's interactions with each other. Cool, right?

MUCH ADO ABOUT NOTHING

PROF. FRANK CLOSE

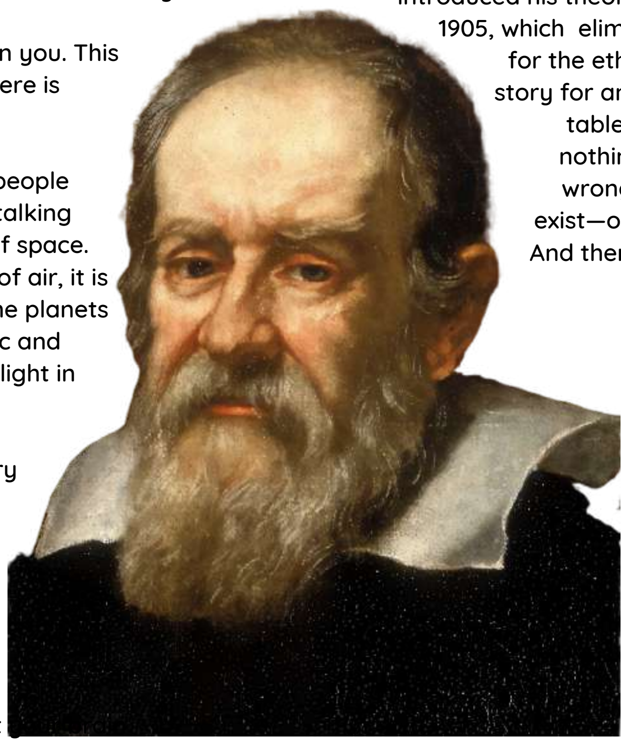
NOTHING is not as simple as it seems.

The concept of nothing has fascinated philosophers and scientists throughout history. The search for an ever-deeper understanding of nothing has driven scientific discovery since the age of Ancient Greece, and today the pursuit of nothing defines the frontier of modern particle physics. But before we talk about nothing, let's talk about something: air.

For millennia, philosophers thought that "empty" air was nothing. Aristotle and the ancient Greeks, though, recognized air as a "thing" in its own right. Wind, after all, is nothing but air, yet it can be felt powerfully. Indeed, the Greeks considered air to be one of the basic elements, along with earth, water, and fire. These elements, in turn, were believed made of some basic something which they called "ur-matter." A familiar modern example, sucking on a drinking straw, seems to illustrate the impossibility of creating a vacuum: The straw doesn't fill up with vacuum but instead "implodes," apparently confirming the Greek belief that "Nature abhors a vacuum."

About two millennia would pass before Galileo and others realized that the implosion is due to the external pressure of the air, and not a cosmic law against nothingness. This soon led to the invention of the barometer and a remarkable discovery: Air pressure decreases with altitude. The reason is that the atmosphere has a finite height and the nearer you get to the surface, the less air there is pressing down on you. This inspired the thought that above the atmosphere is nothing—or, at least, no air.

By the end of the 17th century, then, when people talked about "nothing," they were no longer talking about air: They were talking about the void of space. Today, we know that though space is empty of air, it is filled with gravitational forces which guide the planets and order the galaxies. It is also full of electric and magnetic fields that give us sunlight and starlight in the form of electromagnetic waves.



This created great problems for 19th century scientists: Since the electromagnetic waves from the sun and stars were making it all the way to Earth, they must be traveling through something. After all, they knew that sound waves need a medium through which to travel. I speak and air molecules bump into one another until some hit your eardrums, making them vibrate, generating signals that interprets as sound. The absence of air in space leaves the sun silent, yet we can see it.

To resolve this paradox, scientists argued that there must be some medium through which the electromagnetic waves traveled. "Waves in what?" was answered with: "The ether." And so began one of the greatest wild goose chases in the history of science, as many of the leading lights in the field went in search of this weird ether that was capable of transmitting light at about 300,000 km every second while still allowing the planets to pass through as if there were nothing there at all. The search did not end until Einstein finally introduced his theory of relativity in 1905, which eliminated the need for the ether. (But that's a story for another day.) The tables had turned on nothing: Aristotle was wrong. Nothing could exist—or so we thought. And then came quantum mechanics.

In the quantum realm of tiny subatomic particles, the more closely you look at nothing, the more things you discover. What looks empty to our gross senses turns out to be effervescing with particles of matter and anti-matter. The apparent void is a medium filled with stuff, a froth of will-o'-the-wisp particles of matter and antimatter.

This new quantum mechanical view of nothing began to emerge in 1947, when Willis Lamb measured spectrum of hydrogen. The electron in a hydrogen atom cannot move wherever it pleases but instead is restricted to specific paths. This is analogous to climbing a ladder: You cannot end up at arbitrary heights above ground, only those where there are rungs to stand on. Quantum mechanics explains the spacing of the rungs on the atomic ladder and predicts the frequencies of radiation that are emitted or absorbed when an electron switches from one to another. According to the state of the art in 1947, which assumed the hydrogen atom to consist of just an electron, a proton, and an electric field, two of these rungs have identical energy. However, Lamb's measurements showed that these two rungs differ in energy by about one part in a million. What could be causing this tiny but significant difference?

When physicists drew up their simple picture of the atom, they had forgotten something: Nothing. Lamb had become the first person to observe experimentally that the vacuum is not empty, but is instead seething with ephemeral electrons and their anti-matter analogues, positrons. These electrons and positrons disappear almost instantaneously, but in their brief mayfly moment of existence they alter the shape of the atom's electromagnetic field slightly. This momentary interaction with the electron inside the hydrogen atom kicks one of the rungs of the ladder just a bit higher than it would be otherwise.

This is all possible because, in quantum mechanics, energy is not conserved on very short timescales, or for very short distances. Stranger still, the more precisely you attempt to look at something—or at nothing—the more dramatic these energy fluctuations become. Combine that with Einstein's $E=mc^2$, which implies that energy can congeal in material form, and you have a recipe for particles that bubble in and out of existence even in the void. This effect allowed Lamb to literally measure something from nothing.

This suggests that the contents of the vacuum—the "stuff" of nothing—could be organized in different ways at different times in the history of the universe. Think of water molecules: They can roam freely in the liquid or lock tightly to one another in ice crystals. This analogy hints at an intriguing possibility: Could the contents of the quantum vacuum be in a different configuration in today's cool universe than they were in the first moments after the hot Big Bang?

At creation, the thinking goes, particles had no mass and moved through the vacuum at the speed of light. Around a trillionth of a second after the Big Bang, the universe was cool enough that a mass-giving field called the "Higgs field" condensed in the vacuum, as water condenses from steam.

The Higgs field is believed to disturb the motion of fundamental particles like electrons as they move through it, producing the effect that we call mass. If this is correct, there should be particle manifestations of the Higgs field, known as Higgs bosons, just waiting to be discovered.

The Large Hadron Collider (LHC) at CERN is hot on the trail of these particles, but decisive evidence of the Higgs boson—which is very massive and can only be produced in an enormous blast of energy—is still elusive. Scientists working on the LHC expect that they may see the first glimpse of the Higgs by the end of 2012. Whether this is the real deal or whether we are being fooled by some cruel, random throw of Nature's dice, time will tell.

Aristotle was right: There is no thing that is nothing. Is the Higgs field part of the something? Within a few months we may know the answer.

FOR MORE INFORMATION...

- Read "Nothing - A Very Short Introduction (Oxford)" by Frank Close
- Read "The Infinity Puzzle (Oxford)" by Frank Close
- The former is what the article was inspired by; the latter deals with the Higgs boson and brings everything up to date.
- Francis Edwin Close, OBE, FInstP is a particle physicist who is Emeritus Professor of Physics at the University of Oxford and a Fellow of Exeter College, Oxford.
- His primary research interest in particle physics is the dynamics of hadrons, in particular the role of glue in the strong interaction limit and of mesons "beyond the quark model", such as glueballs, hybrids and molecules. Most of his work, post-retirement, is in writing about physics.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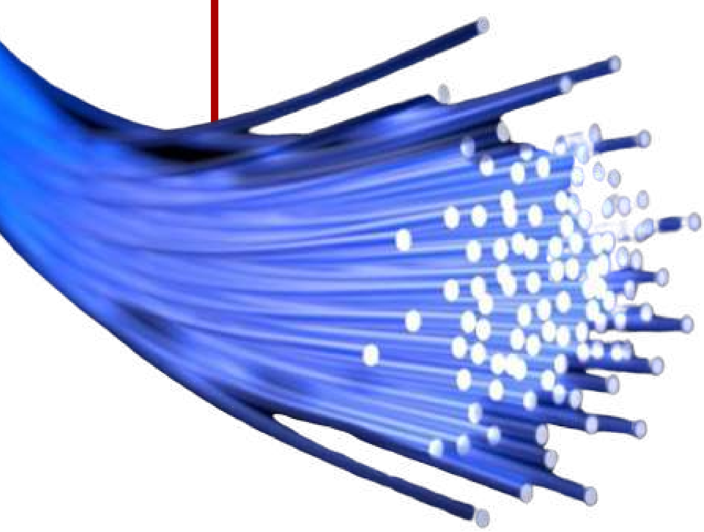
Gadget
Bio Elastic Display

A bio elastic display is an ultra-thin sheet that has microscopic electronics embedded in it. It is highly flexible, and is currently used in hospitals as a high-end way to measure heart rate, blood pressure, etc.

OF THE MONTH

Material
Optical Fiber

Optical fibers are essentially highly reflective and transparent cables that light easily passes through. In the image, you can see how the tubes are brightly lit up as light passes through them. These optical fibers are also the same cables that transmit wireless signals all over the world.

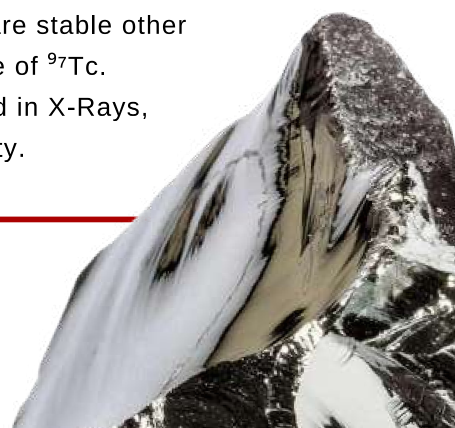


Species
Glaucus Atlanticus

The *Glaucus Atlanticus*, or the Blue Dragon are often only about a few inches long and can be found in the Indian Pacific Oceans. The blue dragon floats upside down in order to blend the blue side of them with the water, and the silver side with the surface of the ocean. This tiny dragon feeds on creatures like the man o' war and can even deliver a sting similar to it..

Element
Technetium

Technetium is a chemical element with the symbol Tc and atomic number 43. It is the lightest element whose isotopes are all radioactive; none are stable other than the fully ionized state of ^{97}Tc. Technetium was also used in X-Rays, due to it's mild radioactivity.



Scientist
John Edmark

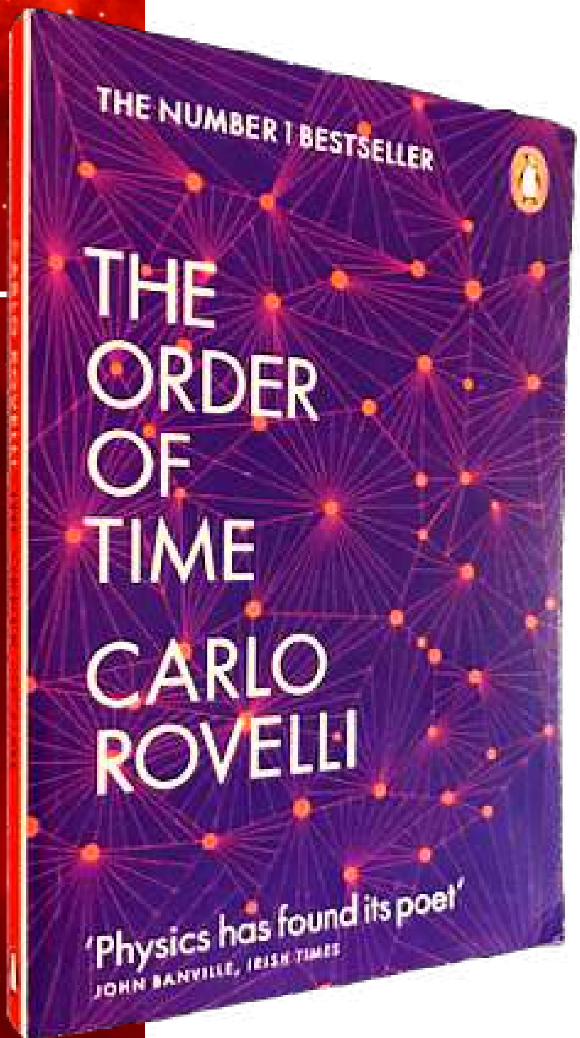
John Edmark is a professor at Stanford University, whose work focuses mainly on spirals. He has done various kinetic sculptures around the concept of spirals.

Compound
Fluorite

Fluorite is the mineral form of calcium fluoride, CaF_2.It crystallizes in isometric cubic habit, although octahedral and more complex isometric forms are not uncommon. The Mohs scale of mineral hardness, defines value 4 as Fluorite.

Book
The Order of Time

Why do we remember the past and not the future? What does it mean for time to "flow"? Do we exist in time or does time exist in us?For most readers this is unfamiliar terrain. We all experience time, but the more scientists learn about it, the more mysterious it remains. We think of it as uniform and universal, moving steadily from past to future, measured by clocks. Rovelli tears down these assumptions one by one, revealing a strange universe where at the most fundamental level time disappears. He explains how the theory of quantum gravity attempts to understand and give meaning to the resulting extreme landscape of this timeless world. Weaving together ideas from philosophy, science and literature, he suggests that our perception of the flow of time depends on our perspective, better understood starting from the structure of our brain and emotions than from the physical universe.



WHAT IF

You ate Uranium?

Movies depict people swallowing radioactive material and becoming superhuman. The movies are the worst possible reference for any possible scientific question. The movies exist to make you feel excited, or disgusted at the effects of something, and send adrenaline pumping down your veins. No, we will answer this question scientifically. First, the average human consumes about 0.1 micrograms of uranium, daily. How is this p[possible? Well, when you eat vegetables, rain or wind blows tiny quantities of uranium and other radioactive material onto it. These are such tiny amounts that no amount of washing can get rid of it. But, don't worry. These amounts are virtually harmless.

But, what would happen if you ate a large chunk of uranium? Well, it would quickly start causing damage to your stomach, and large doses of this radiation would cause organ failure. Why? That's because uranium gives off what is known as beta radiation. This means that it keeps giving of neutrons that bombard everything around it. But, eating uranium is much less toxic than inhaling it. That's one good reason why you shouldn't eat uranium curry for dinner tonight...


EATIN
CORRECT


G MEAT
OR WRONG?

DEBATE

Let us begin this end of the debate with some facts and statistics. Meat is quite surely not the most efficient way to feed us humans and provide nutrition for our survival. This is due to the lengthy process of production and the expenses involved. We have over 25.5 billion livestock animals which we need to feed. This means that large portions of our planet are solely used for farmland. And 83% of this farmland is used for feeding all the livestock.

This means that 26% of Earth's total landmass is devoted for breeding, feeding and housing all these animals. 27% of Earth's freshwater is required to feed all these animals. You now realise that the amount of resources spent is much higher than the output meat that we consume. For one kilogram of steak, there is 25 times as much kilograms of grain required, and 15,000 litres of water. The amount of resources and crops utilised for animal production, every single human on earth as well as an additional 3.5 billion people could be fed according to projections. Meat production is also extremely unsustainable, as 15% of greenhouse gas emissions caused by humans are from the meat industry. Which is about as much of emissions caused by all transportation combined.

Dhruv Ramu

DEBATE

Akhilesh Balaji

Humans began to influence their surroundings at an early stage. We domesticated animals, selectively breed them to suit our needs. For instance, humans bred foxes and wolves to become adoring and loyal dogs, bred wild bulls to become docile calves, and boars to become pigs. But this relationship wasn't just a one way relationship. It was a two-way relationship, or a symbiotic relationship between humankind and the other species. That way, both human and animal benefited from this. How, you may ask, does slaughtering and eating animals help them?

The answer is wreathed in irony: If we removed animals from the menu, then they would go extinct. That would mean an ecological disaster - these animals survive and are bred in the care of humans: without these humans we would die. Animal sentience and welfare are not at the center of this debate - ecology is. What, I ask, is the difference between a leopard pouncing on its prey from a tree top, and a human ravenously attacking his steak with a fork?

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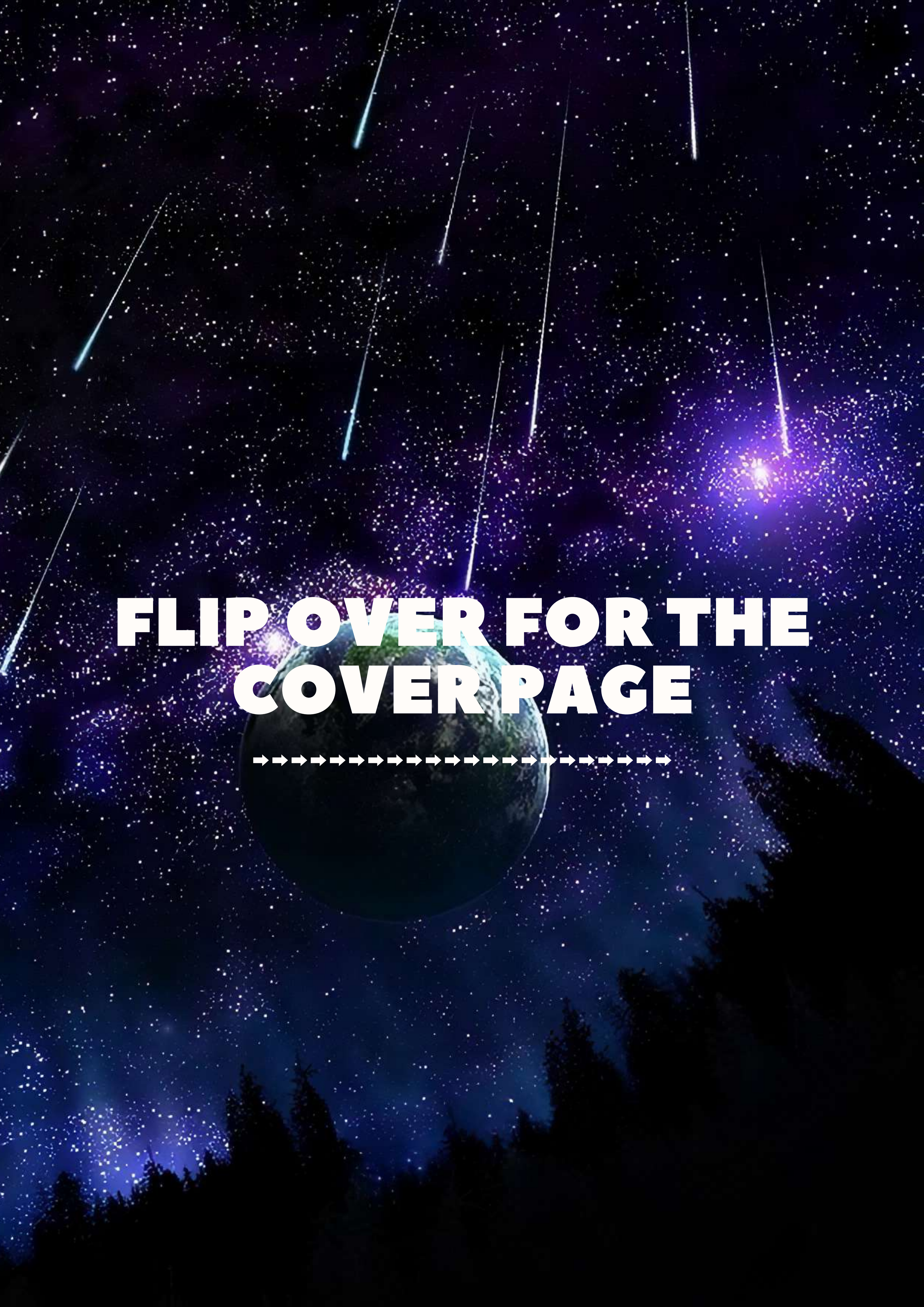
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