THE GEEKLY

The Perfect Magazine for Science Lovers.

IS GOD REAL?

VOLCANOES

FRACTALS

KARDASHEV SCALE

ABIOGENESIS

RIBOSOMES

SCANNING THE STARS

Dhruv Ramu

The vast expanse of outer space seems almost limitless, infinite. But, is it really? In that vast expanse, hidden somewhere, is there... life?

Issue 6

THEGEEKLY

EDITOR'S NOTE

"A small step for man, a giant leap for The Geekly!"
This is the 6th issue of The Geekly! Can you believe that? One entire year of The Geekly issues! Why, it seems like just yesterday we were planning how to launch it! In this issue of The Geekly, we bring to you a vast array of topics: How did life begin? Did life come from other life, or non-living things? We explore the possibilities of Extraterrestrial life in *Scanning the Stars*, and interview Nobel Laureate and President of the Royal Society, Venkataraman Ramakrishnan. Join us on an enthralling journey through fractal dimensions, and the Kardeshev scale! There are various religions all over the world, all preaching the existence of some supernatural all-powerful being: God. Does he really exist? Can modern science prove his existence? I won't delay you any longer.
Happy Reading,

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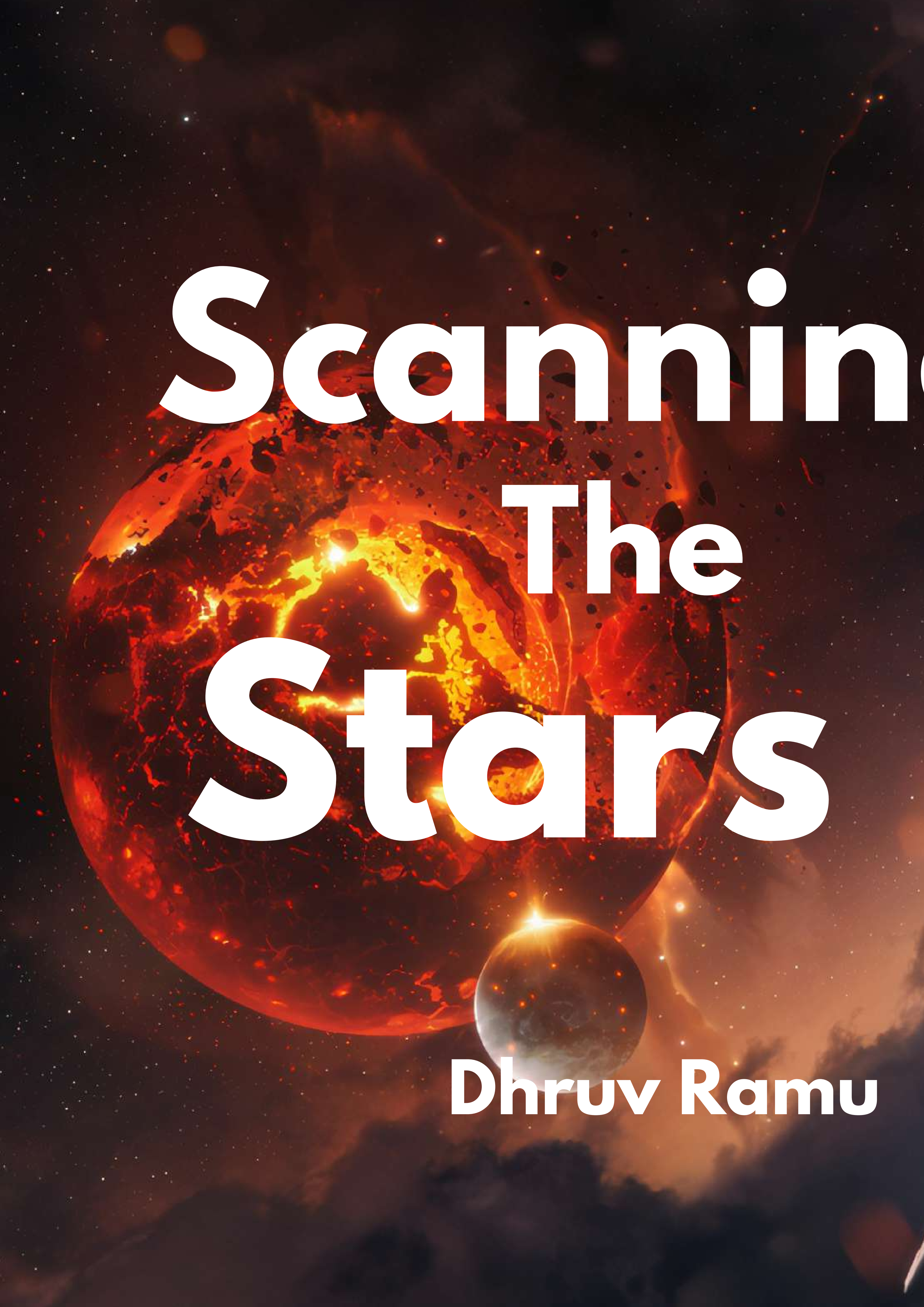
An Expert in this Issue

THE GEEKLY



Scanning The Stars

Dhruv Ramu

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When Medieval astronomers gazed up at the stars, they were utterly bewildered by what they saw: Weird formations that looked like animals, bright points of light, and a large, glowing orb. Today, we know a bit more, but one question has been nagging us since then: Is there life outside earth? Dhruv Ramu finds out...

Are we alone in the vastness of the universe? Are there intelligent beings from different worlds asking the same question? Or are they more advanced civilizations that have achieved interstellar travel and communication with each other? Such questions have long since been in the heart of speculative fiction. We believe that the probability of planets similar to Earth bearing life is likely throughout our galaxy, but how likely?

The Kepler space telescope was launched in 2009. Its mission was to find the number of planets orbiting 150,000 stars in 'one part of the sky'. It also was supposed to aid answering the question: Are planets where life can evolve common or rare in the universe? It is quite certain that there are more planets than there are stars, and the Kepler space telescope helped us figure out that a quarter of the planets surveyed with the same size of Earth are in a habitable zone - Neither too hot nor too cold for life to develop. With over a hundred-billion stars in the Milky Way itself, there are a minimum of 25 billion planets where life could form. This is only our galaxy alone. Now imagine the remaining trillions of galaxies with similar probabilities of life's ability to take hold.

This brings us to a paradox, the Fermi Paradox. Although explained in further detail in an article in Issue One, it is relevant to this topic. In short, the Fermi Paradox discusses the probability of alien life existing and even visiting Earth. This paradox was formed in 1950 When Fermi realized that an alien civilization with rocket technology can colonize various satellites and planets, advancing in roughly ten million years. The basis of the paradox and its relevance today is that there are so many spaces wherein life can begin and advance is that the probability of aliens is high. Some

scientists responding to the question - “If Aliens exist, why haven’t we seen them” is simply that we are a civilization that has advanced quickly, but in a relatively short space of time, compared to what is predicted to be the progression of alien civilizations. Humans on earth have not existed for such a long time, and therefore it is probable that Aliens have indeed visited Earth, just that it may have been too long ago for us to notice. There are so many possibilities for life to exist, or not. There are high probabilities that life may exist on most habitable planets, but not intelligent life that can travel across space with advanced technology that we can only dream of. We humans are fairly new to the universe, and this study is new as well. We know little about astrobiology, and we face many challenges throughout our explorations.

It is a series of discoveries that has led to the end of bleak days in the field of astrobiology, which is life outside of Earth. In the 1970s more basic telescopes found no trace of life, and spacecraft landing on the Moon did not find any life either. People thought the chance of alien life might have been high but the chances of us knowing about it is bleak.

An important point to consider is that these exoplanets are so far away that we cannot send a probe with enough fuel to travel all the way there and observe, not now at least. Scientists and engineers are working to delve into and understand this field, but it is a slow process.

If we cannot send probes to the planets yet, we can still observe them by telescopes. And that is exactly what we are doing and planning to improve. We found these exoplanets with telescopes, and better ones are being developed for further efficiency and better understanding of our galaxy and the exoplanets we are interested in.

Astrobiology / Exobiology is a novel field of science and space exploration, and bigger developments are yet to come. Scientists from NASA as well as ISRO are working on telescopes and more satellites to observe the vast galaxy we happen to reside in. There are many theories as to what kinds of life we may find, but the probability is that we won't be able to predict it simply because our knowledge of shapes and forms are only based on what we have seen.

Let us hope for success in space exploration, and we will certainly see development over time.


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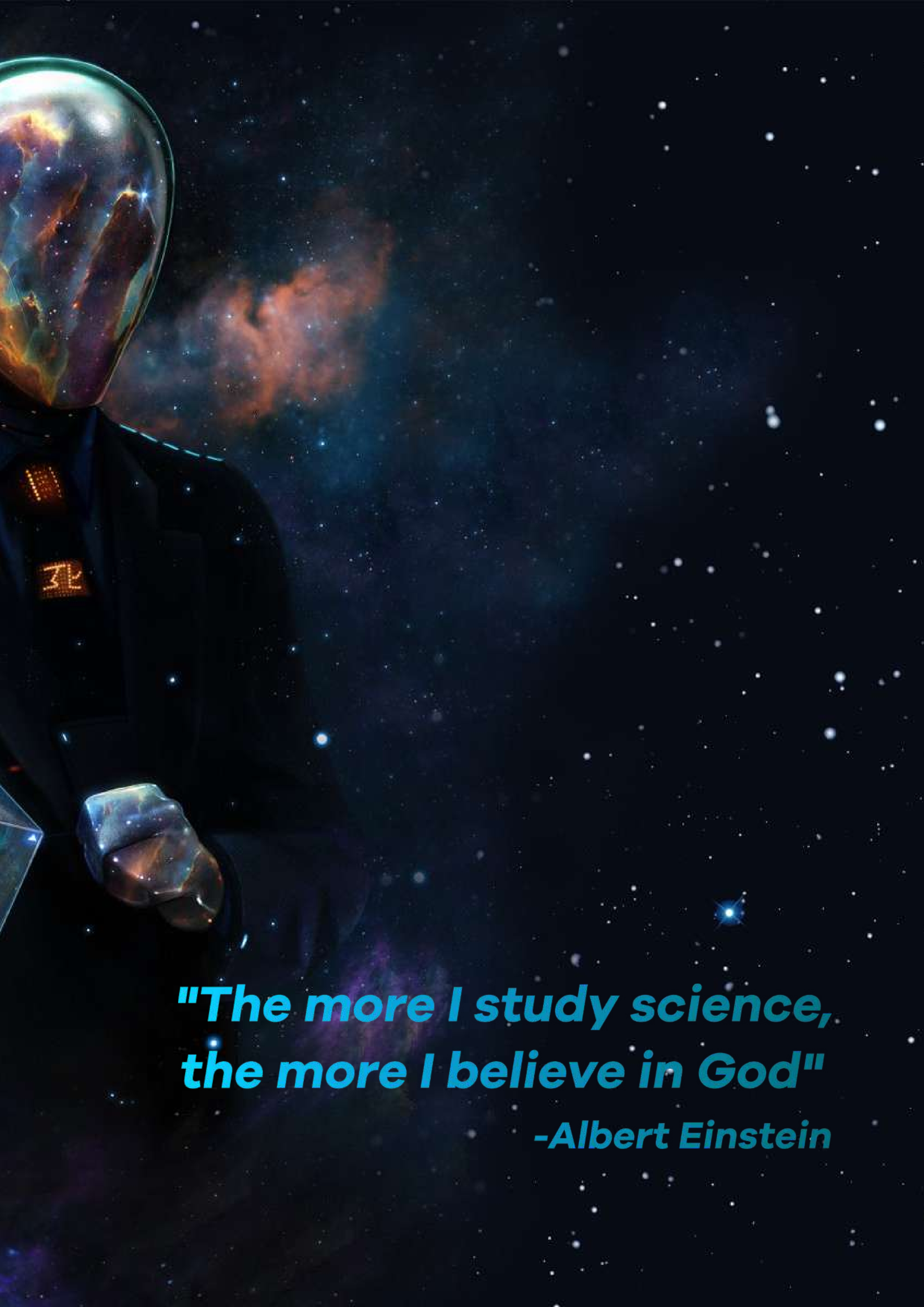
Mystery Man?

Akhilesh Balaji


"The more I study science,
the more I believe in God"
-Albert Einstein

Homo Sapiens are the single most intelligent species on planet earth. Or so we think. But, Homo Sapiens are just one of the estimated 2 trillion species that exist here on earth. The chance of humans becoming an intelligent species, therefore, is around 1 in 1 trillion. The planet we live on — Gaia, or Earth has extremely low odds of being in the orbit it is around the sun, today (And for the past couple billion years). The universe has unbelievably low odds of being capable of supporting the already low odds of life in it — much less intelligent life. If the universe's constants were just 0.0001% off, the universe would become positively curved. And if it was -0.0001% off, negatively curved.

It is virtually impossible for such statistically low probabilities to exist — almost negligibly so. It so happens that many constants of the universe cannot be accounted for: They just exist, and have a very specific value. This value has been extremely fine-tuned. Just a few decimal points off, as mentioned earlier, could result in a universe with no life in it. Let's have a closer look at the fine-tuning argument.

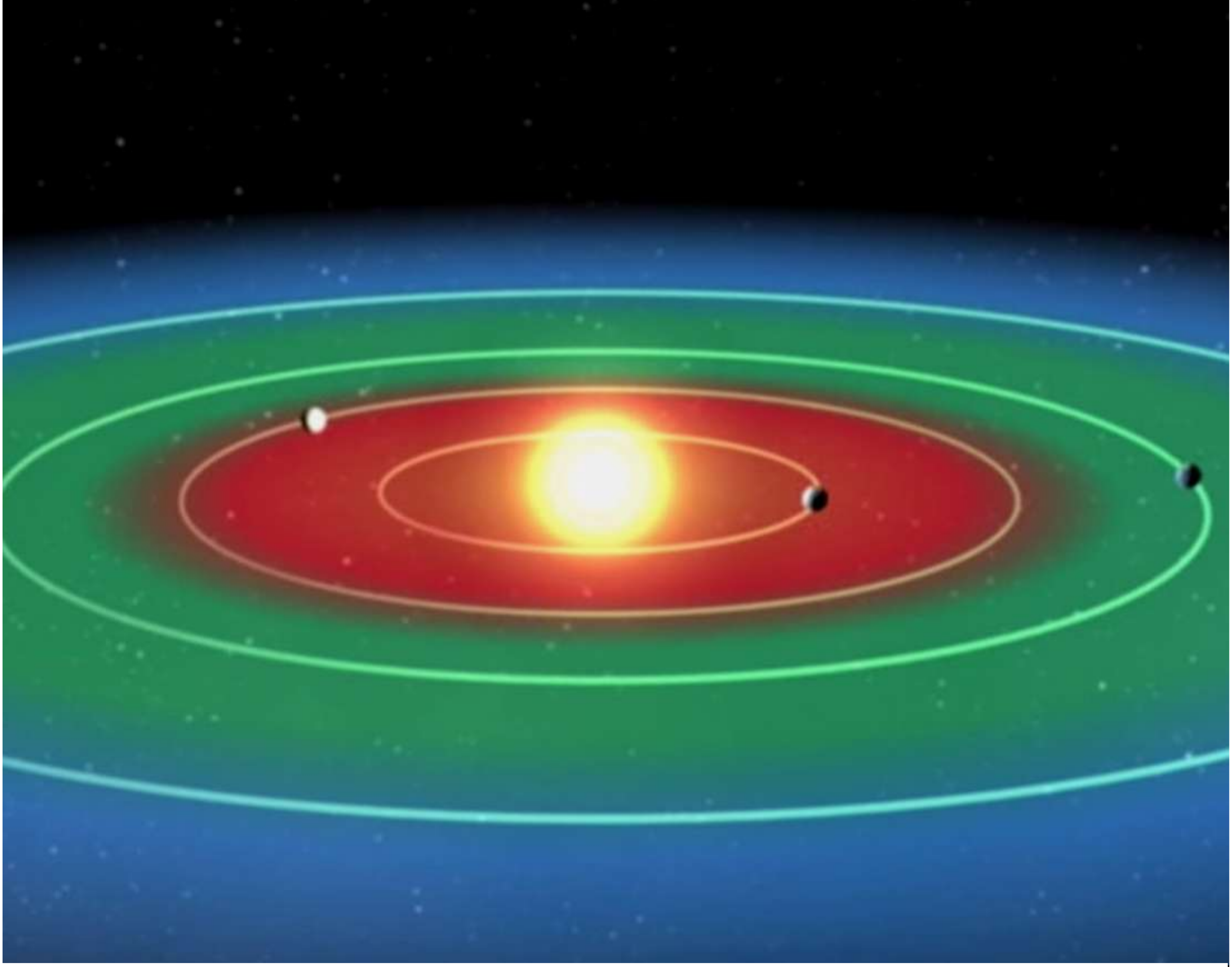
Neil Armstrong was 5 feet (ca. 152 centimeters) 11 inches tall at the time of his death. There is a reason we measure his height in feet, rather than light-years. If we said that he was, instead 2×10^-16 light years in height, then if he was 2×10^-15 light years in height or 2×10^-17 light years in height, then he would be a dwarf less than 50 cm in height and a 60-foot lumbering giant respectively.

Another example would be the mass of a neutrino, 2×10^-37 kg. You'll notice that the mass is expressed in kilograms. That way, even if the mass was 2×10^-38 kg, atoms would be too heavy to support life. Yes, measuring something this small is the equivalent of measuring a person's height in light years.

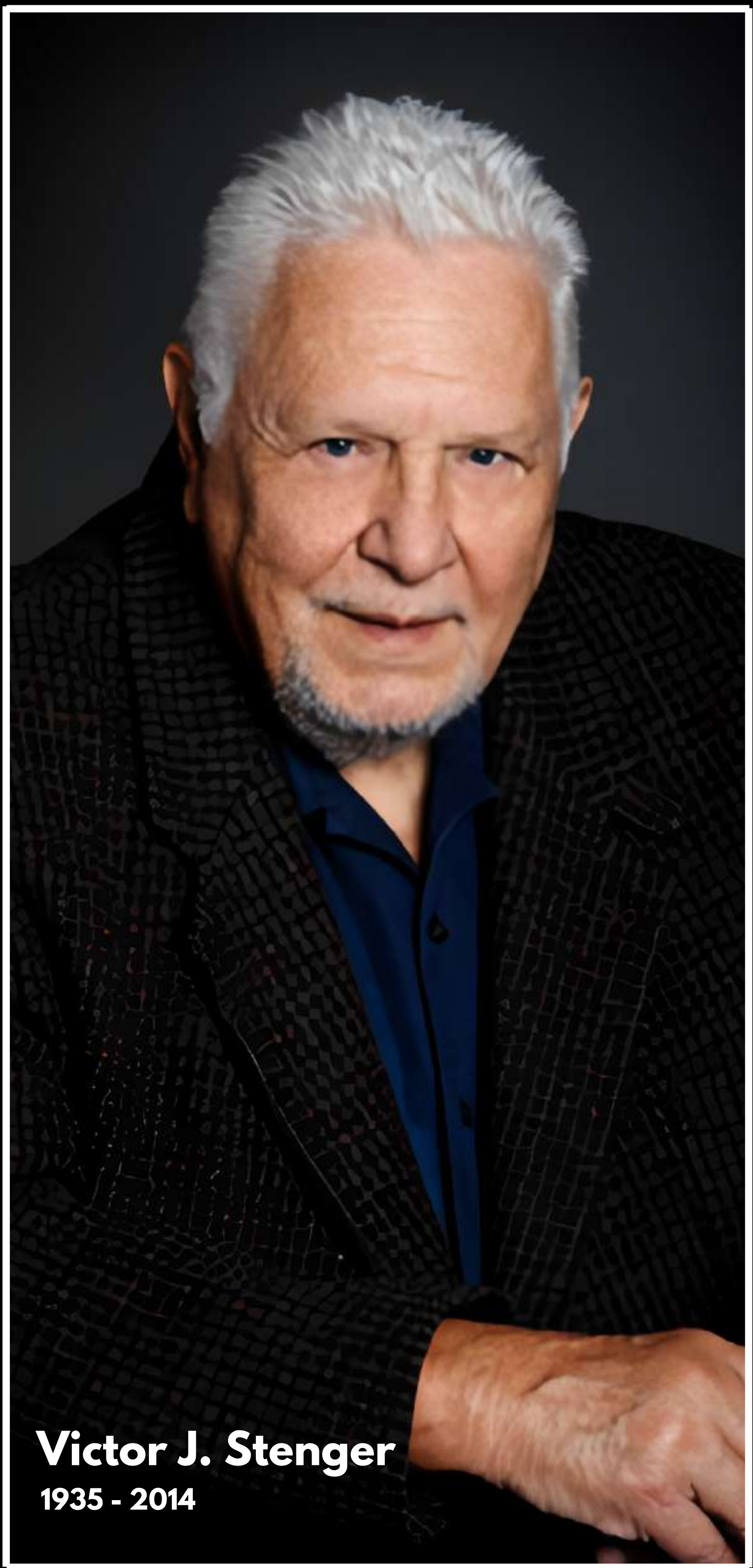
How lucky are we, exactly, that the mass of a neutrino has exactly 36 “0”’s: No more, no less? The answer is “very lucky.” And this leads to the question — Is there some invisible being pulling the strings, tweaking the numbers, so that life can exist?

Well — this depends on how you look at it. Because a few of the universe's constants are different doesn't mean that it cannot support life. That's like saying a square can only

The habitable zone in most star systems (green):



"There's more than one way to skin a cat, and more than one way to build a universe"



be a square if both of its sides are one meter in length. If only the width changed to two meters, it would be a rectangle, but if the length changed to two meters as well, it would still be a square. Thus, there can still be other "configurations" of constants that still support life.

Physicist Victor Stenger did a study in the year 2000. He picked 4 constants of the universe — electromagnetic and strong nuclear forces, and mass of the electron and the proton — and varied them randomly. He analyzed approximately 100 universes where he varied the values by 5 orders of magnitude above and below their actual values. Stegner found that at least 50% of those universes had stars that lasted at least a billion years - enough time for life to evolve. But, a long stellar life is not the only requirement for life, it is merely one unusual and important parameter. "There's more than one way to skin a cat, and more than one way to build a universe", says Arvin Ash, YouTube star.

It may seem almost impossible that such coincidences are possible, but they happen all the time! For instance, read this passage from www.boredpanda.com:

"A set of twins from Ohio who were separated at birth grew up without any knowledge of each other's existence. Their lives did however share a number of strange similarities. They were both named James on their adoptions, they both grew up to be police officers, and both of them married women named Linda. But that's not all. Each had a son, one named James Allan and the other one named James Alan, and each also had a dog named Toy. Both brothers later got divorced, and both ended up remarrying women named Betty!"

Just because there is a possibility that god does exist, it does not mean that it is certain that he does exist. As of now, the existence of god cannot be proven, or disproven. Did the universe come into existence because of a st of pre-existing laws, or because a pre-existing entity created those laws? We may never know. He may probably never emerge from the constants of the universe.

But, if the existence of god was disproved, for instance, would you still believe in him? For that reason, I implore you: Don't let your faith, if you have one, serve to enrich you, and not take away your wonder and curiosity of the natural world. There's always a certain satisfaction of figuring out the answers to the questions ourselves that no one should be cheated out of. But, until then, keep learning!

▲ Artist's impression of a higher level civilization

Beyond

Akhilesh Balaji

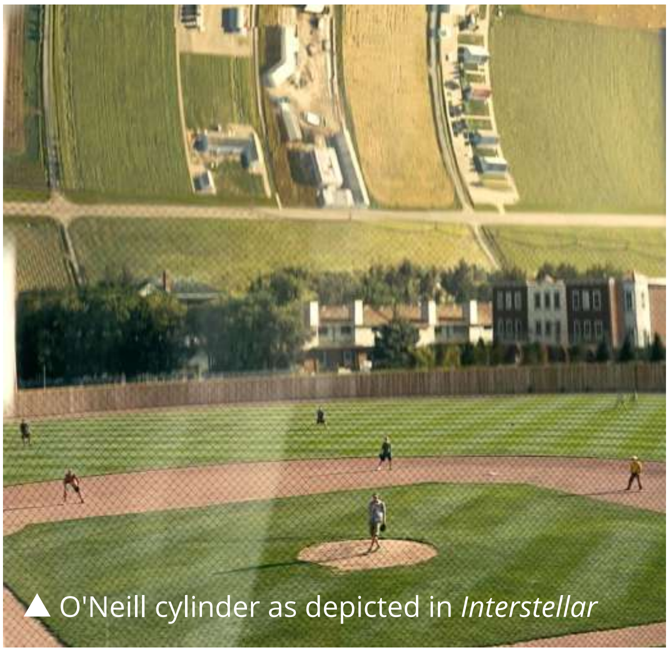
In a puny spiral galaxy called the Milky Way, there exists a tiny star system, which houses a trivial blue planet called Earth. Upon its surface walk a unique species of primate called Homo Sapiens, one of the trillion or so other life forms on its surface. This diminutive race may be one of many in the vast universe, perhaps even multiverse. Humanity, you might think, is considerably advanced: We have gone from harnessing fire to towering metropolises that scrape the stratosphere. But what humanity has achieved is barely an atom's width in relation to the Burj Khalifa, in comparison to what civilizations are believed to be able to reach, or have already reached.

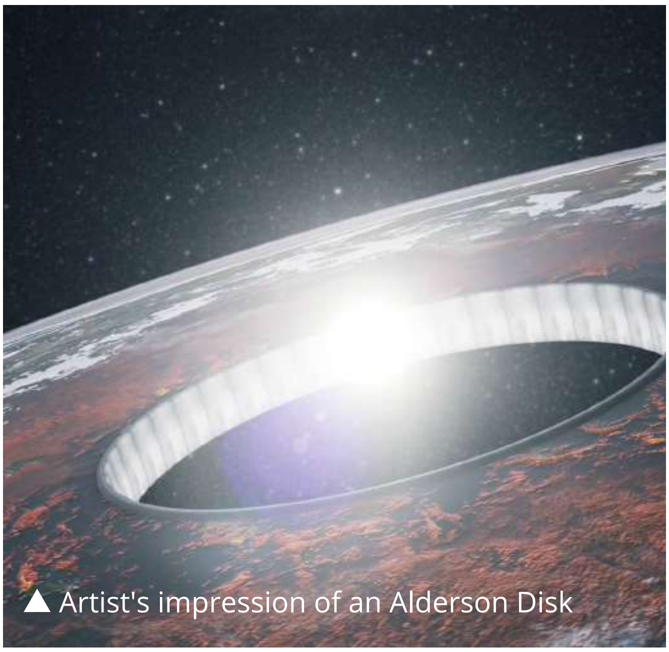
Enter the world of the Kardashev scale. This scale was invented by Nikolai Semenovich Kardashev in 1963. Kardashev said that there were three different stages to civilization (at least, the original scale had three different stages), organized based on how they could harness the surrounding resources.

In the first stage of civilization, they are able to harness all the resources on their home world: This doesn't just mean mining every ounce of natural gas, coal, and oil out of the planet, it also means harnessing every gust of wind, every photon that hits the earth, every wave in the oceans, and all the heat in the planet's core.

When they've exhausted their home world of all its resources, a civilization may feel the need to use the resources from its neighboring planets, and home star. It was a big enough deal extracting resources from their home planet, but how do you extract resources from an entire star system? Well, that's the fun in Type two. Let's look at the star itself, first. Freeman Dyson proposed a method for extracting energy from an entire star, in 1960. This method involved a huge mega structure built around a star, to harness the heat and light coming off it.


▲ Artist's impression of a Dyson Sphere


▲ O'Neill cylinder as depicted in *Interstellar*

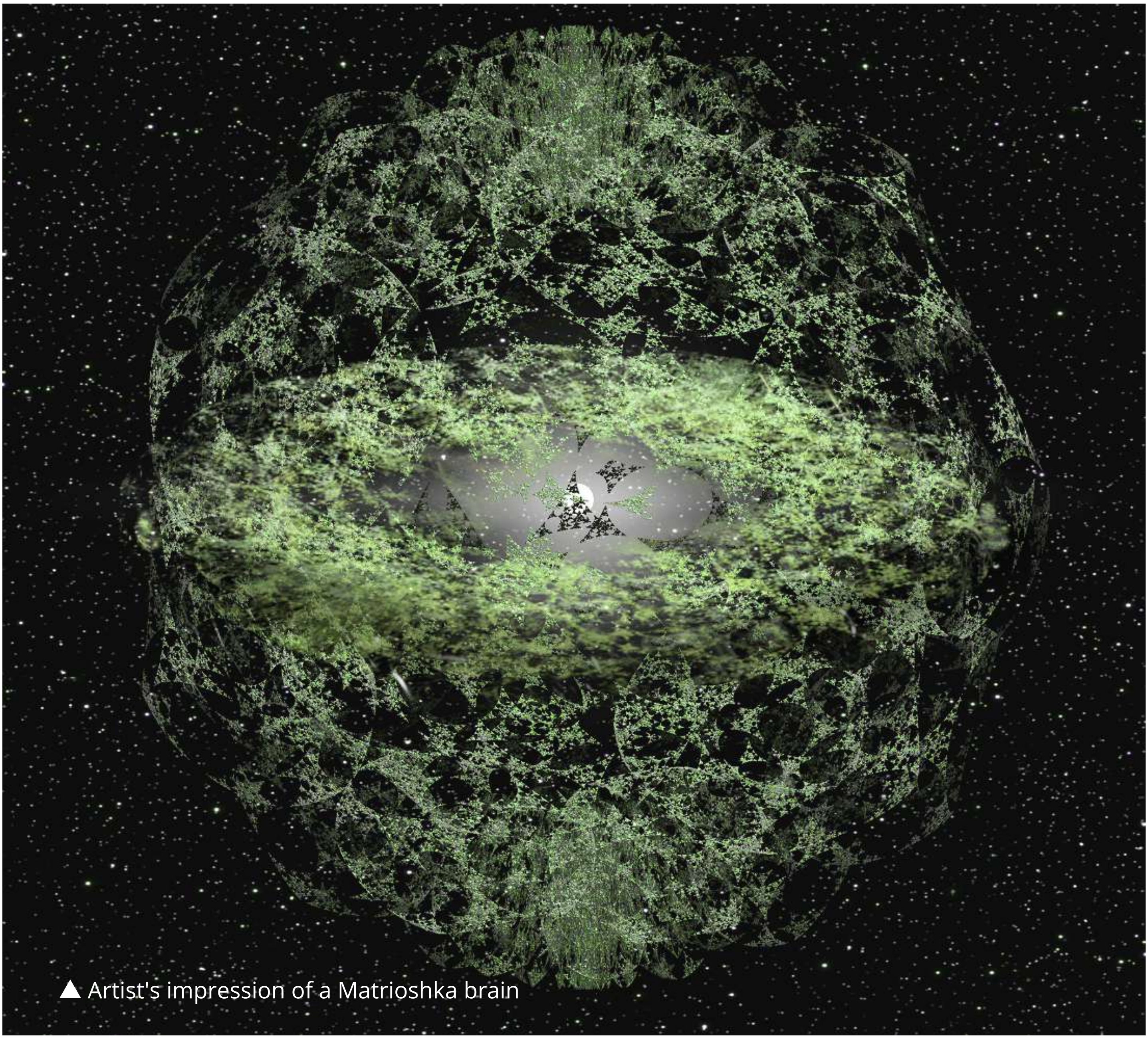

▲ Artist's impression of an Alderson Disk

Building this would require a monstrous, even demonic amount of resources to build, that would drain the entire solar system of its resources (excluding the sun). This legendary idea was called the Dyson Sphere, and this is something that no Type two civilization would be complete without. A Dyson Sphere is a Class B stellar engine. Stellar engines are essentially hypothetical mega structures powered by the sun, used for various purposes. For instance, a Shkadov thruster is used for propelling an entire star system, while a Matrioshka brain is for computational purposes. Of course, no planet would be habitable by the time the giant structure was built, so humans (If humans are still humans and not another species) might have to live in giant space stations, such as an Alderson Disk, or an O'Neill Cylinder. These are essentially huge space stations that are able to support life, in the shape of a disk and a cylinder respectively. Cooper station in the movie *Interstellar* is an example of an O'Neill Cylinder.

Now, we are getting into the kind of development that is unimaginable to Humankind; it's on such a large scale. We are now in the third stage of the Kardashev scale. This is the kind of level where a civilization controls and harnesses energy from an entire galaxy. How do you set about doing this? Well, first, you would need to harness the energy from every single star in the galaxy. 100 thousand million Dyson spheres doesn't sound that bad, does it?

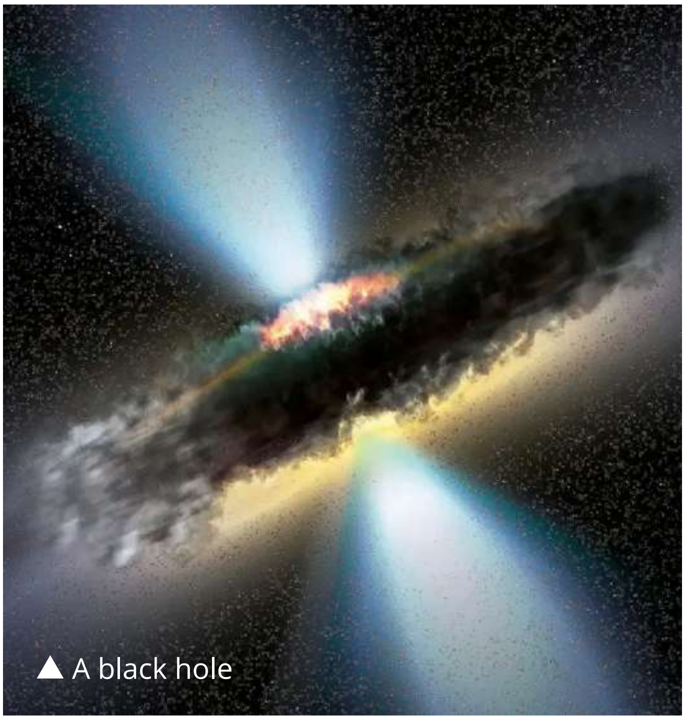
A Type three civilization might be able to tap into the energy and gravity of the black hole that is at the center of most galaxies! In the Milky Way, the black hole is called Sagittarius A*. Theoretical white holes are also another example of how a Type three civilization might be able to harness energy—white Holes are the theoretical opposite of black holes: They spew out energy continuously, but don't take anything in.

Kardashev's original scale ends there—but scientists have continued to propose more and more stages, the most common one


▲ Artist's impression of a Matrioshka brain

having 5 stages, and others having 7. Type 4 civilizations, theoretically, should be able to control the entire universe, and Type 5 civilizations can access energy from the entire multiverse! Further, many scientists have proposed a Type Ω civilization—this is the highest possible stage of civilization in the Kardashev scale. Beings of such scale would have enormous power. If there are any creators of the universe, as such, then they are probably it.

Physicist Michio Kaku has put us on Type 0.72 of the scale. So, we'll probably reach Type one in another 100 to 200 years. Comparing us to Type Ω beings is like comparing microbes on an ant hill to Type 2 civilizations. Perhaps Type Ω civilizations have succeeded in building a Matrioshka Brain, and we are nothing more than a simulation in it. They might even have the ability to harness the energy in Dark matter and energy!


▲ A black hole

Physicist John Barrow also proposed a micro dimensional version of the scale, revolving their abilities to manipulate their environment. These stages of civilization go backwards, as they get more and more precise. Type 1-minus beings are capable of manipulating matter, Type 2-minus beings are capable of manipulating their genes, Type 3-minus beings are capable of manipulating molecules, and molecular bonds, to create new molecules, and Type 4-minus beings are capable of manipulating atoms themselves, to create atomic-level nanotechnology. Type 5-minus beings are able to change the composition of the atomic nucleus, and the particles that compose it, and Type Ω-minus civilizations can manipulate and twist the very fabric of space-time. Humans are Type 1-minus beings on the Kardashev micro dimensional scale.

Must See

The Pre-planetary, Planetary, Stellar, Galactic, Intergalactic, Universal, Multiversal, and Omniversal—the six (or so) stages of the Kardashev scale. If such civilizations are out there, why haven't we detected traces of them? We wouldn't be able to detect traces of Type 4 and above civilizations, because their activity would merge with that of nature itself: If you were to harness dark energy, your activity would appear like the activity of dark energy itself! But what about Type 3 and below?

Why aren't we able to detect traces of such civilizations? A Type 2 or above would have been able to build a Dyson Sphere. So, wherever you find a Dyson Sphere, aliens are sure to follow. Scientists are actually doing this, by analyzing the light patterns in different stars—but of no avail. We must conclude that higher level civilizations do not exist. But, is there a chance they could have existed? If so, probably not in our corner of the galaxy. We will surely have chanced upon mega structures left to ruin in the dark void of outer space. But, until we can find a Type Ω civilization to tell us all the answers, you'll have to figure them out on your own. Stay curious!

▶ Prof. John Barrow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FRACTALS

Akhilesh Balaji

A FRACTAL IS A WAY OF SEEING INFINITY

ALMOST everything in nature seems to have a mathematical significance, from snail shells that follow the golden ratio to Hexagons in honey hives. But there is one thing in nature that we see every day, yet completely ignore—fractals.

Fractals are commonly described as self similar shapes, no matter which scale you look at them in. These fractals normally follow a mathematical pattern. For instance, there's the Mandelbrot set — A series of numbers that follow a specific pattern ($f(z) = z^2 + c$, where "c" is a complex number), and form this cool looking shape that you see on the screen, here. But, this is not what Benoit Mandelbrot, the father of fractal geometry had in mind. Mandelbrot said that self similar shapes give a model for the regularity that roughness can be based upon.

Self similar shapes are just a category under the broad umbrella of fractals. Mandelbrot proposed the concept of fractals as a way to emulate the roughness in nature, infinitely. This, in a way, is in direct defiance to the laws of Calculus, which states that things start to get smoother and smoother as you zoom in. The purpose of this article is to uncover the definition of what a fractal really is.

But, let's start with the basics. Let us take the Koch Snowflake as an example. The Koch snowflake is essentially triangles overlaid on top of each other infinitely.

However, when we represent these fractals visually, we have to give the computer a point to stop at. If we didn't, then the computer would go on forever, as the fractal got more and more complex. For this reason, whenever we see a picture of a fractal, it's not truly a fractal — it's just the closest possible approximation of a fractal we can get to.

But, back to the snowflake for now. Take two equilateral triangles, and overlay them so that they form a star shape. This is the first iteration of the Koch snowflake. Now, the star will have triangles jutting out of its sides. Use these to overlay smaller triangles on top of them to form miniature stars around its perimeter. Now do that again. And again. And again. And again. And… ▯…

You get the point. But, think about this for a moment: If the pattern of the Koch snowflake went on forever, then it would have an infinite perimeter — There would be no end to the triangles that jutted out of it, if it were a true fractal. What a paradox! Here, we have a shape with an infinite perimeter, yet a finite area! The same is true for the Mandelbrot set — A set of complex numbers that forms an incredibly fascinating and beautiful visualization.

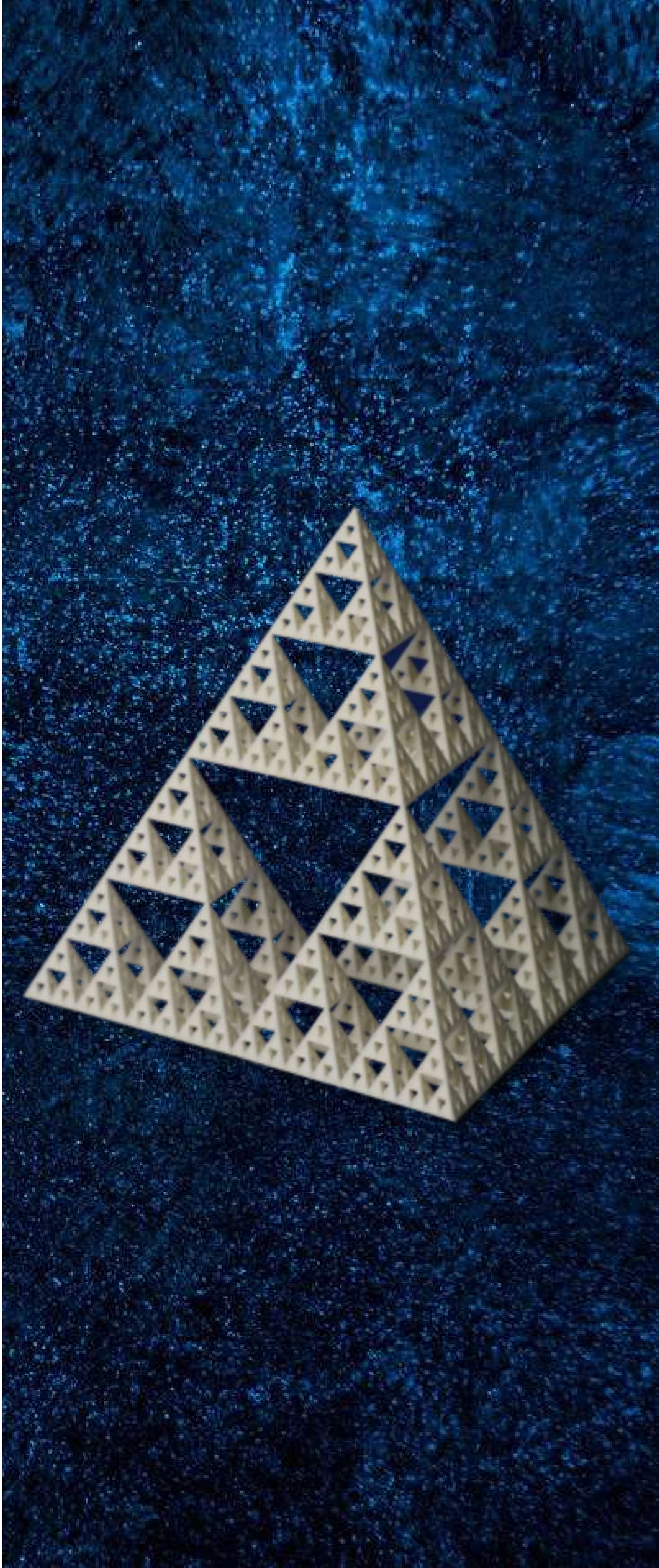
To understand the true definition of the word "fractal", we must first familiarize ourselves with the concept of dimensions. Sure, you know what a dimension is — The 0th dimension is a point, the first is a line, the 2nd is a square, the third is a cube, etc. But, did you know that a Koch snowflake is a 1.26186 dimensional object? What nonsense, you may be thinking. How is that even possible? Well, let's redefine the concept of dimension in this context.

Let's start off with the simplest shape: A line. A line can be broken up into two lines that have half its length, those lines can be broken up into two lines that have half its length, those lines can be broken up into two smaller lines, etc. This makes it self-similar. So, the small lines are one half the **length** of the original line. Then, let's take a square. A square can be broken up into 4 squares, completely identical to the original. These smaller squares are ¼ the **area** of the square. Then, the cube: The cube can be broken up into 8 identical smaller cubes, which are ⅛ the volume of the original cube. Now, let's take a Sierpiński triangle. This is essentially a set of triangles that follows a specific pattern. It also has higher dimensional analogues, such as the Sierpiński tetrahedron, but we'll stick to the triangle for now.

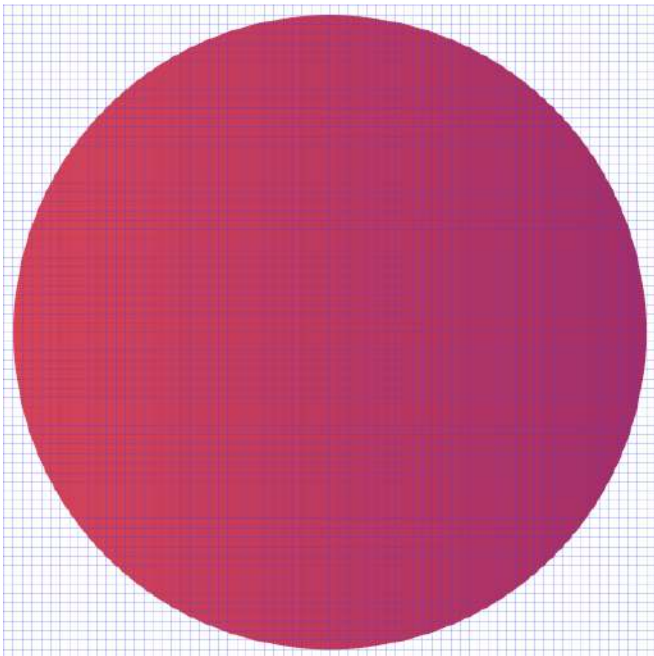
The Sierpiński triangle is made up of three identical copies of itself, which are made up of identical copies of the second iteration, and so on. But, because it's a fractal, how do we define its self similar units that come together to form the triangle? In other words, we don't know what percent, or fraction of the original, the smaller copies are.

In reality, it's possible to have shapes whose dimension is any whole number, not just any integer. Why, the coastline of Britain is 1.21 dimensional! The concept of fractional dimensions relies on the mass of the object. So, it's reasonable to assume that the small line is ½ the mass of the original line. The mass of the small square is ¼, or $(½)^2$ of the larger one. This is easy to see, because it takes 4 of those small squares to make up the larger one. Likewise, the small cube is ⅛, or $(½)^3$ the mass of the larger cube.

Then, wouldn't it be logical to assume that a smaller Sierpiński triangle is ⅓ the mass of the original, because it takes three of the smaller triangles to make up the larger one? You see, there is another way of defining a dimension. Did you notice the nice, whole numbered exponent that ½ was raised to, in order to equal the fraction? When you scale an object, its mass is that factor, raised to the number of its dimension. For example, when you scale a line in half, the mass is $(½)^1$, where the scaling factor is ½, and the exponent is 1, which is also the dimension of a line. In a cube, the mass is $(½)^3$, where 3 is the exponent, as well as the dimension.



Must See

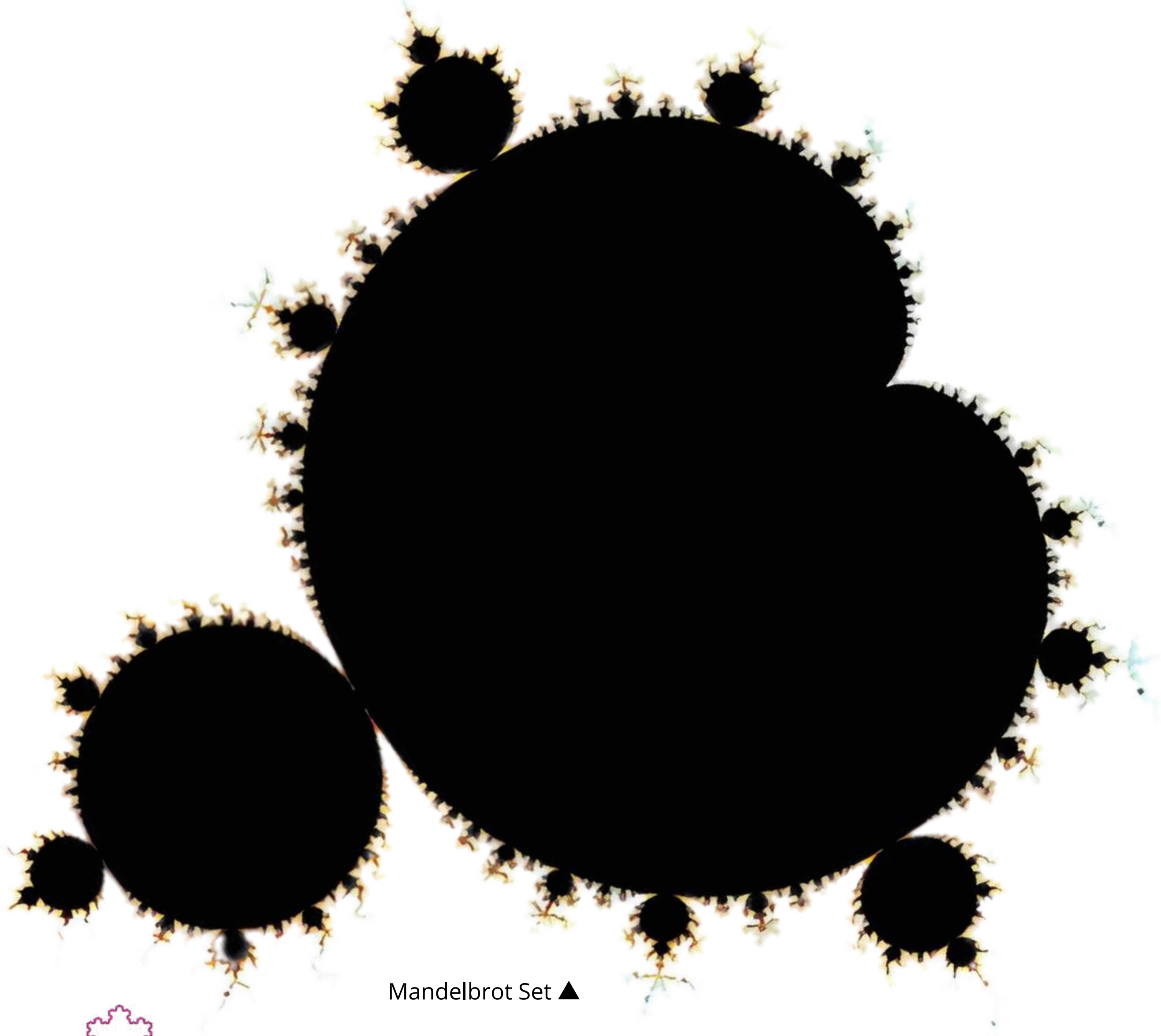


So, the mass of a Sierpiński triangle would be $(½)^D$, where D would be whatever its dimension is. We scale down the Sierpiński triangle by ½, and we know what its mass is: ⅓ the original size — but we're trying to find its dimension here. So, we're asking: ½ to the power of what gives you ⅓? Well, that's the kind of question that logarithms are meant to answer. Asking the above question is the same as asking 2 raised to which power gives you 3? As always, a trusty scientific calculator has the answer: $\log_2(3) \approx 1.585$. There you have it! The dimension of a Sierpiński triangle is roughly 1.515! Neither 1 dimensional, nor 2 dimensional — Neither length nor area appear to be able to measure it. Its length is ∞, like all other fractals, and its area is 0. This is true for any self similar shape — But remember: Self similar shapes are just a tiny bit of the larger shape. What we've explored so far is what you might call the self similar dimension.

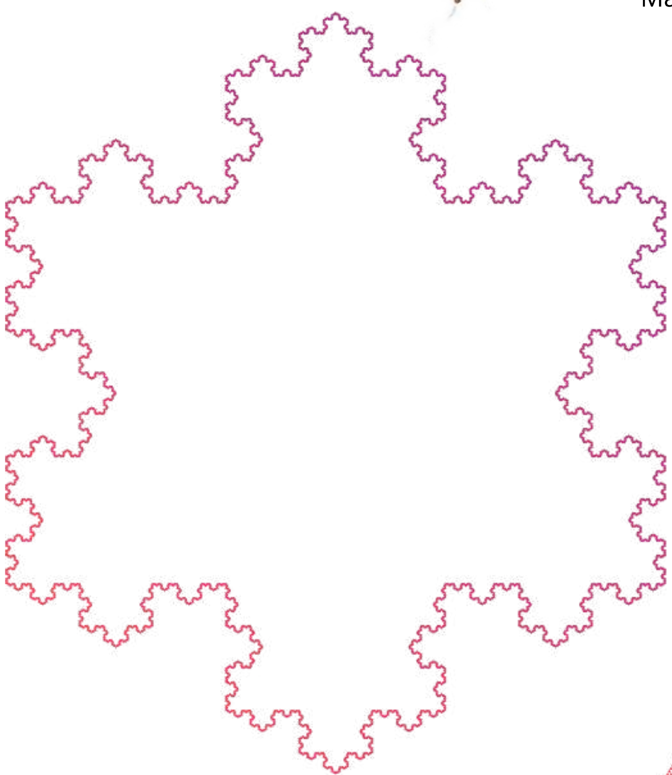
After all, most 2d shapes aren't self similar, like the circle. The circle still has a dimension, though: 2. But, no matter how we try to arrange 4 copies of that circle scaled down by ½, we can't seem to match up that circle exactly. So, to find its dimension, we plop it on to a grid, a fine grid, and count how many squares the circle is touching. Then, we scale it up by a factor, let's say, 2, and count the number again. If we divide the first amount by the second amount, we should approximately be 4, or $(2)^2$.

The finer and finer you make the grid, the closer and closer you will get to 4. This means that we can play the same game with self similar shapes, and irregular fractals — A Sierpiński triangle yields ≈1.515, and the finer and finer the grid becomes, the closer and closer you will get to that value. Let's try this with irregular fractals. Say, the coastline of Britain. Yep, it works — the coastline of Britain is a 1.21 dimensional curve!

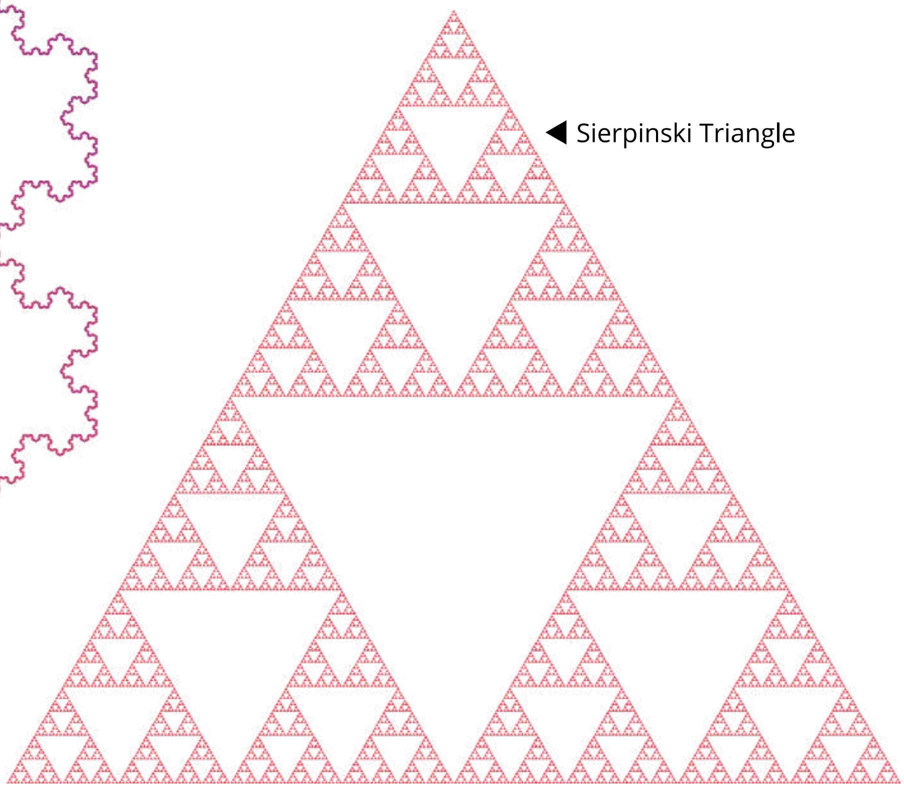
Which brings us to the main question: What is a fractal? Well, a fractal is essentially a shape that never gets smooth — It has an infinite perimeter, and an area and volume of 0, because of this. Typically, Fractals are fractionally dimensional — Their dimension isn't a whole number. Cool, right? But the field of fractal geometry keeps evolving every day. What's more, you can actually explore fractals in your garden — fern leaves follow the same pattern as you keep zooming in. But the disappointing part is that these aren't real fractals. These fractals have to end at some point. But not the ones in your head! Keep thinking!



Mandelbrot Set ▲



Von Koch Snowflake ▲



◀ Sierpinski Triangle

CORONAVIRUS RISK
9
BARS
8
BUFFETS
SPORTS STADIUMS
7
BASKETBALL
6
CASINOS
RESTAURANTS, INDOOR SEATING
5
DINNER PARTIES AT A HOUSE
AIRPLANES
4
DENTIST'S OFFICE
WALKING IN A BUSY DOWNTOWN
3
GETTING GROCERIES
CAMPING
2
GOING FOR A WALK, RUN OR BIKE RIDE WITH OTHERS
1
GETTING TAKEOUT FROM A RESTAURANT
SOURCE: MLIVE
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LEVEL BY ACTIVITY

- LARGE MUSIC CONCERTS

- GYMS
- AMUSEMENT PARKS
- CHURCHES

- PUBLIC POOLS
- SCHOOLS

- PLAYGROUNDS
- HAIR SALONS, BARBERSHOPS
- PONTOON BOAT RIDES
- MOVIE THEATERS

- BACKYARD BARBECUES
- MALLS
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Venki Ramakrishnan
AN INTERVIEW

What is X-ray crystallography? What real world application does it have?

It is a method for determining the structure of molecules. Without knowing their structure—even of a simple molecule like common salt with only two atoms—it is hard to understand their chemistry properly and how they work.

How do you find the structure of a protein from the diffraction image?

You measure the intensity of all the spots produced, but you also have to determine the phase of each spot relative to the others which is more complicated. Then you can carry out a calculation in a computer—effectively doing a Fourier Transform—to compute the image.

Why is it so difficult to find the structure of the ribosome?

The ribosome has half a million atoms. So it was both difficult to crystallize and to analyze and interpret the data.

At the diamond light source, what makes the beams so special? What other equipment is used in X-Ray diffraction?

The DLS is only one of many first-rate synchrotrons. All synchrotrons produce an intense beam of x-rays from a ring of electrons that are orbiting at close to the speed of light, i.e. at very high energies. Apart from the x-ray beam, you need sophisticated equipment to detect the x-rays and transfer data to a computer system, you need equipment to hold and rotate the crystal and to keep it at liquid nitrogen temperatures.

What is the function of the ribosome? What makes it so important?

The ribosome is the large molecular complex that reads genetic information to make proteins, Proteins carry out many of the thousands of functions in life, as well as build the structures that make up cells and tissue.

Venki Ramakrishnan

AN INTERVIEW

The protein is a large and floppy structure. How do you arrange these proteins in a crystalline structure?

This is done by very gradually changing conditions so the proteins come out of solution. If you are lucky, one of the thousands of conditions you try will coax the molecules to form regular three dimensional arrays that make up a crystal.

Why are high intensity X-ray beams important to use?

Protein crystals and especially ribosome crystals diffract x-rays weakly because of intrinsic disorder and also because there are fewer of them in a crystal of a given size. So you need high-intensity x-rays to get enough signal from the diffraction image.

Why can't electron microscopy be used to find the structure of large proteins?

You are wrong to even ask this question. Check out the 2017 Nobel Prize in Chemistry.

If ribosomes are what manufacture proteins, and the ribosome itself is a protein, how did the ribosome come into existence?

Most of the functionally important parts of the ribosome are made entirely or mostly of RNA. So the current view is that the first ribosomes were made entirely of RNA and only later did some of the proteins they made actually bind to the ribosome itself to make the ribosome we have today.

Does the structure of the ribosome differ based on which protein in it translates? In other words, are ribosomes specialized?

Generally, no, but there is now evidence that some ribosomes in some cells are specialized to translate only certain genes. However, this is an ongoing research area and it won't be clear for a while.

CON TEST

WHY DON'T YOU WIN SOMETHING?

This widget gives you the chance to be featured in our next issue: If you get it right. You can send us one of your works, and if you don't, your name will anyways be put up on the Hall of Fame. E-Mail Your Answers to info@thegeekly.net

DEBATE THE ANSWER, AND JUSTIFY:

There is a runaway trolley barreling down the railway tracks. Ahead, on the tracks, there are five people tied up and unable to move. The trolley is headed straight for them. You are standing some distance off in the train yard, next to a lever. If you pull this lever, the trolley will switch to a different set of tracks. However, you notice that there is one person on the side track. You have two options:

- Do nothing and allow the trolley to kill the five people on the main track.
- Pull the lever, diverting the trolley onto the side track where it will kill one person.

Which is the more ethical option? Or, more simply: What is the right thing to do?


Volc
GAL


anos
LERY
Mount Sinabung, Indonesia

Oro Oro Ombo, Indonesia

Speaking of tourist destinations, there will be no end. Moreover, this nature is infinite to be explored. Glancing at a town in the southeast corner of the city of Malang is hidden a destination that in recent months began to rise and not out of the list of hunting photos of nature explorers. Yes! Lumajang City, not only famous for its waterfall destinations. There is also a unique destination of this mountain go international background, especially if not Mount Semeru. Actually this is not a tourist spot, but the dramatic landscape of his dream lens is the eye of nature explorers.

Marc Szeglat shot this picture in 2014 during an eruption of Mount Sinabung on Sumatra.

West Sumatara, Indonesia

Mt. Bromo, Indonesia


Mount Sinabung, Indonesia


Sakurajima, Kagoshima, Japan

Lava from Kilauea on Hawaii flows into the ocean.
IMarc Szeglat shot this picture in October 2017

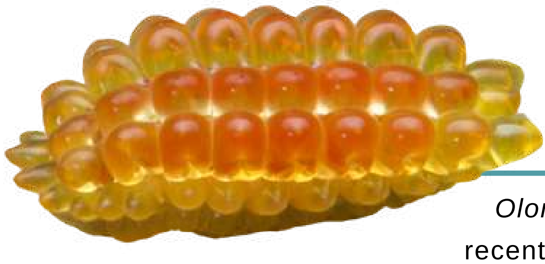
Gadget
Anki Vector

Vector is a cute little robot that has built in face recognition. You can play with him, ask him questions, and more. He also comes with a cube that he occasionally plays with. This is a great example of Artificial Intelligence.

OF THE MONTH

Material
Spectralon

A couple of issues back, we told you about Vantablack: The world's blackest black. Well, here we have Spectralon: The world's whitest white! This material reflects up to 93% of all the light that hits it. Like Vantablack, and object coated with this material appears almost 2d. You can find out more at labsphere.com

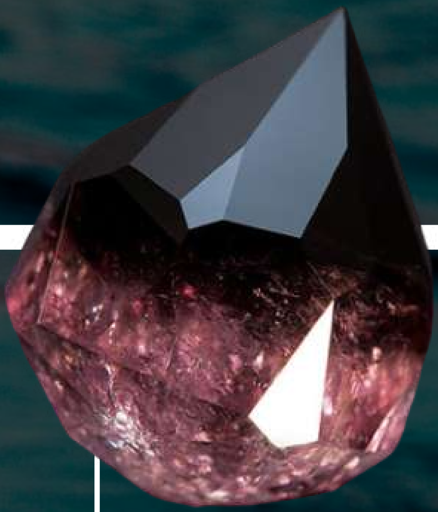


Species
Olona Limacodidae

Olona Limacodidae is quite a recent discovery. Discovered in 2018, these are quite common in Sydeny, USA, Fully grown, they are called painted cup moths. But we aren't interested in the moth here. We're interested in the caterpillar. It looks like a squishy jellybean, but beware! If you touch it, it will shed all it's Squishy bumps, and bolt like the wind!

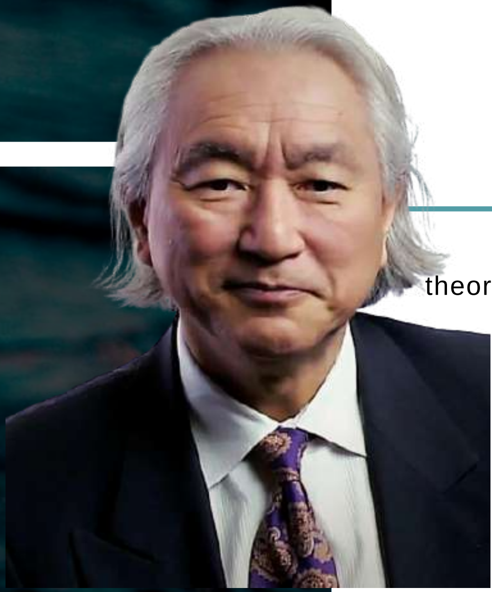
Element
Technetium

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 its mild radioactivity.



Compound
Tourmaline

Tourmaline is a crystalline boron silicate mineral compounded with elements such as aluminum, iron, magnesium, sodium, lithium, or potassium. It has a Trigonal crystal structure, and falls under the category of cyrosilicates. It has the chemical formula $Al_6B_3Fe_3H_{10}NaO_{31}Si_6$

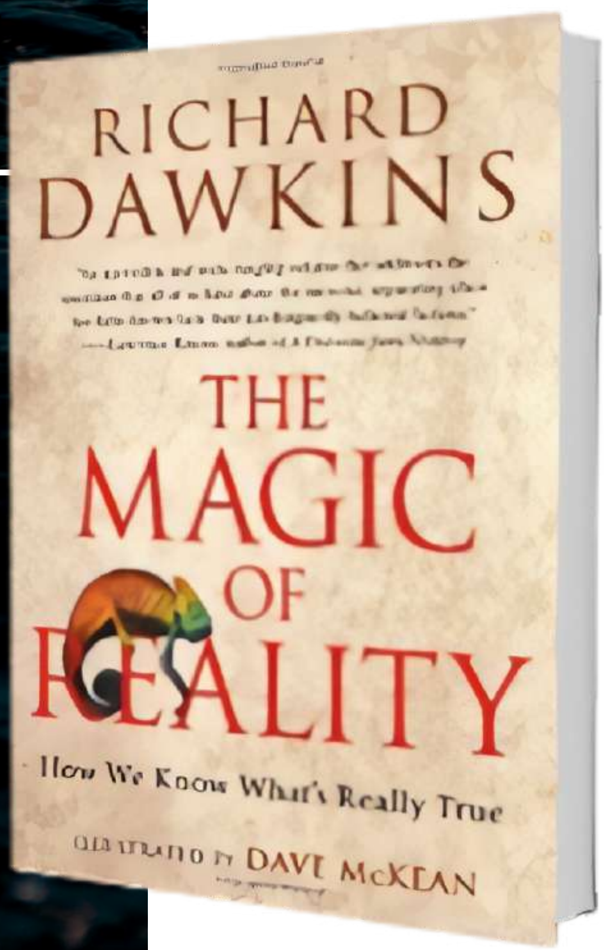


Scientist
Michio Kaku

Michio Kaku is an American theoretical physicist, futurist, and popularizer of science. He is a professor of theoretical physics in the City College of New York and CUNY Graduate Center.

Book
The Magic of Reality

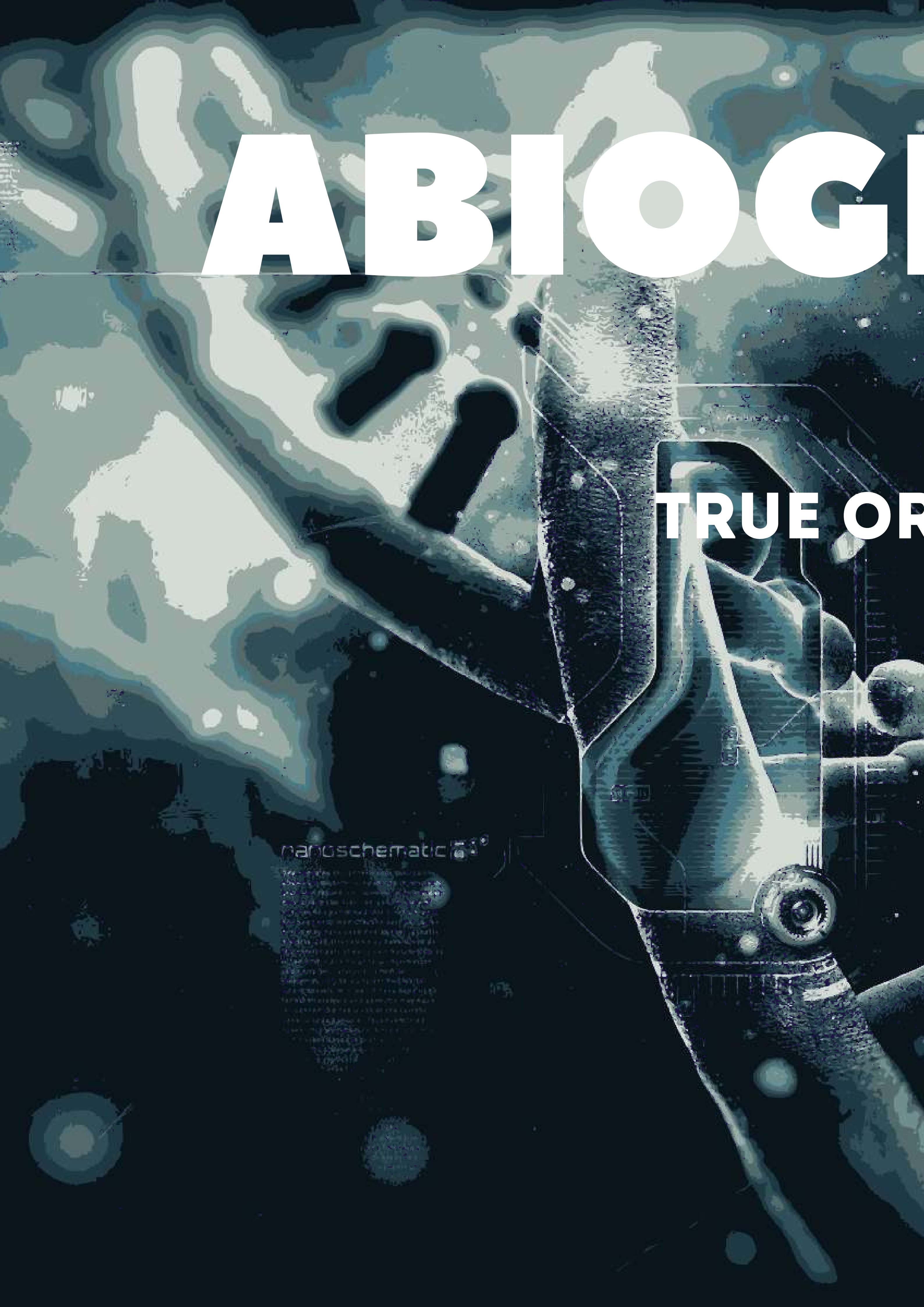
Richard Dawkins, bestselling author and the world's most celebrated evolutionary biologist, has spent his career elucidating the many wonders of science. Here, he takes a broader approach and uses his unrivaled explanatory powers to illuminate the ways in which the world really works. Filled with clever thought experiments and jaw-dropping facts, The Magic of Reality explains a stunningly wide range of natural phenomena: How old is the universe? Why are there so many kinds of plants and animals? Who was the first man, or woman? Starting with the magical, mythical explanations for the wonders of nature, Dawkins reveals the exhilarating scientific truths behind these occurrences. This is a page-turning detective story that not only mines all the sciences for its clues but primes the reader to think like a scientist as well.




WHAT IF
Everyone on Earth Jumped at once?

7.8 billion people have been accumulated and stand as close together as possible, taking up around 3140 km². This is the approximate area of Rhode Island, and the crowds are assembled here. Everyone is to jump exactly at 12:00 Noon, at the same time. This jumping event does not affect the Earth's rotation in a significant manner. The estimated weight of humans on Earth is 316 million tons. The weight of the earth is 13 billion trillion tons. If the Earth was rigid and had the capacity to be pushed downwards, this jump would cause Earth to be pushed down by less than the width of an atom. There is a relatively great deal of pressure exerted on the Earth, but since it is not in the same point, and spread out across the entire Rhode Island, it sends a pulse of pressure across the North American continental crust but dissipates. Instead, when everyone's feet hit the ground, at the same moment, there is a very loud roar.

Then, there is a problem with 5 billion devices. When someone takes out their phone, they are struck with the familiar notice: "No Signal". When 5 billion phones are switched on at the same time, it causes a massive overload on the cellular network. There are no personnel maintaining all the machinery and factories, they begin breaking down. Rhode Island's airport will not be able to simply transport 7.8 billion passengers in even a decade running at maximum capacity. Earth's orbit around the Sun continues like nothing ever happened and animals in the Amazon Rainforest continue living, the grass keeps growing in the African Savanna and the human population dwindles, to hopefully rise again in a few decades.


ABIOG
TRUE OR
nanoschematic


ENESIS
R FALSE?

DEBATE

Biogenesis is a scientific theory that tells us that Life came from Life, and not something non-living. This is a paradox: Where did the first life even come from, if life originated from other life? Let's start off with its origins. Ancient Greeks believed in spontaneous generation, known today as Abiogenesis. They believed that gods could make life spontaneously arise from nonliving and inert things, such as stones. For instance, they believed that maggots were spontaneously generated when there was something rotting and that fish were spontaneously generated when there was water. This may seem like a ridiculous theory to you. But, let's not jump to conclusions. Let's carry out an experiment to see what really happens.

Let's seal a piece of meat inside a container. In another container, we will do the same thing, but we won't cover it at all, leaving it open. And, lastly, as a control, we will leave an empty jar. We will leave this set up for 10 days. What happens? Well, in the closed container, there are no visitors. In the container sealed with gauze, a few flies laid eggs on top of the gauze. The open container, on the other hand, is teeming with flies and maggots. The control variable, as predicted, also has no visitors. Thus, we can conclude that spontaneous generation is impossible—if it was true, then both the containers would have been teeming with flies, regardless of weather the container was open or closed.

Akhilesh Balaji

DEBATE

Dhruv Ramu

Abiogenesis is part of evolutionary biology because it is theorized that the life forms arose from non-living matter but slowly became more complex. The theories and hypotheses pertaining to biogenesis are to find out how certain and different conditions made it possible for life to emerge. Abiogenesis requires the understanding of biology to learn how life forms evolved and changed characteristics in the process, whilst maintaining their survival in harsh conditions. The planet Earth that existed then is very different from today. Chemistry is integral to understand the remnants of the life forms and the chemical structure and composition of its source. Finally, geophysics aids in hypothesizing the formations and conditions that made life possible. These three pillars, recently, can also be related with astrophysics. If the theories of abiogenesis are accurate and we can understand the composition of Earth and conditions at the time, it can be employed in planet search and narrowing the results of discoveries to the conditions that would make life emerging very likely.

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