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dmystify
A 9.9 Media Publication
The Small Book of Big Thoughts
Fringe Science
Cutting-edge discoveries or pseudoscience hoaxes?
Epigenetics
Death Rays
Teleportation
Multiverse
Wormholes
Circlons

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dmystify
September 2017

Not this "Fringe"

We're not talking TV Shows

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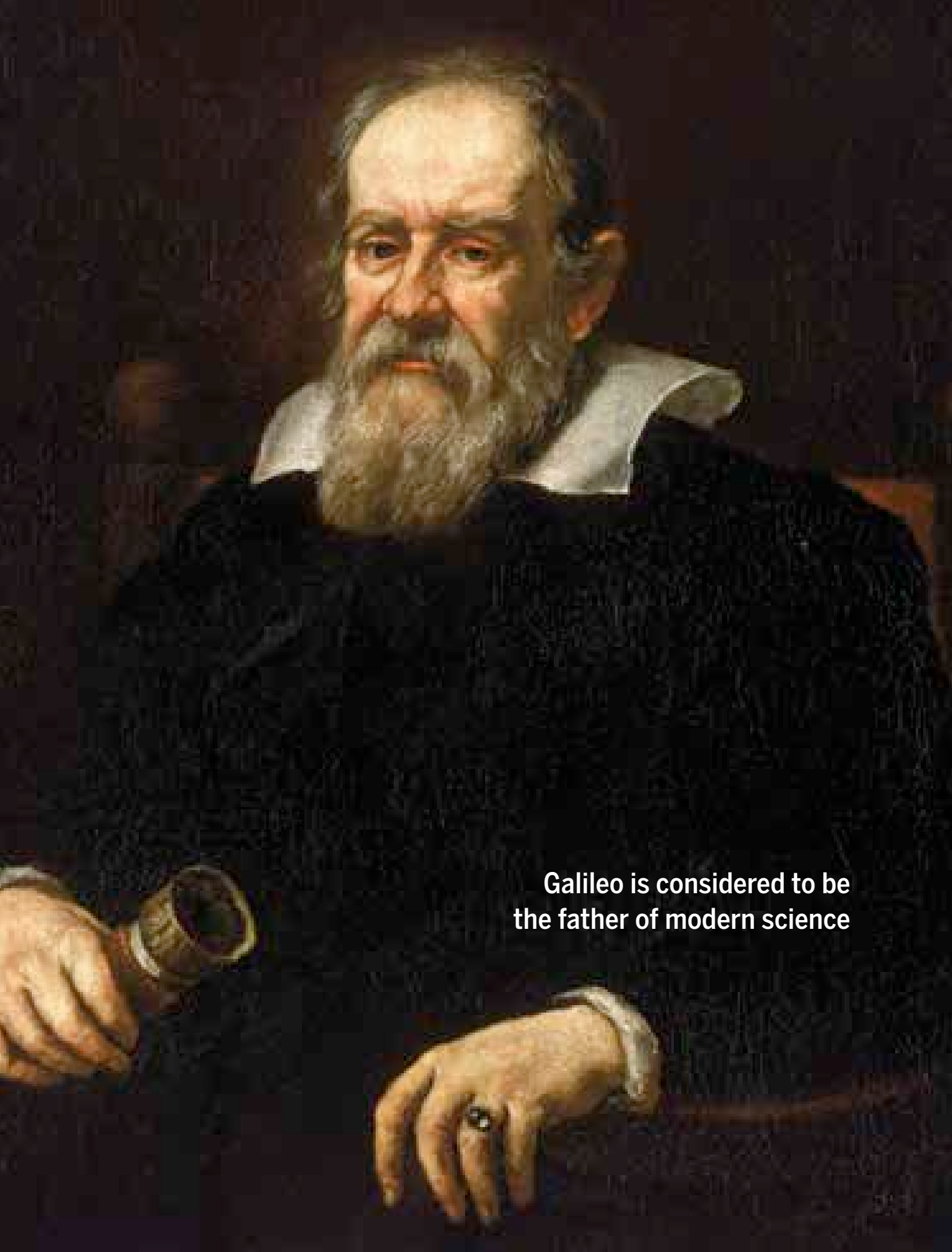
Protoscience

The difference between a fringe-science, pseudoscience or protoscience is often a very thin, and blurry line. While many of us are conceited enough to think we humans have learnt most of what there is to learn, it doesn't change the fact that the more we learn, the more we realise how ignorant of reality we really are.

The surest way of knowing where exactly a particular field of science really lies in the bigger picture is to travel to the future to find out. Problem is, time travel itself is either a fringe-science, protoscience or even a pseudoscience. Until it's achieved or proven to be decidedly impossible, it will be called all of those sciences. Since we cannot go into the future, we can trace the beginnings of the various sciences to their past. Undoubtedly, all that is science today was at some point in the past considered fringe science or basically scoffed at by the majority.

However, what does that mean? Should we treat all self-claimed sciences seriously? No, obviously not, as you would have guessed if you'd read our Pseudoscience dmystify (June 2017). While it is a hard task choosing what's a protoscience and what's fringe science, with even experts sometimes divided, we're going to present our own list with our reasoning, and ask you to make up your own minds. ■



Galileo is considered to be
the father of modern science

Protoscience 101

What are fringe sciences, and how do you spot one in the wild?

As we've mentioned in the introduction earlier, it's often just the passage of time that separates a " fringe scientific idea" from being treated as "cutting-edge science". Does this always happen? Not at all, quite the opposite! In fact the landscape of all that is currently accepted scientific theory is littered with discarded theories of yore. At the time that those discarded theories were formulated they might have been laughed at, or they might have been celebrated as the crowning achievements of humanity's brilliant intellect. Still, it wouldn't change anything, because most of them would go on to be disproved and discarded along the way to what is science's eventual goal – to understand our universe, and arrive at objective truths about the way in which it works.

Looking back into the past is a lot easier, and is often the best technique we humans know of in order to predict the future. Learn from the past, see the changes from then to now, and then use logic to try

and extrapolate data to arrive at a probabilistic model of the future... there's actually big money involved in doing that for pretty much any business or corporate house in the world. Governments, stock markets, banks – pretty much the world's entire wealth is invested in the future. This makes scientific predictions very valuable indeed.

However, because the future is uncertain, and because a few ideas that were considered crazy once are now accepted scientific fact (evolution is a prime example), pseudoscience builds castles in aforementioned uncertainty. This makes the job of trying to differentiate protoscience and pseudoscience very hard indeed.

It's why we called this piece "fringe science" instead of protoscience, because the only thing we're pretty sure of is that this list of ours will be neither exhaustive, nor will it be proven correct decades from now. We do hope that we get more right than we do wrong though...

Let's start at the start though, and look at some of the more famous examples of protoscience becoming accepted into the mainstream eventually. Perhaps a history lesson will help us set the stage for the current theories that will follow.

Pseudoscience

Although we've done an entire dmystify on this topic before, we have to touch upon it very quickly to be able to explain the difference between pseudoscience and what's covered in this book. For starters,

the problem with all pseudosciences is that they do not use the scientific method to arrive at their conclusions. Most of what is considered pseudoscience in the modern day are non-scientific beliefs that just cannot be proven or disproven using only their standards. Thus, say, homeopathy is considered a pseudoscience because it offers no way of testing its own hypothesis, has not proven its own claims and offers no way of being falsifiable. Astrology is another prime example of a pseudoscience that makes claims that it has no way of proving, or for that matter, disproving. In fact, using the scientific method, both astrology and homeopathy have been proven to be nothing more than confirmation bias or the placebo effect at work.

As you can already tell, pseudoscience has no element of science in it, and is merely made up stories based on very circumstantial evidence (often, none at all), based mostly on beliefs or leaps of faith.

In contrast, fringe science is just a semi-scientific theory that has a grounding in science but at the same time makes leaps of faith, or conjecture, without the ability to be wholly tested just yet. Time travel, for instance, is scientifically thought to be very possible indeed. When we're talking about apparent time travel to the future, it is absolutely scientifically possible because of Einstein's theory of relativity. Because time is relative to the observer, and because the effects of time are dilated by gravity or by speed, it is very much possible for someone to travel close to the speed of light, or be subjected

The Time Machine is a good story of time travel if you've got some time to kill

to a very high gravitational field, and then return to a point that he perceives to be the future. Because while under the effect of gravity or speed, the traveller would experience a much shorter time than, say, people on Earth would have felt. In fact, some astronauts have already travelled a few nanoseconds into the future because of the slightly less gravity they experience up in orbit.

Fringe no more

So without further ado, let's look at some fringe ideas of yore that eventually came to be accepted theories of science.

Evolution

Our favourite, of course, is evolution. While the idea that things change gradually with time was with humans since antiquity, with even the ancient Greeks, Romans, Chinese, Islamic, etc., cultures all having some philosopher or thinker opining about it, it was merely conjecture, or the extrapolation of logic.

Anaximander (610 to 546 BC) was the first that we know of to propose that life must have risen out of the sea, and that humans could not have formed the way they were, and must have had a different ancestor, because human babies were just too useless compared to all of the animal kingdom.

Fast forward to the early 1800s, and we find Jean-Baptiste Lamarck proposing evolution of sorts with his transmutation of species idea. He didn't believe that all life arose from a single ancestor, but felt life was constantly being created in simpler forms, and those would slowly transmutate into higher lifeforms.

Eventually Charles Darwin and Alfred Russel Wallace would simultaneously, yet independently, come up with the explanation of how evolution was possible and why it happened. Because both were

gentlemen, they insisted that the other get credit for the finding. Wallace wrote Darwin a letter about his theory, which is exactly what Darwin was writing in order to publish at the time. So concerned about people thinking him to be a copycat, Darwin was all set to burn his work and never mention his theory. It was fellow scientists, who Darwin had spoken to at length about his theory for years, who convinced him to publish his theory in the interest of science. Many believe that Darwin's brilliant theory is about evolution, when in fact, the theory was about the method of evolution, which Darwin called "Natural Selection".

The theory of evolution by natural selection is now considered to be fact by all serious biologists across the globe, as more and more evidence is found every day that only reinforces the theory, and no evidence has ever been found that disproves it. However, because the idea of nature itself acting as a selector, and it "designing" various species to appear absolutely perfect for their environment went against popular religious beliefs, the theory was mocked for hundreds (if not thousands of years). Yet here we are...

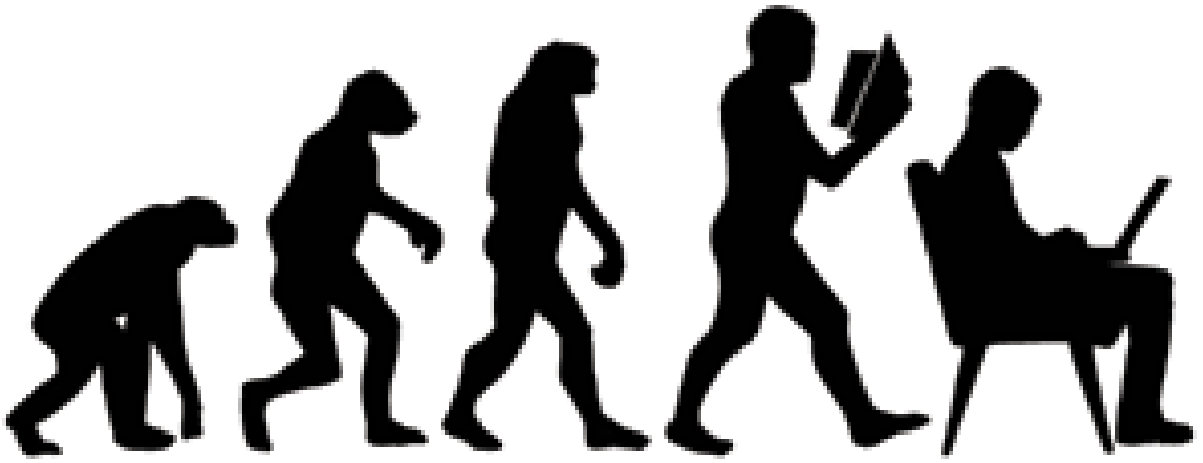
Continental Drift

Abraham Ortelius was a Dutch cartographer from Antwerp (present-day Belgium), who was also the creator of the modern atlas (which all of us have studied in school). As early as 1596, Orte-

lius had noticed that the eastern coastlines of North and South America seemed to fit like a glove in with the western coastlines of Europe and Africa. It was almost like someone had snapped the continents and then pushed them apart in the oceans. Ortelius suggested that the Americas were torn away by earthquakes and floods. Of course, with no way to prove this at the time, and the idea that land itself could move, even a few metres, let alone the distance of Africa to South America, was just considered ridiculous. In fact, Ortelius was summarily ignored on this point by pretty much everyone.

Much later, in a paper in 1912, German geophysicist Alfred Wegener laid out his hypothesis about a very old continent that he called Pangea, which then broke up and eventually drifted apart to become the continents we see today. He was the first to use the term "continental drift" to describe the movement of continental landmasses. It was rejected widely by everyone because he could not explain why or how continents would move.

Then, in 1958 Australian geologist Samuel Warren Carey wrote an essay about plate tectonics, which tried to explain how the crust of the earth could be changing and moving. Of course, Carey put the movement down to what he called the expanding earth (more on this later). Carey was one of the most vocal proponents of Wegner's continental drift theory.



What's next?

Although the modern science of plate tectonics is very different from what Carey imagined, and showed that Wagner was as much as 100 times off the mark with his estimates on the amount of movement per year of the continents, it does agree with the basic idea of continents slowly drifting away (or towards) one another. While Wagner had estimated drifts as large as 250 cm per year, the modern estimate is that continents can move as much as 2.5 cm per year. This may seem like a very small amount, but it adds up to a lot over millions of years!

But enough of the history lesson. There are many more sciences that were once ridiculed but are now accepted, and we could probably fill the whole book with them, but you're here to read about the future, not the past...

We'll break up the fringe sciences into three categories, to make this an easier read, and first up we have Biology. ■

Biology

Fringe theories about life and all things living that might not be as crazy as you'd think

To many of us, the science of living things is the most fascinating, because of the sheer diversity of life, and the fact that we find it in pretty much every nook and corner of the earth. Despite being the most easily accessible field of study, in terms of specimens being readily available, and the fact that it's a lot easier to travel across the earth to study, say, algae in the pacific ocean, than it is to study other planets, or the sun, or things like that.

Physics, for instance has to find answers by analysing particles smaller than atoms, and also black holes millions of light years away. Blology on the other hand, is pretty much all about what we can see or detect. At some point smaller than a living cell, biology becomes chemistry, and biochemistry is a totally different field of its own. Yet, despite the seemingly easy access to all things living, Biology has some really large gaps in its knowledge.

For one thing, biology essentially has a sample set of one to work with. Earth is the only place we know of that has life, and all life we have encountered so far has been pretty similar, and suggests a common ancestry. Finding life that didn't originate on earth, or rather, life that is different from existing earth-life in some significant way would be a huge shot in the arm for biology. In amongst all the grey areas that are the gaps in our knowledge about biology are some fringe theories that might revolutionise the field. We're going to discuss a few of them now.

Astrobiology

This is an example of a field that theoretically shouldn't exist until it's needed, but at the same time, we're happy it does, because it allows us to imagine non-earth life and plan for what we should do if or when we encounter it.

While many subsections of astrobiology do in fact deal with life on earth, and bits of astrobiology deal with the very origins of life on earth, it is still mostly about life beyond earth. Not just alien life, but also how we could take life to the stars ourselves.

We've really only taken life (human life) to the moon, and brought it back. All our other explorers of the solar system have been lifeless robots or satellites. We do however plan on visiting Mars, and eventually visiting other solar systems (we hope). In order for this to happen, astrobiology becomes a very important field of study.

Of course, one of the most important questions for all of humanity is "Are we alone in the universe?", which is a terrifying thought in all honesty. A subset of astrobiology called exobiology is dedicated to trying to find such non-Earth life. While most scientists are certain that life should find a way to get started on many different planets across our own galaxy, many of those same scientists suggest that we might never find that life, because of the vast distances in space and time. Over the 14 billion year history of our universe, who knows how many times life got started and then wiped out when the planets on which it formed died along with its star? Even if life is thriving out there in some distant galaxy, the chance of us ever encountering it is so remote that it's as good as non-existent. However, we might be able to find basic life (akin to the bacteria on Earth) on nearby planets such as Mars, or even on the moons of Saturn or Jupiter, and recent discovery of a planet in the habitable zone of our closest star, Proxima Centauri, means that life might be closer to us than we think.

The search for intelligent life, however, is something that is a lot harder and is perhaps on a much lower scale of probability than we'd like to admit.

There are a few aspects of astrobiology that are important for us to know about:

Astronomy: Parts of the field of astronomy fall under astrobiology, especially when the astronomers are focussed on identifying,

say, habitable planets, or identifying sun-like stars in an attempt to find not just possible locations in the cosmos where life might already exist, but to identify places where we might want to consider setting up colonies in the distant future.

Communications: The search for extraterrestrial intelligence (SETI) is an example of a study or search for communications from intelligent aliens. The idea is that if aliens exist (or even once existed),

Will we ever realise this astrobiological dream?

they might beam communications out into space in all directions as a way of informing the cosmos, "We exist!". Some communications experts and projects keep their eyes and ears (metaphorically) fixed on the skies to try and find such signals. While some scientists believe we should be sending out such communications to inform any aliens listening as we are, others, such as Stephen Hawking think we should not, just in case said aliens are raiders looking to raid or find planets worth colonising.

Astroecology: This is a subset of biology and astrobiology that looks specifically at how earth life could survive in space, on other planets, on asteroids, moons, etc.

Vampires

At this point you're probably wondering what recreational drugs we've been experimenting with. However, let us be clear, we're not talking about the movie versions or mythical vampires. We're not talking about blood suckers with pointy teeth and a Romanian accent, or magical and mythical creatures that can turn into bats and fly, and who hate sunlight... or any of that...

What we're talking about is new research that suggests that "young blood" can revitalise an old person. In cutting edge research that is still being published and, to be honest, is also yet to be subjected fully to the rigours of peer-review, it's been shown that young

blood does in fact help older individuals. The individuals in question who this was tested on were mice.

The research project is being undertaken at Stanford, and headed by Dr Tony Wyss-Coray, has the noble aim of helping people who suffer from Alzheimer's disease, or other neurodegenerative ailments.

The practice of parabiosis is over a century old, and is basically the connecting of an old individual to a young person's blood supply. Think of it as connecting two people the way conjoined twins are, except they're not twins, and one is much older than the other.

In studies done on mice, the researchers found that getting young blood did in fact make old mice "younger". This was measured by looking at memory capacity, and activity levels.

Basically, the study looked at how well a mouse was able to remember the exit from a maze, from a fixed starting point. The results found that younger mice were able to find their way out of the maze much faster, which was chalked down to capacity of memory – older individuals have less memory capacity, as neurons don't fire as well, and the connections inside the brain reduce when age increases.

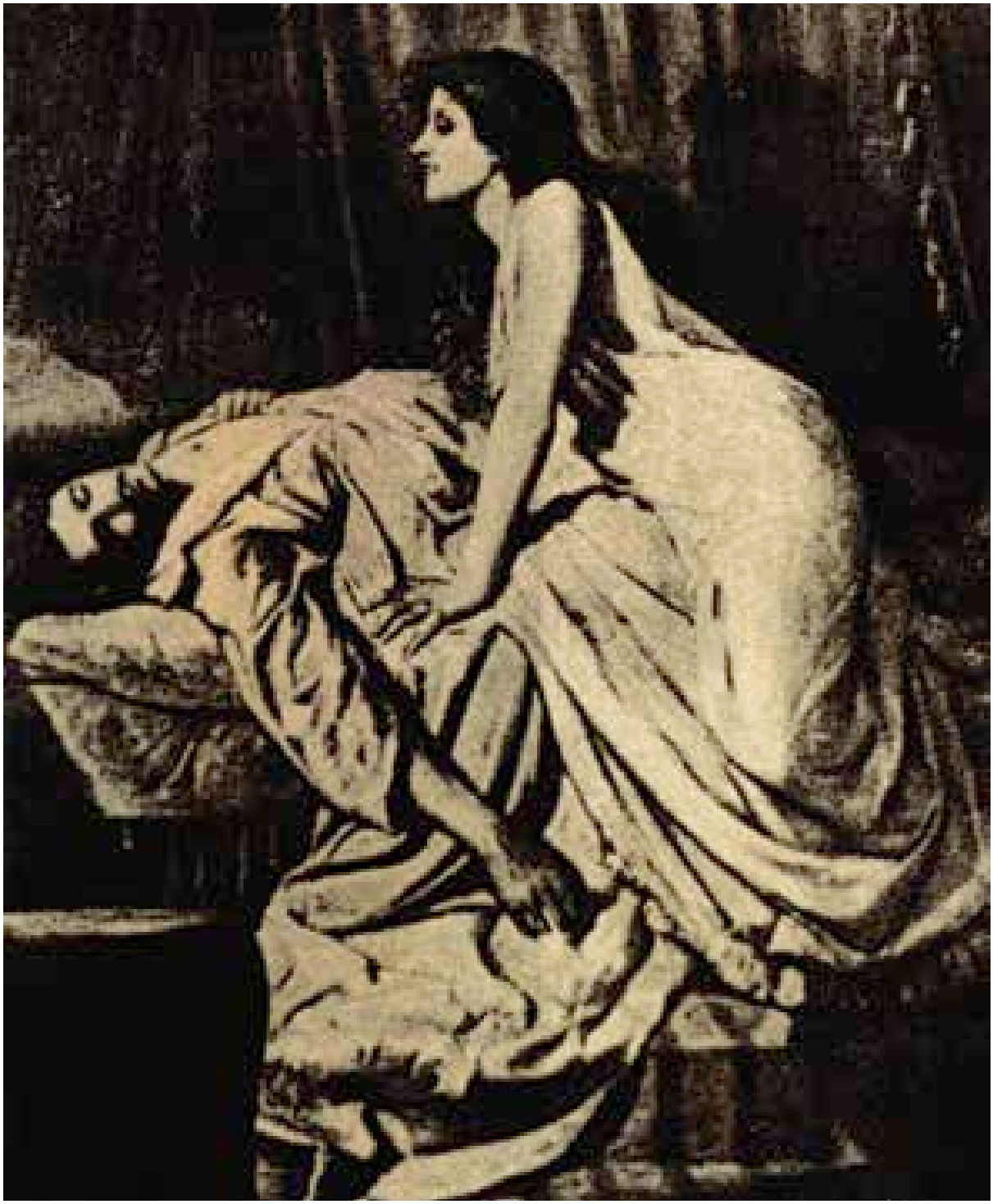
Instead of joining the mice together as a way to achieve parabiosis, what the researchers did was transfer plasma obtained from younger mice into older mice. Think of it like getting a blood transfusion from a younger individual...

Their results confirmed that older mice were able to find their way out a lot quicker when they'd been transfused with young mouse blood.

Human trials on Alzheimer's patients have been started already, and results of those studies will take a year or two to come out.

The major objection to this is an ethical one, because people fear that old, rich people will start paying for young blood, which will result in many illegal blood farms being set up, and young people being trafficked. People are also concerned about how young the young blood is. If it's 20-somethings then at least there's consent, but what if the studies find that the blood of prepubescent children works better, will we start off a whole new underground market where children from third world countries are being exploited and farmed and kept in captivity as donors to rich people?

In fact, there is already a company that's been launched on the back of the work of the researchers, without any scientific principles, and without understanding the work of the researchers, which claims to give older people (above 35) blood plasma from young and healthy humans for a mere $8,000 a transfusion! That's about ₹5 lakh per transfusion. Imagine if you were 20 something, healthy and being offered a lakh for your blood in India? The line of donors would be longer than the lines at ATMs post demonetisation! We aren't giving you the name of the company on purpose, because it's indulging in a scam, as per Dr Tony Wyss-Coray himself. He told



The Vampire, 1897, by Philip Burne-Jones

Science (sciencemag.org) that this so called clinical trial doesn't include a placebo group, which is the basis for every treatment research out there. It's just not science if it's not done scientifically, and charging people money to participate in such a trial clearly speaks to the motives of the company.

Although living forever might be out of the question with young blood, if it actually helps Alzheimer's patients it might be worth all the woo and snake oil peddlers that it will bring with it. Either way, "vampires" who stay young using the blood of young people already exist today. Bet you didn't expect that, huh?

Genetic memory

This is something you might have read about or seen in a science fiction book or movie. Frank Herbert's *Dune* series and the Ridley Scott's *Alien* franchise talk about genetic memory in the way that is widely considered to be woo or pseudoscience today. This is akin to saying that actual memories of our ancestors are passed down in our genetics. Not traits, but actual memories!

There is no evidence for such a thing occurring whatsoever, and this often leads to the idea that genetic memory is pseudoscience and rejected outright by all of science. That, however, is also false information, because there are aspects of genetic memory that are indeed very scientific, and widely accepted by geneticists. It's just

not the kind of memory that comes from our brain, but more like memory in the form of code stored in RAM in our PCs.

The idea is that DNA is, in essence, biological code that decides who we are and what physical characteristics we have. We pass down some of our unique DNA to our offspring, and this is like transferring code, or basically transferring memory. It's not just that simple either, because the study of epigenetics (we will discuss that next), shows that environmental changes do in fact leave imprints on our DNA, and recent studies have shown that these epigenetic changes are passed down to the next generation, and can survive for as many as 14 generations! Of course what's been studied is roundworms, because we can observe their generations a lot faster than we could, say, monkeys, or even humans. However, if this is true for all living things, then this means that information is passed down from generation to generation epigenetically as well, which is, in essence, an example of genetic memory...

The study was conducted in Spain at the European Molecular Biology Organisation (EMBO) , and they chose roundworms because each generation takes between 3 and 4 days. They found that a certain transgene, when activated, causes the worm to glow under ultraviolet light. When living in a cold climate, the gene was turned off, and when the worms were moved to a warmer climate, the gene got turned on. If the worms are bred in a consistently cold environ-

ment, each generation has that gene turned off. If the worms are brought up in a warm environment, each generation has that same gene turned on. However, when offspring on those brought up in a warm environment are moved to a cold environment, they continue to have the gene turned on, and up to 14 generations can pass before the gene is turned off again.

There is no explanation for this as of yet, but the suggestion is that the information is being passed on from generation to generation, as if it's a "memory" of warmer climates... just in case the offspring encounter aforementioned warmer climate.

There's a lot we still don't understand about genetics, and that's what makes it such an exciting field to work in.

Epigenetics

The epigenome is like a layer of information that sits "above the genome", which is what the term epigenome means, literally. It's hard to explain in layman's terms without a hypothetical example, so let's use one.

Imagine you clone yourself. What does it mean to clone someone? Like an identical twin, it means that you would have the exact same DNA as your clone (or twin). Now, let's say you are 25 years old when you clone yourself, and thus, when your clone is 25, you will be 50, etc.

Will your clone look just like you? Yes, but with minor differences. If you took a picture of yourself today and your clone 25 years from now, you might or might not be able to tell any differences. A 3D scan of your entire body, however, will probably pick up a lot of differences. Why? Because how we live our lives matters, and what we eat matters. Thus, what you eat, how much you exercise, whether or not you drink or smoke, and a multitude of other factors growing up define who you become. So, for example, let's say you're a twisted soul, and unlike what your parents did with you, you decide to raise your clone on mostly fast food and junk. From an early age you will start seeing differences between your clone and yourself at the same age. By the time your clone is 25, chances are he or she will be much fatter, much less healthy, and probably much shorter as well owing

to the lack of nutrients available growing up. That is, if they don't die of bad health before they're even 25, based on the nonsense we get for fast food these days!

So far, all of this seems natural. In fact, many of you are probably going "Duh! Of course the clone is different if it eats different. How stupid!" And you're right, thus far it's very straightforward. However, it's now time to throw the spanner in the works.

Recent research in epigenetics is suggesting that not only does your lifestyle affect your growth, and health, and all that, but also affects all of that for your children, and even your grandchildren, and perhaps even longer! In the example given above under genetic memory, we know that it can continue for 14 generations in worms, and with the human genome being so complex, it's impossible to tell conclusively whether it continues for just a few or many more generations than worms.

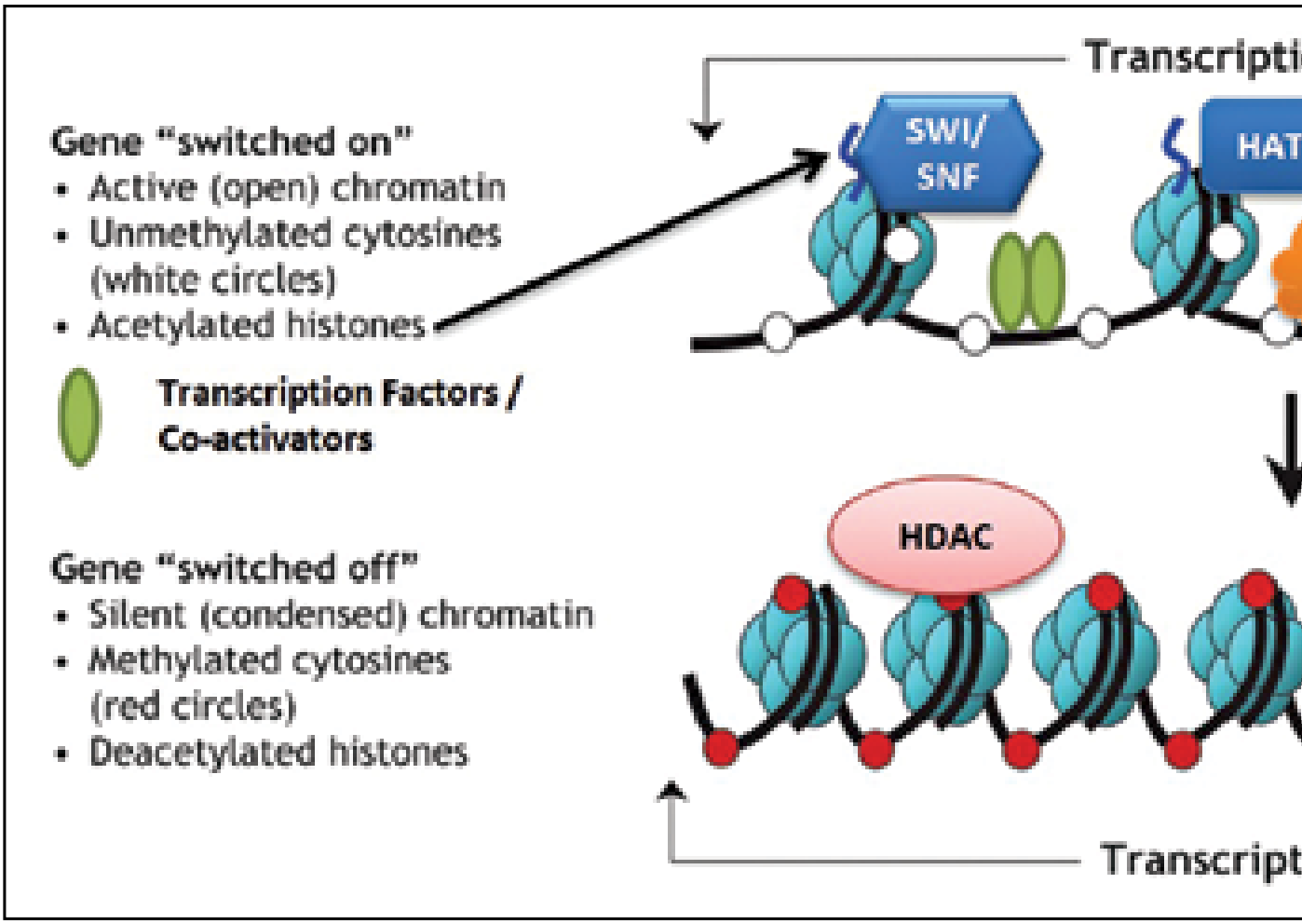
Let's run through a very short Epigenome 101 class. While the DNA of clone is identical. Think of it as a very long paragraph of text. In your clone and in you, all of the letters of that paragraph are exactly the same, and in the exact same order. Thus, identical. Or is it? Think of the epigenome as the punctuation and spacing of the letters in that paragraph. While a raw DNA dump would be akin to removing all spaces and punctuation and looking at only the letters and the order in which they appear, the epigenome is

the punctuation, which is what the readers actually read. Here, the "readers" would be the cells that read the DNA code and turn genes on or off based on punctuation.

Cells need instructions on how to use DNA. Methyl groups (compounds of hydrogen and carbon) are added to a DNA molecule (like punctuation) to give meaning to the DNA. It's how, for example, a stem cell knows it's supposed to become a brain cell, or a liver cell, and why you don't get liver cells growing in the brain, or brain cells growing in your heart... etc. This type of methylation is called promoter DNA methylation (note: promot**O**r, not promot**E**r), and is one of the ways in which cells know what type of cell they are or should be. The methyls bonded to the DNA tell that cell which genes are switched off and which aren't, and that's how cells are made.

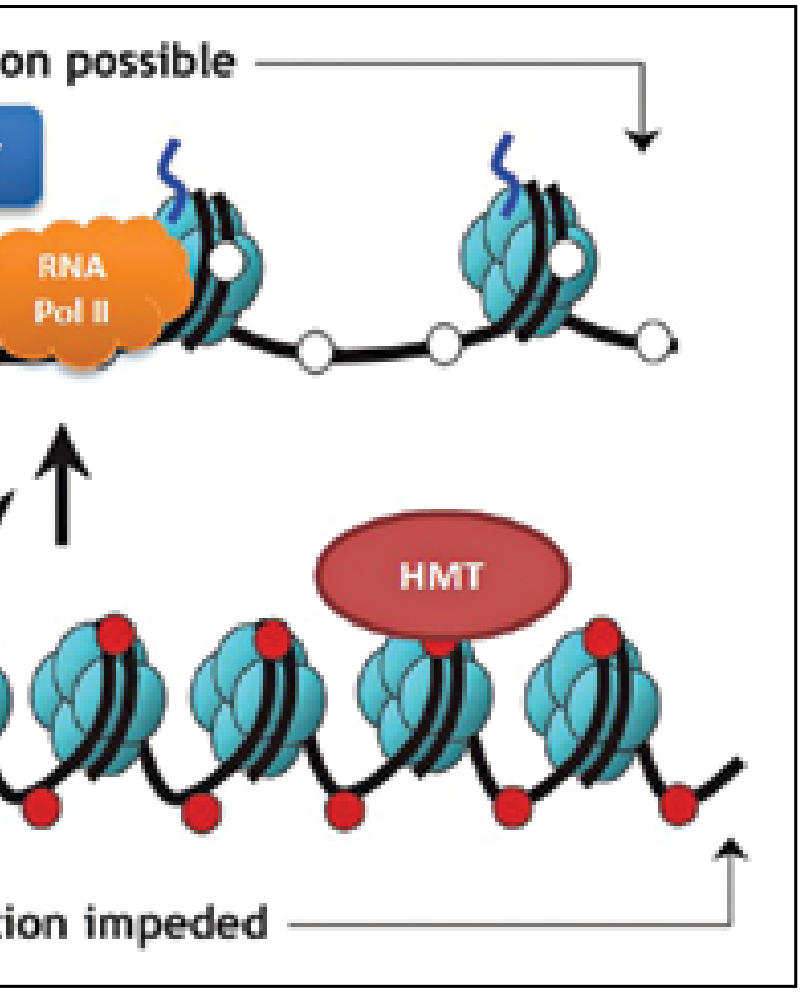
Another method is the use of proteins called histones that DNA is wrapped around. When the DNA coils around the histones (by ionic bonding). When tightly wrapped around a histone, a section of DNA is inaccessible, and thus the gene that is wrapped around the histone is inactive. When it is loosely wrapped around a histone, or there is a section of the DNA free between histones, the genes on that part of the DNA are available to the chemical processes of life and thus are active.

Note: This is an oversimplification, of course, as each of these topics could essentially be a dmystify unto themselves, so biology majors please don't get upset with our oversimplified layman speak.



How genes are switched on and off

Traditionally, all biologists would have agreed that all methylation of DNA is reset when DNA from parents are passed down to offspring. It's why some of the findings of epigenetics are so hotly debated today, because the suggestion is that although almost all methylation is reset, there is still some process that's transferring epigenetic information to following generations.



This currently fringe theory of genetic memory via epigenetics is gaining traction, and we expect to hear a lot more from them in the coming decades.

Epigenetics is already helping a lot in cancer research (as cancer is really just the epigenome layer gone bad in a person), and holds a lot of promise. It also is a very scary prospect, and perhaps a wake up call to all of us, because as this is studied more, and we learn more about it, you might not just have to face guilt for not taking care of your own body, but you might have to accept at least partial responsibility for quite a few of your direct descendants! Maybe that guilt will eventually get us to live healthier lives! ■

Physics

There's a lot we don't know when it comes to physics, and some of the following fields claim knowledge. But is there any?

If the size of a scientist's ego was the indicator of importance of their field of study, then physics is by far the most important scientific field of them all! We jest! Please don't send us angry emails if you're a physics fanboy. Physicists we don't have to worry about, because there are none reading this. They're too busy re-reading their own theses and marvelling at their own brilliance! OK, fine! That was the last one. We promise!

Pretty much all modern physics, especially theoretical physics, can be considered to be on the fringe of scientific breakthroughs. String theory, for example is perhaps the biggest and most popular fringe theory of them all, and we hear so much about it that you would be forgiven for believing that it is mainstream physics. All string theorists talk about their theory as if it is fact, and we've mentioned in this space several times the difference between a theory and a

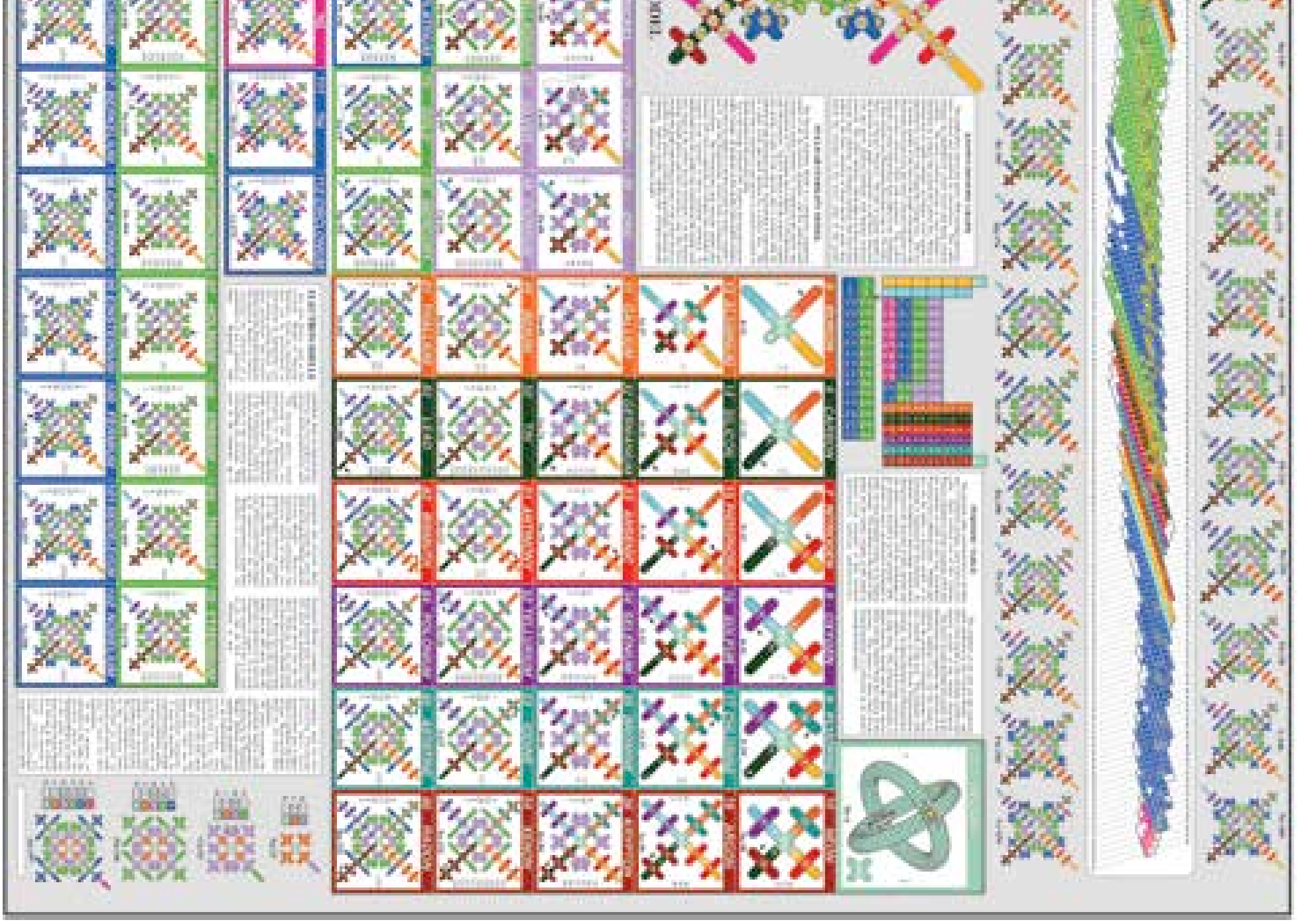
hypothesis, and just wild conjecture. We've even ridiculed people who consider a scientific theory to be "just a theory", akin to something any crackpot can come up with. However, "string theory" has us running for cover. Honestly, there are many who would rather call it string hypothesis instead, but string theory uses a loophole of logic. It isn't a "theory" that can be considered a fact based on repeatable and testable experiments, or be confirmed repeatedly with evidence, or make predictions, etc., as all good scientific theories should do. However, it is a mathematical theory that is proven with complex and advanced mathematics by balancing equations that only a few people who have ever lived could even understand. In essence it is a valid mathematical theory about a physics problem!

In this section we're going to quickly run through some theories in physics, and look at some of the latest research in the field. However, we will remind you that each of the topics in this dmystify could essentially be a dmystify unto themselves, so we urge you to do further reading if you want to truly understand the topic, even at a layman level!

Circlons

We apologise for starting with what is widely considered to be pseudoscience by the scientific community at large, but this author happened to read a book about Circlons, and wanted to give it a mention, just in case you also come across the same book.


The
Circlon Model
of Nuclear Structure
By James Carter
NUCLEAR STABILITY



A glimpse at Carter's version of the periodic table

Image Credit: Physics on the Fringe (Book)

The theory was thought up by James Carter, a pseudoscientist (and widely considered to be insane) trailer-park owner from the US.

His theory is that the entire universe is made up of rings. We only mention it immediately after mentioning the theory that the universe is made up of tiny vibrating strings (string theory) for fun. Please do not assume we are equating the pseudoscience of circlons with string theory, or even suggesting that they are at par in any way whatsoever.

Carter says that smoke rings (of what, we don't know), are good approximations of the atom, and he uses smoke rings and how they interact with one another to visualise this. He believes that all matter is made up of mechanical rings that are circular in shape, and that even all forces of nature can be explained using circlons. He claims to have re-written physics, and considers himself to be the next Newton.

This writer, being a college dropout like James Carter understands the desire to feel intelligent when in a group of truly knowledgeable people, and also the incredulity of realising that many college graduates don't even know the basics of many things. However, to step that up to the level of ignoring all criticism and refusing to give up on ideas that have repeatedly been proven wrong by simple logic, mathematics, and even advanced physics does border a little on insanity.

The only reason this is being shared here is to inform you about how even woo and pseudoscience can appear to be sincere,

be incredibly detailed, and will always try and appeal to the anti-intellectualism trait that all of us have. When dealing with concepts that we secretly know we are too ignorant about, a lot of us like to try and ridicule intellectualism, and one of the ways is to fall for pseudoscientific nonsense such as this, or all of the ones mentioned in our pseudoscience dmystify.

By all means we encourage you to read more about circlons and James Carter, but please do not associate his claims with science. Also, try and do the same for all the other pseudoscience and snake oils you will encounter in life...

And now, back to the science!

Teleportation

While the most popular image that springs to mind when you think teleportation will be "Beam me up Scotty" from the *Star Trek* series (or the newer movies), there is an entire field of physics dedicated to quantum teleportation that looks and functions nothing like in the movies.

As usual, sci-fi is a lot prettier than reality, at least so far. In order to understand quantum teleportation, you'd first have to understand quantum entanglement, and that would take more text and images than in this entire writeup to explain properly, so we will try and do it the quick and dirty way...

What Einstein termed a "spooky action at a distance", was a quirk of the quantum world in which particles could be entangled with one another, so that reading one could reveal the state of the other. Think of it as two particles in a system whose quantum spin totals zero. Thus, if you know the spin of one particle about an axis is clockwise, you will automatically know that the spin of the other particle is counterclockwise along the same axis. This has been tested thoroughly, and found to be true.

The real mind bender is that these particles need not be interacting with one another at a close distance. You could take on particle far away from the other, measure it, and then measure this particle and find that it is indeed still entangled. Now, particles not changing when the other is separated from it is all well and good. You could consider it to be inherent traits that are unchanging. Take two one rupee coins, one with heads facing up and one with tails, but inside opaque boxes, so you don't know which is heads and which is tails, move them to different cities, open one, find it's heads, summarise that the other is tails, open the other, prove it's tails, and whee! Physics! Right?

Wrong. Let's explain why. To begin with, measurement of the spin of a particle is always done in a given axis. So assuming you were to measure the spin of a particle in the Y-axis and find that it is spin "up" then measuring the spin of the other particle would reveal spin down. However, when particles which are spin up in the

Y axis are measured along the X axis, there is a 50 per cent chance of them being measured as spin "up" or spin "down". Here "up" and "down" are merely measurements along the axis. Think of "up" as a positive spin, and "down" as a negative spin, or clockwise and counterclockwise (respectively) if that makes it easier to picture.

This can be experimentally tested, and has been. After measuring the spin of a particle along the Y-axis, and finding the spin to be "up", all subsequent measurements of that same particle are always "up" when measured in the Y-axis. When this same particle is measured in the X-axis, the spin changes to either up or down (in the X-axis), and Y-axis spin up particles are found to become X-axis spin up half the time, and X-axis spin down half the time.

Thus, if we entangled two particles in the Y-axis (one spin up and the other spin down) and then measured them both in the X-axis, we should sometimes get one with spin up and one with spin down, or both with spin up, or both with spin down. Thus, there should be a 50 percent chance of finding the same spin on even entangled particles. And yet it never happens!

It's as if the particles are in some quantum entangled state, and the act of measuring one particle decides the spin of the second. This has been done across large distances, and still it seems that entangled particles always have the opposite spin, no matter what axis they're measured on.

The reason Einstein called it spooky was because he did a thought experiment, where the two particles were separated by a large distance, let's say a light year, and both particles were measured at the same instant across the light year, it would seem that one particle would know when the other was measured, and thus, information between the two particles was travelling at faster than the speed of light! This was absurd to Einstein, and yet, although we haven't proved it at distances as far away as that, we have measured it across non trivial distances.

Now, quantum teleportation isn't teleportation as we know it. It is the transfer of information, not of the physical object itself. In fact, since the act of measuring on one side changes the quantum particles being measured, in essence, it's like destroying what's on this side in order to send data to the other. If Captain Kirk teleported a thousand times in Star Trek, it means that Captain Kirk was killed a thousand times, and a new Captain Kirk was re-assembled a thousand times!

But let's not get ahead of ourselves, because that kind of teleportation just isn't possible yet. What is possible is teleportation of quantum particles, and here's how it works. To begin with, you're going to need three (yes, three!) quantum particles. Two are entangled to one another (A and B), and the third (particle C) is the actual particle we want teleported.

How this works is that we take the entangled quantum particles, separate them by the distance we desire, and then start the teleportation process. A process called a Bell measurement is made – this is named after the Irish physicist John Bell, who came up with the mathematics that enables the quantum measurement that allows for quantum teleportation.

So, what we do is throw particle C in with one of the entangled particles (say, A), and then make Bell measurements on the two, which is a way of measuring the quantum states of the two particles A and C together, and still keeping A and B entangled. Thus, a Bell measurement produces no information about either particle A or C, but tells us things like whether both particles have the same spin, or whether they have opposite spins, etc. However, by making the measurement, and by entangling C with A, the quantum state of C has been destroyed. If the results of the Bell Measurements are sent from where A is (point A) to point B (where particle B is) then it is possible for someone or a machine at point B to convert particle B into an exact copy of particle C, by using the Bell Measurements.

Although quantum entanglement works instantaneously across large distances, seemingly faster than the speed of light, quantum teleportation is limited to the speed of light, because the Bell Measurements of point A have to be communicated to point B in order to recreate particle C. Also, since particle C (at point A) is being

"destroyed" (or at least information overwritten), and particle B is now becoming particle C, there's no magical "teleportation" of matter happening here, it's more a teleportation of states of matter.

So far the distance record achieved is when the Chinese succeeded in quantum teleportation of a photon to a satellite that was 1,400 km away! Given that this is just one photon, it's safe to assume

Source: Valve

Portal (and Portal 2), the game uses the concept of teleportation. Well sort of. A must play!

that the teleportation of any serious amounts of matter is a very, very long way away, and Star Trek-like teleportation might very well be impossible, after all!

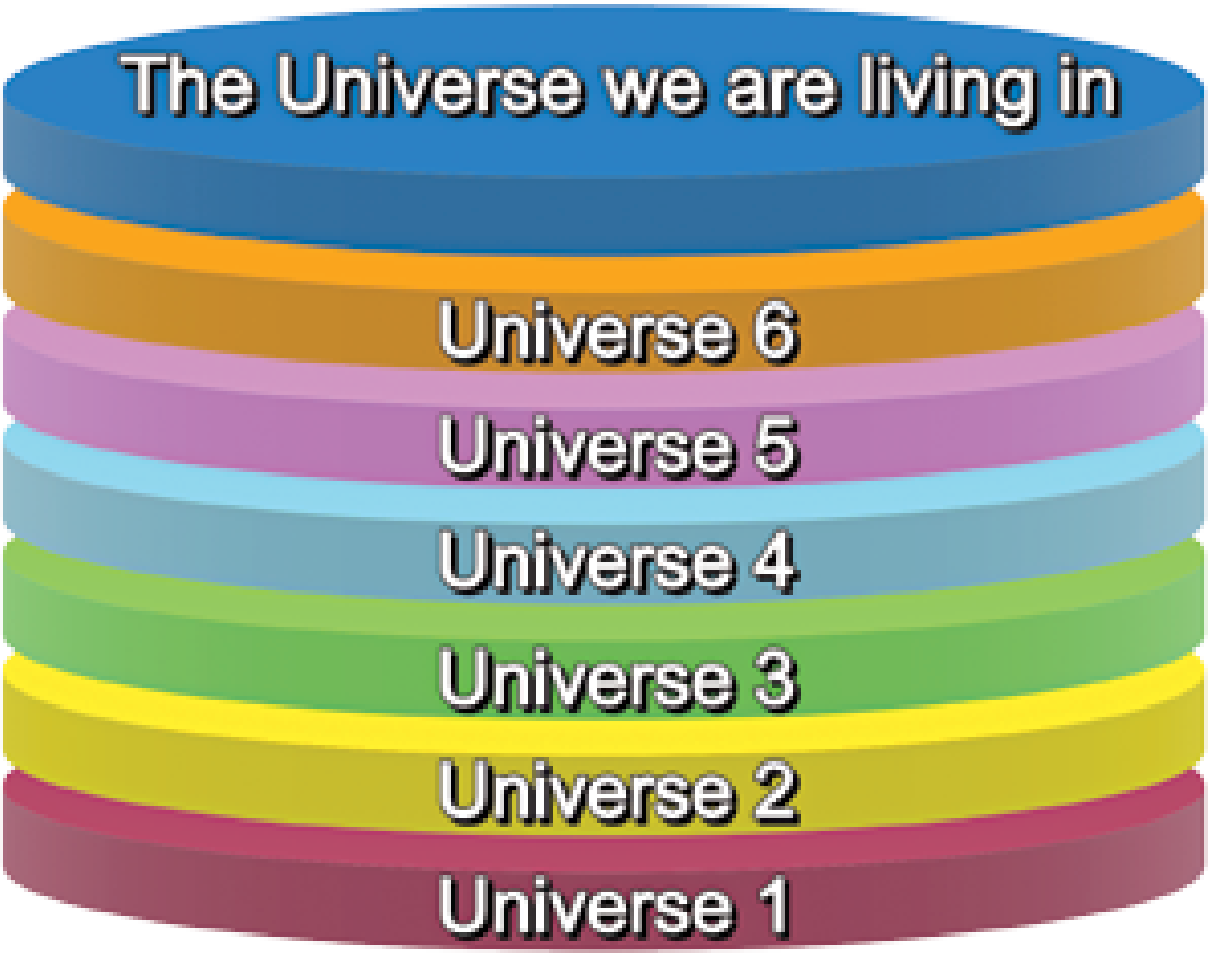
Multiverse

The theory of the multiverse is complex, and there are many who have their own versions of why they believe in it and why they don't, with many data from tests suggesting that it is a possibility, only to have new data wipe out the possibility, and then even newer data reinstate it... If the world smartest physicists cannot agree on whether there might or might not be a multiverse, what hope do ignorant science readers and writers have of ever finding out? However, because it is so hotly contested an idea, it has to be added to our list.

On the one hand you have brilliant minds such as Stephen Hawking, Michio Kaku, Max Tegmark, Brian Greene, Leonard Susskind, Neil deGrasse Tyson and Sean Carroll telling you that it's possible that the multiverse exists, which is a formidable panel, and thus we are obviously swayed by them. However, on the other hand, you have Steven Weinberg, Roger Penrose, Paul Davies, Neil Turok, David Gross and even Paul Steinhardt telling us that the multiverse doesn't exist, or at least that there's no evidence for it, and we're officially confused. Paul Steinhardt, in particular is one of the great

minds behind the theory of inflation, which gave rise to the theory of the multiverse from the complex mathematics it proposed. However, he's now an opponent of his own theory, and one of the most vocal critics of the multiverse theory, as well as inflation!

The bottomline is that we don't really know, but the multiverse is something that is acceptable to even string theorists, who think of our universe like a brane (from membranes), which is situated



A simple visualisation of universes in 2D

in close proximity to other parallel universes. You can read more about this in our dmystify String Theory.

The main reason why we add the multiverse here as a fringe science or theory is because if it is true, there is one universe out there for every single one of us, where we have won the lottery, or are winning Nobel prizes in physics, or accomplishing whatever your fantasy is, and that's just a nice thought to leave you with...

Wormholes

Unlike parallel universes and the multiverse, wormholes are totally consistent mathematically with Einstein's theory of general relativity, and in fact the idea itself arises from his equations! One spacetime was listed as a dimension, and it was established that spacetime does in fact curve with gravity, it became theoretically possible that there were tunnels between two different points in spacetime.

In 1921, the idea of wormholes was first proposed by Hermann Weyl, the famous German physicist, but he called them one-dimensional tubes. It was American physicist John Archibald Wheeler who coined the term wormhole.

Most theoretical wormholes that have been predicted are essentially not things we can go through in the way we see in science fiction, sadly. Such "traversable wormholes" would need some sort of negative energy to keep them open and allow matter to enter

and exit. Of course, it just so happens that in quantum field theory (don't ask, we don't understand it), there are regions of space possible where the energy density is negative (as compared to the normal vacuum energy of space). This is also contested, because people believe that the vacuum energy of space isn't actually zero energy, and thus what the quantum field theory is describing is merely lower energy than the vacuum of "empty space" (which isn't really "empty"), and not really "negative" energy.

Needless to say, no wormholes have ever been spotted in our search of the cosmos, and for a traversable wormhole to exist, we'd have to spot a white hole. A white hole is obviously the opposite of a black hole. Think of it as the other end of your vacuum cleaner... if one side sucks, the other side blows, and so in theory, if all that mass is being sucked in at a black hole was being spewed out at a white hole, then there'd be a case for wormholes that one could traverse.

If a black hole has an event horizon that nothing, not even light can escape, then a white hole has an event horizon that nothing, not even light can enter, and anything inside would be ejected.

However, because black holes form from the collapse of a star, it's hard to make a case even mathematically as to how that would connect with even a theoretical white hole. Plus, white holes would be extremely short lived, and any wormhole connection between a white hole and a black hole would be shorter lived still! Certainly not

Connecting one place in the universe to another

enough time for anything our size to get into the black hole and out again from the white hole.

In short, wormholes are still a pipe dream, but as long as they remain mathematically possible, they're going to exist in science fiction at least for sure.

Death rays

Another favourite of science fiction, especially with hand-held alien guns or large "Death Stars" is the idea of death rays. The idea that you could project a ray of some sort to damage equipment or kill personnel, as expected, immediately caught the attention of defense labs and governments.

In fact, many inventors claimed to have invented death rays over the years, but none were able to showcase their achievement to the public. From the early 1920s onwards, in the aftermath of the first world war, there was an unprecedented rush to invent new war technology and trying to sell it to the military. This was fueled perhaps by patriotism to one's country, the desire for fame (as being someone who helped their country win a war), and of course the oldest desire of all, for money. People saw how governments spent large sums of money on technologies that could give their side a slight advantage over the other, and this was an obvious draw. Of course we don't know which of these three desires drove the different inventors of the death rays, or if it was any of these three, for that matter.

In 1923, Edwin Scott claimed to have developed a death ray that could bring down planes at a distance. Harry Grindell-Matthews, a British inventor, tried to sell his version to the RAF (British Royal Air Force), without success.

Nikola Tesla also claimed to have invented a "death ray" that he called teleforce in the 1930s, which in fact wasn't a death ray at all, and the misnomer was because of the media and the way they reported it. Although Tesla's teleforce was never realised, he insisted that he could make it, and also hated the death ray misnomer himself. His idea was to send out charged particles (not energy, as in a death ray) at very high velocities, and thus cause much more damage than an energy beam could. High speed projectiles obviously cause more damage than even energy travelling at the speed of light. Another advantage of Tesla's idea was that while energy beams would have to be very precisely focussed at a target (only then would the energy be concentrated enough to do any damage), his teleforce would send out small particles in a general direction towards, say, many airplanes coming in to bomb a city, and his one beam of particles could, in theory, do damage to hundreds of planes – depending on the size and velocity of the projectiles, of course. Think of it as spraying millions of bullets into the skies towards incoming bombers... most bombers were likely to suffer damages, and if the bullets were accelerated to even faster speeds, the damage would be greater because of the greater momentum they carried.

Many more after Tesla also claimed to be able to make some sort of death ray or death beam, but none of them were able to be

realised practically. Even during the second world war, the Germans, Japanese, and even the Americans all researched death rays, but nothing ever came of it.

Even today, death rays are being researched, but they're now given a more scientific sounding title – directed energy weapons (DEWs).

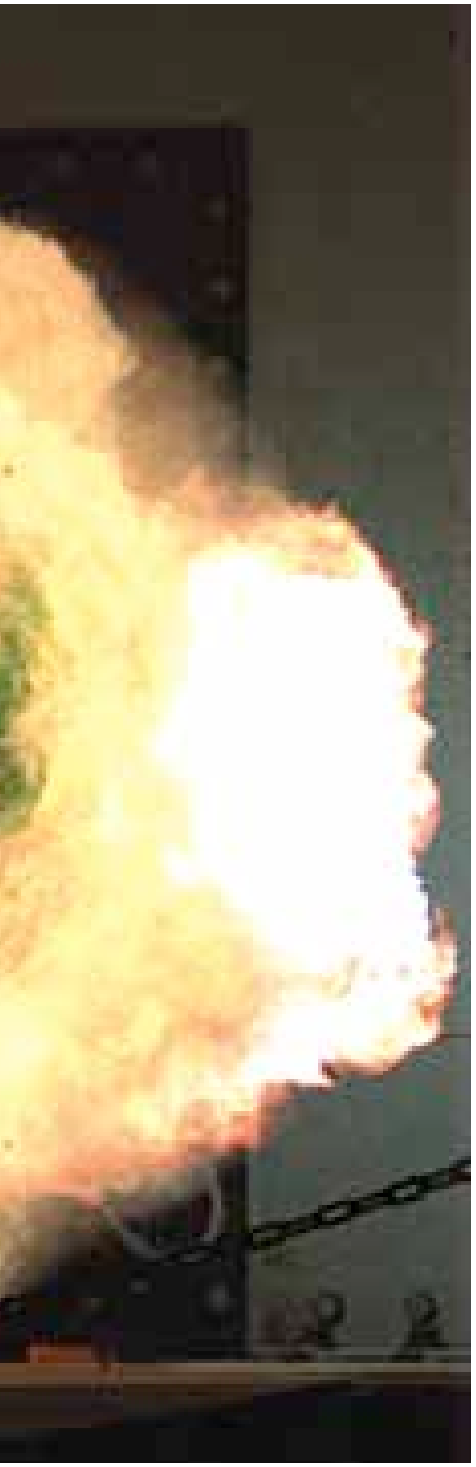
If you've played *Quake*, or if you've seen the *Transformers* movie series, you will be familiar with the concept of a railgun. This is essentially a device that uses electromagnetic forces to accelerate a projectile to very high velocities. In the *Quake* series of games, these projectiles are sent out at near the speed of light, which make them very damaging, and allow you to shoot at a far away opponent where they are, instead of having to predict their movement and fire, say, a rocket at where you expect them to be when the rocket reaches. Well, the railgun is actually being developed by the US military for sure (we don't know about other forces across the world). Of course, we're nowhere close to attaining speed of light projectiles, not even close, but the US has been able to achieve speeds of projectiles up to 3 km/s. For reference, the fastest muzzle speed reached for explosive based projectiles such as bullets is 2 km/s. The advantage of 150% the speed of a gun is enormous. For one thing, the projectiles need not be explosive projectiles, because it is the speed and momentum that's doing the

real damage. This means that the projectiles are far, far cheaper than explosive rounds, are much easier to store and transport, and of course, can be lighter for the same destructive power, which means the ability to carry more rounds. The biggest problem is the high power requirements in order to achieve an electromagnetic force that high. There are certainly no plans for any handheld rail guns such as in the *Quake* series of games!

Other forms of DEWs being tested actually live up to the death ray nomenclature. At least the "ray" part. For example, microwave weapons are being designed which would direct a very focussed beam of microwaves to heat up the water in an enemy's skin, much like what your little microwave oven does. This beam would just give the target immediate and perhaps debilitating pain, but would not kill unless the beam was run for a very long time. Other microwave beams are being researched to not kill, but defend from missile attacks. So if a plane shoots off a guided missile, for example, the microwave beam could cut off communication with the missile and the plane, and thus cause the missile to miss. Other microwave weapons could be used to target electronics, and not harm living things, much like EMPs.

Laser guidance is already a reality in most armies around the world, but the laser itself being used as a weapon is also being researched. There are no significant developments though,

A US Navy test of a railgun



and most weapons are still in prototype stage. The problem with laser weapons is that the enemy can invest in relatively cheap coatings to reflect away the laser, and of course, laser weapons suffer because they have to travel through atmosphere, which means they form plasma when they interact with air, and this dissipates their energy. Even fog and pollution, or thick smoke (common on the battleground) would reduce the efficiency of a laser weapon. In space, however, lasers might very well be effective, and perhaps be even more effective than projectiles. However, we're still a long way away from wars in space, so this is not an immediate priority for most militaries.

Not plagued with the problems of lasers in air are sonic weapons, which actually depend on the air to function. Research has shown that high intensity ultrasonic beams can theoretically cause damage to tissues and organs. Although still being researched, many sound weapons are used as crowd dispersers and are non lethal. ■

Other Fringes

Even more fringe ideas that may not be totally bonkers!

There are plenty of other areas of science that don't essentially fit into either biology or physics, which is where most of the fun is. An example is our understanding of consciousness. We're going to steer clear of any religious theories here, because we're only interested in science, and even science cannot yet fully agree about what the nature of consciousness is. We have an entire field of psychology that is essentially considered to be a "soft science" because it is really hard to measure it empirically as we do with most hard sciences such as physics or biology. Of course, psychology is considered a science by most, but some aspects of it certainly seem a lot more unsure than we're used to science being. The problem is that while it's easy to study the universe which almost always acts in the same way in every place, humans and their brains are all wired so differently and weirdly that it's almost impossible to make rules that have no exceptions the way hard sciences do. In

fact, some would say that most rules in psychology might in fact only apply to small groups with the majority being the exceptions to the rule. However, it would be bordering on philosophy to delve any further, and we can all agree that philosophy is certainly not a science, even if it comes in handy to do some science... sometimes.

Expanding Earth

We mentioned the Australian geologist, Samuel Warren Carey who had the theory that the earth was expanding as a way of explaining continental drift. Science has since rejected that hypothesis summarily, and we now know that the continents moved because of plate tectonics.

However, this did not end the theory of an expanding earth. In fact, we now know that every day about 100 tons of meteorites hit the earth's atmosphere, and while a lot of it is vapourised, quite a bit of that reaches the ground. In effect, the earth is gaining mass ever so slowly, but it is doing so at a rate so small that it would take billions of years for a noticeable change in mass.

Another theory is that the earth's volume has increased over time, even if the mass has remained relatively constant, which means that the gravity at the surface of the earth has slightly decreased over time. Attempts have been made to try and find such an effect, but no evidence has been found in support of it.

The earth's getting fatter by eating too many meteorites


Source: NASA

Now obviously, it is accepted scientific fact that the earth, like all other bodies in space, formed from clouds of dust and gas coalescing, and thus, it is a fact that the earth expanded over time from when it was born, but that's not the same as the expanding earth theory that suggests it is still expanding today. Currently, there is no urgency to try and study this phenomenon, and it seems unimportant, but it might very well have more meaning to it on more of the gaseous planets in our solar system, and others.

While this theory still have quite a few supporters, it is considered completely pseudoscience, and we've only made a small mention to dispel the myth that it is somehow accepted science.

Memetics

Yes, you are reading that right. Ever since Richard Dawkins coined the phrase meme in his famous book "The Selfish Gene", it's

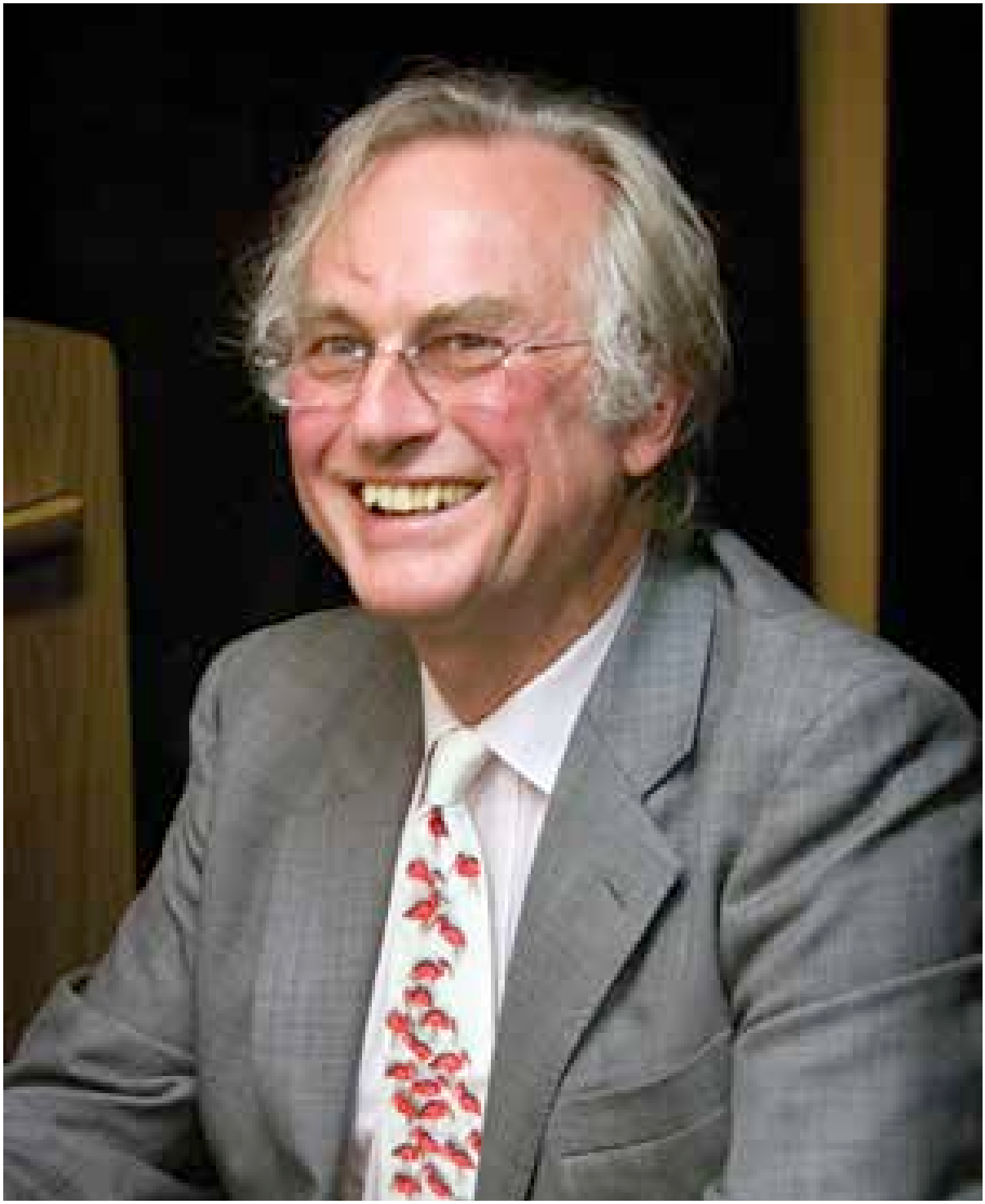
really "caught on". Of course, what we know today as memes aren't exactly what Dawkins had in mind, but he apparently doesn't mind the internet hijacking his invention. What he does distance himself from is the field of memetics.

Dawkins coined the term meme to explain the way ideas are transmitted in human cultures, much in the way genes are transmitted with reproduction. The idea was that even ideas go through the Darwinian process of being naturally selected and then either dying out or becoming popular.

There are two types of memetics ideas, the internalists and the externalists. The internalists believe that the original idea of Dawkins (that a meme is a unit of cultural transmission) is the only correct one, and that the location of the meme is really in the brain. The externalists, however, believe that the meme exists in culture in the form of artifacts or behaviours.

Note that this whole discussion does not include internet memes, because they aren't considered to be anything special, they're also just cultural symbols and ideas.

The idea of memetics seems to be to apply all knowledge of genes and their behaviour to cultures and memes, and it's really a fascinating idea. Of course, it's not a "science" and we wouldn't call it that, but it is an important theory in the studies of cultures, and with the internet exploding everywhere, for all



Richard Dawkins invented the word “meme”

humanity, the study of memetics might well help us hurt or harm entire populations.

It is fun to see terms such as meme pool, memetic engineering, memeticist, etc. being thrown around and to partake in such discussions. With all of the problems we're facing because of the clash of conflicting ideas in society, a little meme engineering might actually be able to direct society to a better outcome... but who will be our memetic engineer?

There is also a burgeoning career to be had in memetics, but of course they go by different names. Viral engineer, viral marketer, social analyst, etc., are all really just the studies of ideas in culture, and perhaps all fall under the broader umbrella of memetics.

Whether Dawkins likes it or not, and whether he approves or not, the idea of memetics has arrived, and given the growing internet obsessed culture we've become, it's not going anywhere!

Sixth Sense

No, this is not another hoax about the mind's eye, or telekinesis, or interpreting deja vu as anything new, or anything like that. This is about a researcher called Joe Kirschvink trying to find a parallel between us and birds.

Now before you make jokes about this idea being "for the birds", we should tell you that this isn't some crackpot theory, and it's not

about a magical sense or seeing the future or something... Birds and many other creatures on earth can use earth's magnetic field to find their way when migrating, for example. Kirschvink is a geophysicist who has been studying this for decades now, and he's recently moved over to studying how the human brain responds to magnetism.

He's even gone to the extent of dissecting human brains (from dead donors of course) to try and see if there's anything magnetic inside them that would even subtly give us a clue as to the earth's magnetism.

He's drawn to humans because researchers used to think only migratory species had this ability to sense magnetic fields, but recent discoveries have shown that even lobsters, worms, frogs and the like also have this ability, and they're not migrating anywhere! It's also been found that large mammals such as cattle and deer align themselves along magnetic lines when they graze, and they do so completely naturally without it making any sense whatsoever visually. Heck, a study done on dogs in Germany and the Czech Republic revealed that the dogs align themselves with the earth's magnetic field, and face either north or south when they urinate or defecate!

He's having some success with EEG readings of humans who are being subjected to changing magnetic fields, and although it is still very early days, he and other researchers around the globe

researching this seem to be making slow headway. So what does this mean for science or human biology? It's hard to say right now, but if we have a sense that the brain relies on, or at least uses at a very basic level even, then the next step is to study the long term effects of that sense being disrupted. After all, the devices we use could be affecting our magnetic sixth sense, and we might not even know what the effects of that are!

Curiously, Joe Kirschvink is not some crackpot who just studies the effects of magnetic field on living things. He's been at the centre of a lot of geophysics of the past few decades. The most famous example is his theory of snowball earth which is a time older than 650 million years ago, when the entire earth froze, and looked like a snowball. He travelled the globe studying the magnetic fields of various rocks and sedimentary layers, and even glaciers, and making a map of where they originated, etc, and painstakingly arrived at the theory he is best known for.

Simulation hypothesis

You've probably heard of this one, and it's been mentioned a lot more recently. It's essentially a philosophical idea that perhaps all of us are merely living in a simulated universe that is perhaps being run on some supercomputer somewhere, by some nth dimensional being... or something as crazy as that!

You can blame Nick Bostrom for the headache you get when trying to decide whether or not we live in a simulation

This theory has been used to great effect in many science fiction books and movies, and The Matrix is perhaps the one we're most aware of. Of course, the simulation hypothesis doesn't necessarily

suggest that we're alive (as shown in The Matrix), but is more a hypothesis that suggests that we might be mere software that's so we designed and complex, running on a computer so smooth and powerful, that it is capable of fooling us into believing that we're real.

While this may seem like a totally pointless path to go down, because there is no evidence for such a thing, and we don't even know how to look for such evidence, the idea is powerful because there is one field it is very relevant to.

Obviously, AI is a field that would greatly benefit from us working towards creating our own simulation, where the character(s) being simulated feels like it (or they) are real. If we were actually able to do that, it would teach us a great deal about how to code AI. Again, The Matrix springs to mind, and also some concepts of the movie Inception. Sort of a cross between the two, where we might very well be a simulation that's so convinced it's real, that it knows about simulations, and seeks to create its own simulated world. Then again, maybe we're the simulation or a simulation... it could go on forever!

There is a way to find out. The theory suggests that if we are in a simulation, there must be some limit to the processing power available to whoever is simulating us. Just as we would have limits on anything we simulated. Thus, if we want to "overload" the system, all we need to do is create enough complex simulations of our own, and that should do the trick. Of course, the risk is that an "overload"

might be a reset trigger, which might end our simulated universe, and all of us would return to the nothingness that we came from... could the big bang itself be such a reset event when a previous universe arrived at the same state and overloaded the system with their own complex simulations?

We'll stop now, your head probably already hurts, and we know we need some coffee right about now!

As we come to the end of this rather complex and odd dmystify, we want to ask you to send us your feedback at *dmystify@digit.in* and tell us what you thought. If you want a longer dmystify on any of the topics that we have barely scratched the surface of here, let us know, and we'll try and fit it into our schedule. Make a choice though... "all of them" is not a valid request, though "none of them" certainly is...

Next month we hope to write about Stem Cell research, if all goes well. ■

MAP OF THE

SQUARE AND STATIONARY EARTH.

BY PROF. ORLANDO FERGUSON,

HOT SPRINGS, SOUTH DAKOTA.

Four Hundred Passages in the Bible that Condemn the Globe Theory, or the Flying Earth, and None Sustain It.
This Map is the Bible Map of the World.

PROF. ORLANDO FERGUSON,
HOT SPRINGS, S. DAKOTA.

These men are flying on the globe at the rate of 68,000 miles per hour around the sun, and 1,042 miles per hour around the center of the earth (in their minds). Think of that speed!

SCRIPTURE THAT CONDEMNS THE GLOBE THEORY.

And his hands were steady until the going down of the sun.—Ex. 17: 12. And the sun stood still, and the moon stayed.—Joshua 10: 12–13. The world also shall be stable that it be not moved.—Chron. 16: 30. To him that stretched out the earth, and made great lights (not worlds).—Ps. 136: 6–7. The sun shall be darkened in his going forth.—Isaiah 13: 10. The four corners of the earth.—Isaiah 11: 12. The whole earth is at rest.—Isaiah 14: 7. The prophecy concerning the globe theory.—Isaiah: 29th chapter. Woe to the rebellious children, sayeth the Lord, that take counsel, but not of me.—Isaiah 30: 1. So the sun returned ten degrees.—Isaiah 38: 8–9. It is he that sitteth upon the circle of the earth.—Isaiah 40: 22. He that spread forth the earth.—Isaiah 52: 5. That spreadeth abroad the earth by myself.—Isaiah 54: 24. My hand also hath laid the foundation of the earth.—Isaiah 58: 13. Thus sayeth the Lord, which giveth the sun for a light by day, and the moon and stars for a light by night (not worlds).—Jer. 31: 35–36. The sun shall be turned into darkness, and the moon into blood.—Acts 2: 20.

Send 25 Cents to the Author, Prof. Orlando Ferguson, for a book explaining this Square and Stationary Earth. It Knocks the Globe Theory Clean Out. It will Teach You How to Foretell Eclipses. It is Worth Its Weight in Gold.

If the big ideas in this book make you feel stupid, remember, there are still people who believe in this!