MYTHSTAKES BOOK ONE: THE STORIES WE TELL

INTRODUCTION

True or false? Fact or fiction? Right or wrong?

The idea that beliefs either correspond to the realm of Reality or are simply wrong is a very popular one indeed. Other than cultural relativists who hold that no 'facts' figured out by human minds are ever quite one-to-one correspondences with Truth, it's also the belief most of us have about the world. But, what if the world we inhabit consists of a more complicated artificial reality than this binary choice between fact and fiction?

Welcome to the 'Mythstake'. As the first book in this series will show, humans are storytelling animals and the world we inhabit is a narrative created through intersubjectivity. We live in a world of myth, some of which are provably false and indeed the evidence needed to debunk them is abundantly available, and yet nevertheless we're expected to accept them as though they were true.

That's what a 'Mythstake' is. Such a falsehood is different from a consensual fantasy or a lie, because those who spread Mythstakes sincerely believe such stories. They think they are talking about categories of reality, but in fact are repeating what is actually a myth's take on evidence that needs to be viewed from a fundamentally different angle.

In order to get the reader into the sort of mindset required to see how and why mythstakes arise, this series of books opens with the discovery of human artwork in the Chauvet cave, using them as a springboard to distinguish between objective reality, subjective reality and, finally, how humans uniquely create shared realities through language, art, religion, money, culture and science.

We then move out of Chauvet cave and pose the question, "is there another sort of 'cave' we can never fully leave?". We will see how the brain, and therefore the mind, is locked inside the skull, only indirectly perceiving objective reality through sensory data. Drawing on the lessons of Chauvet's cave, we will learn about Intersubjectivity and how virtually everything humans regard as 'society' consists of collectively maintained stories- 'myths'- that create and maintain governments, corporations, laws, money and even scientific paradigms.

Next, we focus on Science itself and the distinction between two scientific methodologies. We will see how Empiricism, which begins with observation and experiment and progressively constructs explanatory theories, contrasts with Deduction, whose starting point is elegant first principles and which attempts to derive Reality mathematically. We will see how Deduction can be extraordinarily powerful within the field of mathematics itself, but when applied to messy reality it can lead to the pursuit of mathematical elegance or philosophical preference being allowed to override contradictory evidence.

Furnished with an understanding of how Mathematics can be distorted from an extremely useful tool to an authoritative source of reality stubbornly immune to falsifying evidence (the very foundations for creating Mythstakes) we will finally turn our attention to a mythstake that

arose as the pioneers of Economics tried to answer the question, “where did money come from?”.
“Be realistic”. “That’s just not how the real world works”. Such phrases are common in today’s discourse, particularly whenever somebody should be so bold as to suggest we don’t have to put up with things carrying on as normal. By understanding that many of these claims about what is ‘realistic’ come from mythstakes, we may learn the vital lesson of the late anthropologist, David Graeber.

“The ultimate hidden truth of the world is that it is something we make, and could just as easily make differently”.

But, anyway, enough introduction. Follow me to Ardeche, where that cave awaits…

CHAPTER ONE

Ever since he was 12 years old, Jean-Marie Chauvet (b. 1952) had been spelunking. The region of France he grew up in- Ardeche- was an ideal location for adventurous types who liked to explore the underworld of potholes, caves and caverns. Chauvet and two other spelunkers by the names of Christian Hillare and Eliette Brunel Deschamps began to carefully survey the region in 1988, and over the following six years they were able to discover many new caves.

On the afternoon of December 16, 1994, those three were, once again, exploring the gorge at Ardeche. There was no reason to suppose they would make any notable discovery on this day, because the area they were exploring, close to the entrance to the gorge, was not a remote one. The group followed a mule path, worn down by the many shepherds who had passed this way before. And who knew how many spelunkers had been this way? No, there was not much hope of a great discovery, but December 16 was a cold day, and since this location was a sunny area, it made the trip more comfortable.

Onwards Chauvet's team went, until the mule path took them to a cliff. Before long, they found a hole in that cliff, one barely large enough for them to crawl into. Upon entering this hole, they discovered it was the entrance to a passageway that sloped downwards for about a hundred yards. At the end of that narrow passageway, the path was blocked by rubble.

So, not much to see here, just as they must have suspected? Actually, there was a hint that something might lie beyond that debris, because they could feel a slight draft. Deciding it might be worth a look, the three began to clear away enough rubble to be able to progress further. This was arduous work they were obliged to carry out on their tummies, heads downwards, but eventually enough space had been cleared to let the smallest member of the team wriggle through to let the others know if the effort had been at all worth it.

Eliette Deschamps was the smallest, so onwards she went. After crawling a further ten feet, the passageway opened up, and there, illuminated by the beam of her flashlight, was a giant gallery, the floor of which was some thirty foot below her current position.

The other two joined her, and they used ladders to descend to the gallery's floor. As they made their way deeper into this underworld, they discovered a mammoth. A little further on, a trio of lions were illuminated in the beam of their flashlights. More and more animals were spotted, until the count reached four hundred. Four hundred animals of various types, sometimes solitary, sometimes in great herds. But these were not live animals nor their fossilised remains. It was something far more fascinating: Images that people had painted at least 32,000 years ago.

But why should cave paintings be so much more fascinating than animal remains or the cave itself? Simply because Chauvet's team's discovery invites us to ask questions that cannot reasonably be asked of anything not created by a mind as intelligent, inquisitive and creative as a human being's.

An Objective Universe of Stuff

To see why, let's suppose there were no signs of human activity in this cave, nor any animals or animal remains. Nothing but rocks, minerals and other inorganic stuff. In that case, yes, they may well have found things that caught their attention. They may have found stalactites or rock formations that happened to be shaped in an interesting way, like that rock that's meant to look like a witch in the English cave known as Wookey Hole. If they were really lucky, they may have chanced upon gemstones whose rarity and beauty have fascinated us since time immemorial.

But still, if only inorganic stuff had been in that cave, then setting aside the cultural significance attached to gemstones, the questions that could legitimately be asked of such discoveries would be limited, restricted to questions concerning 'What?', and 'How?'. "How did this stalagmite get to be this shape?". "How old is this rock?" "What caused this section of the tunnel to collapse?". Questions of this type would be legitimate, but questions that begin "why…?", cannot sensibly be asked.

Imagine that it was not just our imaginary cave, but the whole universe that contained nothing but inorganic matter. In this universe, there are no minds. No animals, no people, no gods, just stuff in the various forms stuff takes. In such a universe there would be only one reality- objective reality. There would be no ambiguity about the existence of things; either X exists, or X does not. If 'X' did exist, it could not be asked why, unless such a question could be rephrased as "how' or 'what', as in "why does the sun shine?/ "what causes the sun to shine?". But if you were curious to know why the sun shone, like there was some purpose or plan behind such phenomenon, well that's not a legitimate question to ask of our hypothetical universe. A universe devoid of life or mind is a pointless, purposeless universe comprised of nothing but random events and semi-stable patterns. Nor would there be any beauty, ugliness, hope or fear, because subjective states like these cannot exist without minds to experience them.

A Subjective Universe with Life

But let's leave our 'dead' universe and instead imagine one that has life in it. Nothing as complex as human life, let alone gods, mind you. Just plants and animals. The first difference we would likely notice is that there is a great deal more complexity in this universe, particularly complexity of a particular kind, namely 'functional complexity'. Sometimes, inorganic matter can achieve functional complexity. Stars, for example, can be likened to nuclear fusion reactors, or 'factories' producing the elements of the periodic table.

But while stars could be said to have some functional complexity, it pales before the extent to which life seems designed for a purpose. In 'The Blind Watchmaker', Richard Dawkins (b. 1951) devoted several pages to the echo-location ability of bats, inviting the reader to ponder the many design issues an engineer would have to overcome in order to create an autonomous flying object that uses sonar to home in on targets. The point of all that detail was to leave no doubt that something as complex as a bat could never have come about by random chance.

Dawkins was not the first to reach such a conclusion. Up until the 19th century, others had ruled out random chance being responsible for the functional complexity evident in lifeforms, and then concluded that only a god could have been responsible.

But, in the 19th century, Charles Darwin (1809-1882) figured out that there was a purposeless but non-random process that could naturally come about and which was capable of building up biological forms of immense complexity, including human beings. This process is what we call evolution by natural selection, and for folk like Richard Dawkins the existence of such a process means we no longer need attribute life's existence to the handiwork of gods.

As well as increasing functional complexity by orders of magnitude, life also brought about more ambiguity and uncertainty. In the objective world of the lifeless universe, there was no deception; nothing was anything other than what it appeared to be. But deception became a handy survival option that natural selection bred for in its blind way. A small fish spots a worm and is drawn towards an easy meal. Alas, it is no worm but the lure of an anglerfish, and the little predator becomes prey, paying for its mistaken assumption with its life. Another predator creeps among the branches of a tree, on the lookout for a meal. It does not know that the twig it just crept past was actually an insect.

Once brains evolved, not only deception but also lies became possible. Primatologists have discovered that monkeys and apes make particular vocalisations to warn their fellow primates that a particular predator is close by. Play the vocalisation for "beware! Bird of prey!", and monkeys will nervously scan the sky while running for cover. A green monkey was spotted emitting the call for "lion!". On hearing this warning, another green monkey fled, abandoning the banana it had been eating. Having frightened away its fellow monkey, our liar was able to steal the precious fruit for itself.

Once minds like these evolved, the objective world co-existed with another, subjective world. As we have seen, there is good evidence that animals have the capacity to lie or to believe in things that are not real. But can they also appreciate beauty or withdraw from ugliness beyond a purely reactionary kind of way? We cannot know for sure what is going on in an animal's mind, but since animals do have minds we can ask the question that was nonsensical when asked of a lifeless world: Why? For example, why does this bird bother to collect shiny objects and arrange them into neat little piles?

But, really, all 'why' questions asked of animals have the same answer. In nature, X happens because the genes that coded for X were more successful at getting themselves spread throughout the gene pool compared to genes that did not. So: why do beavers build dams? Because the genes that coded for dam-building behaviour were more successful at spreading through the gene pool. Why do birds of paradise have elaborate courtship rituals? Same reason.

But Chauvet's team found not just rocks, minerals and signs of animal life, they found cave paintings, an unmistakable trace of human imagination. That meant the questions they could ponder multiplied beyond anything that could be asked of lesser minds or no mind at all. The reason why is because such paintings are evidence of minds capable of not just subjective thought, but inter-subjectivity.

Is this really a capability that is uniquely human? Earlier, we imagined a universe with animals but no people. This might have made it seem as if ‘people’ describes a whole separate category of life, and indeed, this was a general assumption that persisted for thousands of years. Such a belief was challenged by the theory of natural selection, because the way it works requires us to accept that every living species is the modern descendent of a common ancestor that existed billions of years ago. In other words, life on earth comprises of one family and, far from being separate from other animals and plants, our species is just one more branch on that vast family tree.

Since humans are just another species, a question necessarily arises: Do our behaviours, beliefs etc also reduce to the one explanation that ultimately explains behaviour in the natural world? Is it all just because such practices had some beneficial outcome for certain genes? If not, then why should our species be alone in having motives beyond successful procreation? When a dog chases after a ball, is it really motivated by nothing beyond a rational strategy to increase its chances of successfully mating? It’s hard to shake the feeling that dogs chase after balls just because they enjoy that kind of thing, just as we like to engage in all kinds of play.

Other primates are known to use sex in ways that seem to have motivations beyond simple procreation. It can be used as a means of diffusing tension, or to establish political alliances, for example. As these undeniably social animals form such complex alliances, what is going through their minds? Is it all ultimately reducible to a drive to procreate, or are such concerns as remote to a chimp trying to climb up its social ladder as they may be to a human being working towards advancing a political career?

In the case of the dog and the chimps, one can always portray such behaviours as ultimately, in a convoluted and roundabout way, being about procreation. Ball-fetching helps hone hunting behaviour and it keeps the dog fit and healthy, all of which helps to make it more attractive as a mate. A chimp with good, strong political alliances stands more chance of having an opportunity to mate and see its offspring survive long enough to do likewise.

But then, you could say the same thing about people’s varied motivations. Why play? Why work? Why pursue art? Why engage in religious worship? Because, ultimately, these are convoluted and roundabout rational strategies for spreading our genes? Well, yes, maybe. But these are such convoluted and roundabout ways of achieving such an aim as to make such a claim seem, well, bizarre. There’s got to be other motivations behind the complexity and variety of human behaviour.

If only we could really talk to the animals, that might clear things up, but alas we cannot. Whatever is going on in an animal’s mind, most of it has no way of being communicated to the outside world. Trying to understand how an animal makes sense of the world and its place in it is a matter of trying to figure out how it would be to live without the capacity to understand complex language. Such a thought experiment is as hard for us to comprehend as a fish imagining life not immersed in water.

Or is it? Maybe I am doing the human imagination a disservice? After all, we can at least give form to the question “what would it be like not to have language?”, and chew over that idea in our minds. But a fish has never heard of ‘water’, and does not know it’s a fish. It certainly cannot ponder the question of what being a fish out of water might be like. As a creature without language, it not only cannot communicate such ideas to others, it cannot form them in its own mind.

The theory of evolution is pretty clear that, if you trace human ancestry back far enough, you would find yourself contemplating creatures that no longer resemble primates, but instead look more like fish. Neal Shubin’s (b. 1960) book, “Your Inner Fish”, lays out the evidence for that assumption in such things as genetics, comparative anatomy and the fossil record.

It inevitably follows from this that if you were to trace that fish-like ancestors’ line of descent forwards in time, taking care to avoid other paths as the lines of decent branch off into other, non-primate species, you would eventually find yourself contemplating a great-great….great grandchild of that fish which could understand language as well as you or I. Most other animals come in a great variety of species. Think, for example, of how many bird species we have. The one exception to this rule are human beings, of which there is only one species. However, the evidence of evolution gives us every reason to suppose that, a long, long time ago, there were many different species of sapiens.

An Intersubjective Universe of People

They would have had the same adaptations that enable the last remaining species of sapiens (us) to bring about a reality that is additional to the objective and subjective: A brain big enough to handle complex language, and the imagination and creativity such an ability enables, coupled with the ability to communicate such thoughts to others possessed of the same ability, so they can maybe join in and contribute their thoughts, their hands, to a drive to give physical form to subjective states. These were the adaptations that led to that additional reality: ‘Intersubjectivity’, or the shared beliefs of many minds. What an amazingly varied and complex world inter-subjectivity is. It is the world Chauvet and his team had to contemplate as they shone their torches on those many cave-paintings and wondered…why?

Like they presumably did, let’s also ask why our ancestors felt a need to daub those walls with images. For all we know, the motivations for some may have been simple defiance, akin to the crude graffiti yobs of today scrawl across surfaces. The images Chauvet’s team uncovered included paintings of hands. What do these represents? A crowd of people? A method of counting (as in, raise your hand to vote for this proposal)? Or was it as rude to these people as a raised middle finger is to some cultures today?

Not all the images in Chauvet’s cave, or in other caves that have paintings, are of instantly recognisable images like hands, people or animals. There are also more abstract shapes. What meaning lies behind these mysterious forms? Should we attach some spiritual or religious significance to them? Were they meant to convey some kind of philosophical idea? Most likely, the significance and purpose of these mysterious cave images were no doubt as instantly familiar as a dollar sign, the image of a crucifix or the Golden Arches of McDonalds are to us. But since we lack pretty much all context, it’s as hard for us to interpret such images as it would be for people who are completely ignorant of our culture and history to guess the meaning of a symbol like £.

At least when it comes to the images of animals we feel more at ease interpreting their meaning, because we know what we're looking at. But really, we only know on a superficial level. Yes, this is an image of a herd of animals, but why did the artists paint them and not something else? Because they thought such animals were beautiful? Because they thought the god of hunts would be pleased and bless them with a successful hunt if they decorated the cave in this manner?

Or was it something more abstract than that? The novelist and social philosopher, Elias Canetti (1905- 1984), suggested they might have been a means of expressing a startling idea. By drawing images of great herds of animals, these artists were challenging the viewer to ask: What would it be like if people were to amass in such vast numbers? What if there were mega-tribes living in mega-villages comprised of hundreds, thousands, millions of people? What would such an unimaginably vast gathering of people be capable of doing? What connections would they form? What would hold these societies together? Or would it not hold together but instead inevitably disintegrate? Is it just impossible to organise humans into such a herd?

In other words, these images of great herds of animals were our ancestors' way of imagining cities and metropolises, where we really do find millions of people living together, with all the opportunities and problems for cooperation and conflict that comes with it. If Canetti is correct then, long before people gathered together to build cities out of physical materials, they were building cities in their minds, at least to the extent that ways of life so unfamiliar from their own could be imagined.

CHAPTER TWO

The images on these cave walls invite us to ask so many questions we could probably study them for a lifetime and come nowhere close to exhausting the possible ways to interpret them. But why restrict ourselves to just these images? There's a whole universe out there. So, let's leave this cave and step into the light of real life. Now we are no longer contemplating the concepts of long-dead ancestors; we are back in objective reality.

VR In the Cave of the Mind

Or are we? Yes, we have imaginatively stepped out of Chauvet's cave, but there is another cave which we can never escape. This is because the mind is locked inside the skull, where no light ever penetrates. But, that can't be right, because we have sensory organs that feed the brain with information about the outside world. If we want to know what's out there, we need only open our eyes, those windows to the soul.

Ah but, you see, eyes are not windows. They don't really let light into your head. Instead, their job is to gather photons and assist in interpreting the information they carry into a coherent representation of the world. This means that there is an objective world…but also the way we interpret it in our subjective mind. We like to think that how we see the world, and how the world actually is, are one and the same. After all, if that were not the case, would we not be mad, believing in delusions?

But, actually, once you understand how the eye functions you have to accept that appearances are, indeed, deceptive. Today, you can buy a VR headset that uses a technique called 'Foveated Rendering". It is computationally expensive to render stereoscopic images quickly enough to achieve effective VR, so any way to reduce the number-crunching is welcome. With foveated rendering, the headset calculates the exact spot you are looking at, and renders just that location in high detail. Everything outside of your direct attention is rendered in lower resolution. As soon as your attention snaps to a different part of the scene, that part now gets the high-fidelity treatment, and the previous spot joins the rest in making do with lower-resolution rendering.

In reality, then, most of the VR environment is rendered in lower detail, with only the part you are directly looking at given the high-viz treatment. But, this is not how it appears from the perspective of the player wearing the headset. As far as they are concerned, the whole world appears to be rendered with high-quality graphics.

Still, you might be supposing that there must be a way to 'cheat' this illusion and see the world as it is really being rendered. Can you not see those lower-resolution parts of the scene in the periphery of your vision? The answer is no, because of the way our eyes work. Only a small part of the eye- the fovea- is capable of seeing the world in high detail. The rest of the eye can only see low detail. So, really, the illusion that you are looking at a high-resolution environment when, really, most of it is rendered in low detail, is not an illusion restricted to expensive VR headsets, it's how we always see the world! It's just that the eyes and the brain employ a variety of techniques that work to bring about a very convincing illusion of seeing the world in full detail, all of the time.

What's really out there? What form does the world outside of our skulls actually have? Is there light? Colour? Modern science tells us no, there are just electromagnetic waves, and 'light' and 'colour' are just our mind's way of interpreting the information carried by those waves. There are no sounds out there, just vibrations of air molecules. In fact, there really are no molecules, vibrations, planets, people, atoms…There is, in fact, nothing in the universe that you can name which has any more existence outside of the human mind, than those images painted on cave walls 32,000 years ago. Everything we know are but human concepts, names and stories we give to things as we try to make sense of the world and what we believe is in it. Whenever we talk about reality we are really talking about fictions that exist nowhere in objective reality but are, instead, a creation of intersubjectivity. We live in a fantasy world from which we can never escape.

But there is still an objective reality out there, and it can be a dangerous place. There is obviously great survival advantage in honing that fantasy so it coincides as closely as possible with objective reality, or at least aspects of reality relevant to survival in whatever environmental niche we occupy. It's fair to say, then, that our everyday perception is indeed a fantasy that coincides with reality. This is because our brain is not just a VR machine; it is also a prediction engine. It constantly 'asks' how our fantasy of the world matches up with what's actually out there, making adjustments where necessary. It does not always get things right. It employs assumptions that can be manipulated to make you see things that are not as they appear. That's how illusions work, and how the stage magician gets you to believe that the pretty assistant really did disappear. But for the most part, our fantasy matches up with reality really well. After all, it has been fine-tuned over millions of years.

Notice, though, that I said we have a close match with aspects of reality relevant to survival. Most animals concern themselves with things they really need to know if they are to survive, and dismiss all else as utterly irrelevant. But we are not like that. Some of us actually strive to know about things so remote from everyday experience it really does not affect survival chances if we know about such things or not. It really does not matter, for instance, to know if light is a wave, made up of packets of particles, or some mysterious thing that is neither wave nor particle but both of these at the same time. Nevertheless some of us go to great lengths to determine what light may actually be. And the existence of stage magicians prove something else. We like to experience fantasies that have nothing to do with reality, at least some of the time.

Stories and Their Relation To Reality

When a stage magician shows us an illusion, or a performer acts out a scene, or a narrator tells us a story, none of these are true, but nor are they, properly speaking, lies. A lie is when somebody wants others to believe in something they know to be false. If a person said "I can read people's minds" when, in fact, he's just using tricks that have nothing to do with mind-reading, such a person would be a liar. Stage-magicians don't really do that, though. They know, and we the audience also know, that it's all fake. It's not a lie, then; it's a consensual fantasy, as are the worlds portrayed in stories or on the cinema screen.

Or, rather, sometimes the person on stage is an illusionist inviting us to enjoy a consensual fantasy. But sometimes the person on stage is a priest, mystic, guru or scientist insisting that the fantasy they convey to us is all real. Sometimes, the story we are being told is said to be "based on real events".

One might say, then, that, in terms of how they relate to reality, stories come in various forms. There are those narratives that are backed up by a good deal of evidence. If you believe that water is wet, that you cannot jump over a mountain, and that evolution by natural selection explains the natural world better than any alternative explanation, you can rest assured that such beliefs are backed up by a huge amount of corroborating evidence. Indeed, in our everyday lives, most of the time our prediction engine matches our model of the world to reality so well, it's not worth questioning what we believe. Everyday life experience is made up of countless self-evident truths.

Things we can be very confident about almost certainly make up an infinitesimal part of all reality. We might think of these certainties as tiny islands amidst an infinite ocean of complete ignorance. Most of reality is so mysterious, so incomprehensible, it does not even register on our mind in the form of a coherent question. Or, rather, I assume this to be the case.

For obvious reasons, there's not much you can say about categories beyond human imagination. They may even be so alien, even simple labels like 'does/does not exist' cannot meaningfully be applied. Let's leave such abstractions, then, and instead consider the next kind of story. Here, we are dealing with beliefs for which there is either insufficient evidence to settle the question, or evidence is simply not applicable.

Do you believe in aliens? Or do you believe we are alone in the universe? People have come up with arguments for either possibility, but we really don't know if aliens exist somewhere or not. How do you distinguish between a real UFO sighting or alien abduction scenario from a charlatan who is out to trick you, or a deluded soul who has misinterpreted some other phenomenon and honestly believes in what is, in actual fact, not evidence of alien life at all? I for one do not think we have ever found definitive proof of other inhabited worlds, but then again it's a big universe and absence of evidence is not evidence of absence.

Still, at least with aliens we can imagine a way in which the question could be settled. Maybe one day we'll visit an alien planet and find it inhabited? Or maybe aliens will come to us, and in such a manner as to leave no doubt of their presence? But some beliefs can never be proved or disproved. Can machines have souls? Is my perception of red the same as yours? Is there a god? It's not just that we currently lack evidence needed to definitively settle such questions. Rather, it's because questions like these transcend the very idea of 'evidence'. They are more like mysteries to be experienced than problems to be solved. While we may one day build robots that act as though they are having conscious experiences, philosophers have succeeded in constructing thought experiments that show we cannot know if this is merely an illusion or not. Some people mistake this for proof that conscious machines are impossible. But it's not. Rather, it's an argument that we can never really know if a machine that certainly seems conscious does, in fact, have the necessary subjective states the term 'consciousness' refers to.

People also believe in gods, spirituality, heaven, for reasons that have nothing to do with ‘evidence’. For such people, belief in the supernatural has nothing to do with explaining things, like how the world came to be, or where evil came from. It’s more to do with giving expression to the inexpressible; of accepting that there’s something greater than ourselves.

For those of us who are non-believers, followers of religion, mysticism and certain schools of philosophical thought can seem, well, weird. But, really, these are not the weirdest beliefs people hold. If a belief cannot be disproved and incorporating it into your life provides you with meaning, why not believe it? But now we come to the final category: Believing in something when there is actually a good deal of evidence to show it is false.

To illustrate what I mean, consider the following allegory. John, an Englishman, believes all swans are white. Evidence appears to corroborate such a belief, because all his life John has only ever seen swans of that colour. But then, Sally invites him to Australia, where she shows him something that should change his mind. “Look!”, she says, “there’s a black swan, a whole flock of them in fact”. John does indeed see the black swans, but nevertheless he persists with his belief that all swans are white.

That was obviously just a story, but people like ‘John’ do exist. They may not believe all swans are white even though there is such a thing as a black swan. But they do believe in things when evidence should persuade them such beliefs are false.

Your next thought is probably: Ok, but even if there are such people, you must mean ancient people, or people stubbornly clinging to ancient ways, because only those people who tried to make sense of the world with non-scientific methods could make such mistakes. No, I am talking about modern people who insist their beliefs are derived at using science. Ah, your next thought may be, in that case you must mean folk on the far fringe, such as holocaust deniers or Trump supporters who believe the election was stolen.

But no, I am not just talking about ideas on the far (some would say lunatic) fringes. I am talking about people very much within the mainstream of their profession. If you read their pop-science books, attend their lectures or watch their documentaries, they will tell you things as though they are supported by evidence. They will lead you to believe they are matters of historical or contemporary fact. But, actually, they are falsehoods. They never really existed. They are fantasies that do not coincide with reality and indeed have been refuted by evidence.

The world we experience is always a fantasy. We are a social, storytelling animal, and the world we inhabit is a narrative spun by our imagination. We live in a world of myth. Sometimes, the myth coincides with reality. Sometimes, myths portray a world beyond evidence’s ability to confirm or deny. But what we are talking about here are myths that are provably false, but we are asked to believe in them nevertheless.

These are not just myths but ‘mythstakes’. They are not lies, nor consensual fantasies, because the people asking us to believe in them believe in them themselves. They think they are talking about categories of reality, when in fact it is a myth’s take on evidence that really should be looked at in an entirely different way. But doing so requires asking questions that the mythstake prevents us from asking.

CHAPTER THREE

How is it possible for mythstakes to become so widespread as to become part of mainstream teaching, when there is supposed to be an effective method for filtering out falsehoods from bodies of knowledge, namely ‘science’? There are two main reasons why mythstakes occur, which we will be looking at in greater detail over this series of books. Here, though, we can only offer an introduction to the two main reasons.

Firstly, there are two ways in which to investigate the world in a ‘scientific’ way, neither of which is one hundred percent capable of uncovering all the facts, and one of which seems more susceptible at generating myths presented as though they are matters of fact.

The Empirical Method

In either case, the task of the scientist is to explain how some aspect of reality came to be. Let’s say you wanted to explain how species came about. One way in which to go about shining light on that mystery would be to go around gathering knowledge from those who work with nature, such as farmers and horticulturalists, learning how, through selective breeding, they are able to modify the descendants of current breeds into remarkable new sizes, shapes, colours etc.

You would collect specimens from the wild, noticing how, on closer inspection, what seems like great diversity turns out to be modifications on a general theme. For example, the skeletons of birds, bats, fish and primates look different at first, but on closer inspection you hardly ever find unique bones, but rather the same basic skeletal structure, only with some bones modified to suit a particular way of life. Examining biological forms even more closely, focusing in on the molecular level, you discover even greater similarities among seemingly diverse species.

But, a person who just goes around amassing a great collection of information is not really doing science. This is merely a part of the process, akin to gathering the scattered pieces of a great puzzle. As in puzzle solving, the greater challenge is to put all those pieces together to form a single coherent picture.

This is particularly challenging for scientists, because, unlike a person doing a jigsaw puzzle, there is no handy picture on a lid of a box to show them exactly how those pieces should fit together. Furthermore, whereas one expects to find all the pieces needed to assemble a jigsaw puzzle, science must live with the fact that most of the pieces will be missing, and therefore the picture will always be incomplete, leaving us to figuratively fill in those gaps, imagining what the complete picture ought to represent.

So, anyway, you’ve gathered up all these ‘puzzle pieces’, but now you must ask the question: how do all these pieces fit together? In order to answer that question, you need to generalise from all this data you have gathered, hypothesise about what physical processes would have produced these pieces and how, given such processes, they should fit together.

In the case of species, your hypothesis might go something like this: “breeders have shown that future generations can take on remarkably different forms when people are consciously choosing which animals or plants will breed and which will not. Call this process ‘selective’ or ‘guided’ breeding. Could there be a process in nature which is in no way intelligent or conscious but which nevertheless does what breeders so, allowing some animals and plants to successfully breed while filtering out those other lifeforms which, for whatever reason, don’t make the grade?

OK, how about this? The Earth naturally provides a great many environments. Within these environments, lifeforms adopt various strategies in their drive to survive into the future. We need not suppose that there is necessarily any conscious thought or planning involved in such ‘strategies’. We need only suppose that, while all lifeforms do eventually die, some die sooner than others. No doubt, a lot of these fatalities will be due to sheer accident, but if enough are due to some defect that the animal/plant happened to have, could we not then speak of the environment acting like a breeder, ‘deciding’ that this animal or plant should not have offspring? Not conscious deciding, mind. We are talking here of a blind process that selects against animals and plants in a non-random way. Along with arbitrary forces of nature that indiscriminately kills life, what if there were other natural forces which happen to take out lifeforms in a more, well, selective fashion?

We know that lifeforms have the ability to produce offspring. We also know that offspring resemble their parents more than any other species, but they are never really exact copies. If the child was always an exact replica of its parent, neither selective breeders nor this hypothesised process would have anything to work with. But, if a child should happen to be born with some advantageous trait, and that trait could be inherited, then wouldn’t it be the case that, over time, animals and plants with favoured traits would out-compete their disadvantaged rivals so that, over time, life evolved to better fits its environmental niche?”

If it is to be at all useful, this narrative we are constructing ought to have explanatory power. In this case, what we are trying to explain is ‘functional complexity’. In other words, how did it come to be that lifeforms took on such well-designed forms, adapted to fit their environment? Since we are trying to explain functional complexity, we can rule out gods being involved in the process. In making this choice, we are in no way suggesting that ‘God’ is a concept that has been disproved; we are merely acknowledging that saying ‘God did it’ is no explanation of complexity because it relies on an even greater (infinite?) level of complexity to bring about the comparatively lesser complexity we’re trying to account for. That is to say, the ‘God’ hypothesis compounds, rather than explains, the problem of functional complexity.

A successful explanation would be one that shows how some process could build up greater complexity from lesser complexity. Of course, one could make up all kinds of just-so stories concerning various hypothetical processes, and indeed before Darwin proposed his version of evolution by natural selection, earlier thinkers like Jean-Baptiste Pierre Lamarck (1744-1829) had proposed their own evolution hypotheses. But Darwin’s hypothesis succeeded where these alternatives failed because it had greater predictive ability.

The test of predictive ability is this: future observations and experiments confirm hypotheses formed in the past. Returning to our puzzle analogy, it’s like looking at the pieces you have gathered so far, and then forming an image in your mind of the picture these pieces represent. With that picture in your mind, you can predict what shape and colour the missing pieces ought to have. If you find more pieces and they fit your image of what the puzzle ought to look like, all well and good. But, what if you were to find puzzle pieces that did not fit your imagined picture? Well, the puzzle is always incomplete, so you might predict that future pieces will be found that connect everything together after all. Having said that, what you are imagining the complete picture to be may not be merely incomplete, but fundamentally wrong. In that case, puzzle pieces that are completely out of place are not waiting future confirmation, but are instead demanding that you abandon your image of what the completed puzzle looks like.

The Holistic Nature of a Good, Practical Myth

Now, obviously, practical scientific work progresses into the future. But what this empirical method does in an imaginary sense is to expand explanatory power outwards and backwards in time, starting with observations and experiments in the here-and-now, and figuring out how things fit together in a way that sheds light on realities that are more distant in time and space. The better the narrative, the less likely we are to come across some obvious contradiction, and the more pieces we gather, not just in our specific area of interest but in other sciences as well, the tighter the correspondence between theory and observation we ought to see.

For example, as geologists and palaeontologists came to understand the processes that have shaped life on earth, it became increasingly obvious that life had been around for millions, even billions, of years. But this presented a big mystery. If you follow any food chain back to its root, you will discover that all life ultimately depends on the energy coming from the Sun. The trouble was, up until the 20th century nobody knew of any energy source that could power the sun for billions of years. In Darwin's day, it was thought that the Sun was a massive ball of iron that had been heated up by friction until it glowed white-hot. Also, as sweaty miners knew all too well, the deeper you descend into the earth, the hotter things get. William Thomson (better known as Lord Kelvin) (1824-1907) thought that this was residue heat left over from the developmental phase of the solar system, when it was supposed planets formed via a process whereby smaller rocks banged into each other to form larger rocks, which banged into each other to make even larger rocks….and so on until, thanks to all that energy being released in these collisions, you end up with a gigantic ball of molten rock that gradually cools down.

How long would it take for an earth-sized ball of molten rock to cool right down? Lord Kelvin calculated that the earth had been in a molten state a hundred million years ago. But, geologists and palaeontologists were beginning to realise that life had been around for a far longer stretch of time, not hundreds of millions of years but several thousands of millions of years. But, if life had existed for billions of years, what kind of energy source could power the sun for such a vast length of time? As far as pre-20th century science was concerned, no known energy source existed that could keep stars shining for billions of years. Still, if life really had been evolving for billions of years, there had to be an unknown energy source that could power stars for that amount of time.

Then, in 1846, fourteen years after Darwin passed away, a French physicist named Henri Bequerel (1852-1908) wrapped a piece of uranium salt in a photographic plate. When the plate was developed, he discovered bright spots, as if the uranium was releasing rays of energy. Then, seven years later, Marie and Pierre Curie (1859-1906; 1867-1934) showed how a lump of radium emitted what seemed to be an unlimited amount of heat.

Discoveries like these led to the recognition of a hitherto unknown source of energy in the basic structure of atoms. This led us to nuclear physics, and the realisation that the Sun is not made of iron, but is instead a prodigious mass of hydrogen, the further collapse of which is balanced by nuclear fusion going on in the core of the star. Nuclear fusion is not an unlimited, inexhaustible form of energy, but it is more than capable of powering the Sun for many billions of years.

So, in a sense, the theory of evolution predicted that nuclear power would be discovered, because it required an energy source that could power the sun for as long as life had been around according to fossil and genetic records.

If you think about it, it makes sense that a good empirical theory should fit neatly with facts not just within its own narrow field, but in other fields as well. After all, it is only in reductionist thought that reality is compartmentalised into separate 'fields'. This is nothing but a convenient fiction that makes an impossibly complex reality somewhat easier to model in our minds. But, in reality, the universe is holistic and everything fits together in an interrelated way.

The Necessity of Math

So far, we have been talking about the empirical method as it is presented in pop-science, which is of scientists gathering data, doing experiments, and coming up with a plausible narrative that explains what we find, is compatible with what we know in other disciplines, and which won't be falsified by future predictions. But, there is something in addition to all this that empirical science needs to do, something usually omitted from pop-science narratives.

The scientific method would be lacking if all we had were narratives outlining the gist of a hypothesis. A good scientific model needs to not only describe relevant processes in general terms, but to describe those processes quantitatively. In other words, a proper scientific theory requires mathematics, bringing about more precision than a mere 'just-so' story can provide.

In the case of evolution by natural selection, the theory was eventually combined with genetics to create the 'Neo-Darwinian Synthesis', and scientists like William Hamilton (1936-2000) and George Price (1922-1975) produced mathematical equations showing how 'game theory' strategies could account for the diversity of life we see today. Such equations are usually absent in pop-science accounts (it's thought to lower sales if you include much math) but they are a vital tool for any serious scientist.

From the viewpoint of empirical science, that is the most accurate way to think about the relationship between mathematical equations and the processes they are describing. The equation is a tool of sorts, the purpose of which is to describe some relationship observed in nature. What determines the validity of such equations is purely the ability to describe current relevant knowledge and future observations in the relevant fields. The equations ought not to be judged according to some intrinsic logic or appeals to 'beauty' or some such thing. They are useful only because they can help us make successful predictions. They have no value beyond this one practical use.

Anyway, you have the framework of your theory, quantified with mathematical tools. Suitably equipped, you can imaginatively work backwards from today's world and describe events that extend ever further backwards into the past. How do you know this tale of the past you are portraying is valid? Well, ultimately you do not, but if there are no contradictions between what your theory says the past should be like, and what appears to have actually been the case according to the latest findings, there would be no need to adopt an alternative narrative. But if, for example, your model predicts that life is no more than a few thousand years old, and then palaeontologists find fossils that are millions of years old according to measurements that are reliable enough not to be seriously questioned, your current model is wrong.

The Missing Puzzle Piece Connecting the Stars to Life

Inevitably, because the scientific reconstruction of the past is always incomplete, you will find that the further back into the past we try to look, the vaguer our understanding becomes, until we are no longer able to rely on any hypothesis let alone theory.

For example, the theory of nuclear fusion not only explains the process that powers stars, it also accounts for how much of the elements of the periodic table were created. Hydrogen atoms combine to produce helium and because E=MC squared, a tiny bit of mass in those atoms gets converted into energy. In fact, the equation is basically a tool that tells us how much energy you can obtain from a given amount of mass (just as there is a mathematical tool that tells us how to convert degrees Fahrenheit into degrees Celsius).

Imagine that you had a super-sensitive set of scales. On one side you place four hydrogen atoms, and on the other, one helium atom. The mass of four hydrogen nuclei can be written as 1+1+1+1=4, and since a helium atom is like four hydrogen atoms joined together, you would expect the weight of one helium atom to balance that of four hydrogen atoms.

But, actually, the helium atom weighs slightly less, about 0.7 percent less than those four hydrogen atoms. Where did that missing mass go? It was converted into energy. How much energy? Well, the equation tells us it's 450,000,000,000,000 times greater than the missing mass.

Now imagine that, every second, four million tons of hydrogen is being transformed, via nuclear fusion, into helium, during which process 0.7 percent of that mass becomes 450,000,000,000,000 times as much energy. But, you don't really need to imagine, because this is what goes on in stars as nuclear forces transform hydrogen into helium.

It’s not just helium that gets produced this way. In fact, all the atoms in your body, as well as the cells of all other animals, plants, and the carbon dioxide or oxygen we need to live, all are, ultimately, recycled star ash.

Astrophysics therefore tells us where the building blocks of life come from. Darwin’s theory shows how, once life arises, it must necessarily diverge into different species. But, in between the building blocks of life being created, and life subsequently arising, there is a big mystery: what lead to the origin of life?

This was not a question that Darwin set out to answer in his book ‘On the Origin of Species’. As you can see from the title, this work takes it as given that life exists, and then explains why subsequent generations won’t all be carbon copies of their ancestors. The question of how life began in the first place is not really the point of this book. But, still, there is obviously a big gap in our understanding, akin to missing segments between “the building blocks of life are produced in stars”, and “life diverges into species”, in our imaginary jigsaw puzzle.

Personally, I favour hypotheses that don’t assume life began and then evolution could get going. Instead, it was the other way around. The question then becomes, what conditions are needed to get evolution started? You need something that can generate imperfect copies of itself, and which can pass information on to future generations. As the chemist Graham Cairns Smith (1931-1976) has shown, crystals have both such properties. Crystals are certainly not alive, but in certain conditions they can behave in lifelike ways, growing and multiplying like bacteria in a Petri dish. Straight away, we can see how a crude form of evolution could get underway. Crystals only exhibit lifelike behaviour in certain conditions, so any crystals that, for whatever reason, sustain those conditions would have a selective advantage.

However, evolution could only get underway if crystals could pass on genetic information. Actually, the way crystals grow naturally allows a very crude from of genetic information to be recorded. Crystal ‘genes’ are nowhere nearly as sophisticated as the DNA molecule with its four-base pairs, but then we shouldn’t expect the very first replicators to rely on such a sophisticated method of storing and transmitting genetic information.

So, you have crystals ‘competing’ to sustain the conditions necessary to keep them growing and multiplying. Now suppose that some accidentally find that organic molecules can assist them. Cairns-Smith tested this hypothesis and found many useful ways in which clay crystals could have used organic molecules. Also, the inorganic chemical industry frequently makes use of organic molecules. As Dawkins explained, “tannins, a kind of organic molecule, are used in the oil industry to make muds easier to drill. If oil drillers can exploit organic molecules to manipulate the flow and drillability of mud, there is no reason why cumulative selection should not have led to the same kind of exploitation by self-replicating minerals”.

We might imagine how, over time, clay crystal replicators incorporated organic molecules in increasingly sophisticated ways. This might explain a mystery surrounding DNA. DNA is like an arched bridge, in the sense that both appear to be paradoxical structures. Why? Because every ‘brick’ must be in place or else the whole structure collapses. So how on earth do you build an arch one brick at a time? The answer is, you first erect a scaffold to support the construction, removing it once the completed structure supports itself. In Cairns-Smith’s hypothesis, clay crystals acted like that scaffolding. They started off ‘exploiting’ organic molecules for their purposes, but along the way organic molecules were also exploiting clay, until finally something like DNA emerged and a whole new branch of purely organic replicators came on the scene.

What I like about this scenario is that you cannot really pinpoint the moment when something with lifelike properties actually becomes ‘alive’. We inquire into ‘the’ origin of life, as though such an event occurred in one splendid step. In reality, there probably never was a single step whereby non-living replicators became alive, but rather a system of growing complexity, blurring the line between inorganic replicators that are not alive, and biological ones that clearly are.

This story I just retold, of how biological evolution was preceded by natural selection increasing the fitness of clay crystal replicators, is just that: a story. Nobody really knows if this is how life emerged, and other scientists have proposed alternatives. Scientists have been trying to create life from scratch in the laboratory, but so far all such attempts have included a ‘cheat’, meaning we cannot strictly speaking call these true ‘life from non-life’ demonstrations. As things stand, then, the stories of life’s emergence that we have come up with belong in those categories of myth where the evidence is too ambiguous to confirm or deny any hypothesis. The best we have managed to do is to propose hypotheses that have some plausibility but also raise questions to which we have no answer. The people trying to figure out these problems with the hope of filling in gaps in that allegorical puzzle, know and admit that there are questions related to their area of expertise to which they (or experts in other areas) lack satisfactory answers. So long as one openly admits a hypothesis lacks sufficient evidence to refute it or elevate it to the status of Theory, and is trying to find testable explanations, one is not liable to fall into the trap of believing in Mythstakes.

CHAPTER FOUR

I want to return to the stars now, as a way of getting us onto the subject of the second methodology used in science, which is ‘deduction’. What are stars made of? Most people know that matter can exist in three states: solid, liquid and gaseous. Given those options, you might say that the Sun is a great big ball of hydrogen gas. But, actually, there is a fourth state of matter. Although people tend to be less familiar with this fourth state, it’s actually the most common state ordinary matter comes in, making up 99 percent of ordinary matter in the universe. What is the name of this fourth state of matter? Plasma.

An Empirical Scientist Versus a Deductive Scientist

Unlike dark matter, which is an entirely hypothetical form of matter unrelated to ordinary matter, plasma is routinely created and studied in laboratories. This is what plasma physicists do, and plasma physics developed along two parallel lines. One such approach took a more empirical line of investigation. This hundred-year-old line of inquiry began with investigations into what were labelled ‘electric discharge in gases’. Practitioners of this method studied plasma and its behaviours in the laboratory, and in so doing they showed how plasma could exhibit such things as ‘double layers’, ‘striations’, and all kinds of oscillations and instabilities. But, what they did not do was come up with elegant mathematical theories that could explain all the complexity of plasma behaviour. Real plasma is too unruly and complex to lend itself to elegant mathematics, and this branch of plasma physics remained mostly experimental and phenomenological, with the theoretical side of things developing much more slowly.

The other approach to studying plasma came from a highly developed theory, which was the kinetic theory of ordinary gases. An alternative name for plasma is ‘ionised gas’, and the thinking was that the field of study known as the kinetic theory of gases could be extended to include ‘ionised gases’ aka plasma. This branch of physics succeeded in producing very elegant mathematical models, and claimed to derive all the properties of plasma from first principles.

But, really, such claims were a huge exaggeration. This approach to plasma physics was highly theoretical and had little to do with experiments in real plasma behaviour. In order to simplify that behaviour, a number of approximations were introduced in order for the complexity of plasma to be reduced to something that could be described in a mathematically elegant way. But, while these approximations were necessary if you wanted elegant equations, they were not always appropriate. Contact with real plasma and how it actually behaves would have shown this, but this line of inquiry was heavily theoretical, hardly ever concerning itself with experiments and ignoring most of the complexities that real plasma was known (by those who actually did conduct such experiments) to exhibit.

Meanwhile, astrophysics and cosmology were also developing in a way that lent heavily towards the theoretical and, because of this, these scientific fields greatly favoured the study of plasma physics derived from the kinetic theory of ordinary gases. As for the pioneers of the alternative method, their ideas were almost completely neglected and even now you would be hard-pressed to find any pop science book on space, stars and cosmology that so much as mentions them.

Now, you would be forgiven for supposing that, if plasma physicists running experiments had practical demonstrations that the theorists were wrong, it should have been easy to show those theorists that they were in error.

But, when one of the leaders in the field of practical studies in plasma- Hans Alvfèn (1906-1995)- tried to show such demonstrations to Graham Chapman (1888-1970) (the leading figure on the theoretical side of things) he found that nigh on impossible to do. At one point, Alvfèn recreated an experiment that a pioneer in the practical side of plasma physics- Kristian Birkland (1867-1917)- had once set up. The plan was that Alvfèn would show Chapman this demonstration, and hopefully that would start a discussion on why Birkeland currents could not also occur in the vacuum of space, when they were evidently being produced in the vacuum this experiment set up. But, as Alvfèn recalled, “he flatly refused to go down to the basement to see it. It was beneath his dignity as a mathematician to look at a piece of laboratory equipment!”.

Eventually, the theoretical side of plasma had to confront all the complexities it had been ignoring for commercial reasons. Once it was realised that stars were powered by controlled nuclear fusion, a tremendously abundant form of energy presented itself. If nature could manipulate plasma into causing nuclear fusion, why could we not do the same? Indeed, the theoretical branch of plasma physics supposed this ought to be possible. After all, their theories seemed to show that laboratory plasma could easily be confined in magnetic fields, and then heated up to a temperature that would allow thermonuclear reactions to commence.

But when this was tried, the plasma absolutely refused to behave itself, exhibiting all those wild, complex and unpredictable behaviours the theoreticians had ignored, making sustained nuclear fusion a far harder form of energy generation than theory had led us to believe. Even now, nobody has managed to commercialise sustained nuclear fusion. We can, at great expense, achieve nuclear fusion for a brief time, using tokomak reactors that try to tame plasma with gigantic magnets, but attempts to achieve sustained nuclear fusion that outputs more energy than was used to start the process remains an elusive goal.

Meanwhile, that practical branch of plasma physics suggested alternative ways, methods that worked with plasma instabilities rather than trying to tame them. This line of inquiry has had as much success in developing fusion toward a commercial energy source, but sadly its advocates get only a fraction of the funds poured into mainstream approaches and remain a small group, out on the fringes, largely ignored.

This last point is an important one, because it addresses a question that may well be raised about ‘mythstakes’. So what if there are thinkers out there who cling to long-disproven theories? Why should that affect my life? Well, it certainly affects our lives in a material sense, because some ‘mythstakes’ have wasted gigantic sums of money, many trillions of pounds in fact, and have frustrated research into such things as practical nuclear fusion that might have saved us a lot of environmental damage if only theoretical dogmatists wedded to ‘mythstakes’ had not succeeded in diverting so much R+D into bogus ventures.

Now, in that discussion regarding the two ways in which plasma physics developed, there were hints as to how the alternative way of doing science operates. We heard about elegant mathematics derived from first principles, and that’s pretty much how the alternative approach works. This is known as the deductive method, and it works in the opposite direction to empiricism.

The Deductive Approach to Science

In other words, it does not begin with practical experiments and observations. Rather, the deductive approach begins in an imaginary past, where certain initial conditions are assumed to have existed, and from where you can work forwards from such conditions to arrive at reality as we perceive it today.

Sometimes, those ‘initial conditions’ may include phenomenon that has absolutely no experimental verification, but are instead the product of some authoritative assumption; initial conditions that appeal to some religious, philosophical, mathematical or aesthetic authority. Whereas the empirical approach prioritises observations and experiment, and is not too bothered if the phenomenon does not lend itself to elegant equations, the priority of the deductive approach is entirely the other way around. In other words, the priority is heavily slanted towards creating equations that are ‘elegant’ or ‘beautiful’, and if reality does not correspond to how such models depict it, well, no matter. This is but an illusion, a temporary error due to the fact that experimental or observational science has not yet matured to the point where it can confirm the way those theoreticians know reality must be, due to logical or aesthetic necessity.

Returning to our ‘puzzle’ analogy, we might imagine such a theoretician contemplating an incomplete puzzle, and proposing what it must be depicting. “Ah yes, logical necessity requires this to be a snake”. Others, though, are finding other puzzle pieces that do not suggest it must be a snake. In fact, it would appear that the puzzle is of an entirely different animal. Something large, grey, standing on four legs and possessed of a snake- or trunk-like appendage. “Oh no!”, our theoretician responds, “do not be fooled by mere appearance and the evidence of your own eyes! Do you not know that experimenters can make mistakes? And besides, so much of the puzzle is still missing. My beautiful theory strongly suggests that, when these missing pieces are found, the elephant illusion will be revealed for the mistake that it is, and my snake theory (which must be, from logical necessity) will be confirmed!”.

As we shall see, something very much like this- clinging to long-disproven theories due to a reluctance to abandon a theory that is deemed ‘beautiful’ or ‘logically necessary’- does in fact happen every now and then. Indeed, it is the methodology that dominates modern theories of money and cosmology.

But, having said that, It should be understood that the deductive method is not in itself a bad way of getting to the truth. In fact, when used properly it can be an extremely powerful approach that can construct more certain conclusions than any other method we know of.

The Eternal Truths of Pure Logic

So let's look at the circumstances in which deduction works best. We find the deductive method working most effectively in the field of mathematical theorems.

A theorem is our most assured way of guaranteeing a conclusion. The idea is to begin with a set of assumptions that everyone agrees are true (the more self-evident the better) which we call 'axioms'. Then, you construct a logical argument that proceeds step-by-step from those axioms until you reach a conclusion. If the axioms are correct and each logical step contains no flaws, then the conclusion is utterly irrefutable.

To see the power of deduction it helps to go through a practical demonstration that anyone can follow, even without any mathematical skill other than the ability to count. We can do this with something known as the 'mutilated chess board' (credit to Simon Singh, who thought up this explanation).

The 'Mutilated Chess Board' is a standard chess board that has the two white squares on opposing corners removed. Now, imagine that you have 31 dominoes, and each one is sized to exactly fill two squares of a chess board. Is it possible to arrange the dominoes so that all 62 squares are covered?

One way to find out would be through the empirical method. That is to say we conduct experiments, laying down dominoes in different patterns to see if any such configuration can indeed cover all the squares. After dozens of failed attempts we might suspect the challenge is impossible, and after trying and failing after thousands of attempts you might feel with near certainty that you cannot cover all 62 squares with 31 dominoes. However, 'near certainty' is as close as you can get to an answer via the empirical method. You cannot be sure that there isn't a pattern that has not been tried which could succeed. The best you can do relying only on experiment and observation is to prove something beyond reasonable doubt, which is not quite the same thing as proving something once and for all.

Ok, now let's see how the deductive method fares. We begin by establishing some 'axioms of the chess board', facts that everyone can agree on. Such axioms might be statements like:

A standard chess board is divided up into 64 squares.

Squares always alternate in colour, so if a square is black its neighbouring squares are always white; if a square is white, its neighbouring squares must be black.

With those axioms in place, we can begin to construct a logical argument that proves beyond any doubt that the challenge is impossible. Something like this:

"A standard chess board has 64 squares. Since half of those squares are black, there must be 32 black squares and 32 white squares on a standard chess board.

However, in this case, two white squares have been removed from opposing corners, meaning this chess board has 32 black squares but only 30 white squares.

Whenever we place a domino, it must cover two neighbouring squares, and neighbouring squares are always opposing colours.

Regardless of how they are arranged, then, the first 30 dominoes we lay down must cover 30 black squares and 30 white squares.

Since there are 32 black squares and 30 white squares in total, that means we must end up with two black squares remaining after the first 30 dominoes are placed.

But if each domino has to cover two neighbouring squares, and neighbouring squares are always opposing colours, then the fact that the remaining two squares are always black means you cannot cover them with your one remaining domino.

Conclusion: It is impossible to cover all 62 squares of the mutilated chess board with 31 dominoes".

In some circumstances, then, the deductive method can establish final and absolute truths. Once a mathematical theorem is proved true, it is proven forever. Whereas a scientist using the empirical method must live with at least a tiny amount of uncertainty that his or her theory might be modified or even rejected entirely in the future, anyone who succeeds in constructing a theorem will have their name associated with a truth that will remain the truth for all eternity.

One such person was Pythagoras (571-496 BCE) , whose name is given to a theorem he proved way back in the sixth century BCE. This theorem concerns right-angled triangles, and the conclusion you reach by following the steps in its proof is summarised like so: 'In a right-angled triangle, the square of the hypotenuse is equal to the sum of the squares on the other two sides".

Using Pythagoras's theorem, you can construct an equation that is true of all right-angled triangles. This is another way of saying that it is the right-angle itself that is defined by this equation. Moreover, the relation of the vertical to the horizontal (the 'perpendicular') is defined by the right-angle, and so, ultimately, is the relation between the three spatial dimensions of anywhere in physical space.

All of which means this humble equation has far-reaching implications. As Simon Singh (b. 1964) said in 'Fermat's Last Theorem', "mathematics, via the right angle, defines the very structure of the space we live in".

Clearly, then, deductive logic can be a very useful tool. Perhaps it's little wonder that early philosophers like Pythagoras came to worship Number. Earlier peoples had used math in a practical way to aid in the construction of canals and other things, but they never really asked why such techniques were so reliable; the fact that they produced the right results was good enough. Pythagoras and other early philosophers took Reason to another level, not just applying math in an everyday, practical sense but appreciating and studying numbers, their properties and the patterns they form. Such a way of thinking considered Number to be a world in itself, and Pythagorean thinking elevated the contemplation of Number to a far higher state of excellence than anything that could be obtained through comparatively unreliable human perception.

The Fallacy of Worshiping Number

But this worship of Number was always in danger of falling back into an argument from authority. We saw in the case of the mutilated chess board that you can sometimes construct a logical argument that needs no maths skill beyond the ability to count. In the case of Pythagoras' Theorem, following the steps in its logical proof requires senior school maths, which is a bit more demanding but still not asking too much of a determined amateur.

However, some mathematical proofs are so complex, the ability to understand why the conclusions they reach must be true cannot be achieved by anyone other than mathematical geniuses. And in some cases, we now have proofs that cannot be verified without the aid of computers to crunch through more data than human beings can comprehend. This leaves the vast majority in the position of having to take an authoritarian's word for it that such proofs really are the absolute truths we're told they are. You can see how such situations slip back towards arguments from authority, even if only slightly.

Furthermore, it's one thing to construct a flawless logical argument when one's object of study is something like right-angled triangles or chess boards. In that case, we're dealing with a simplified reality of two-dimensional geometric shapes. It's one thing to tease out objective facts about a cartoon world like that, but figuring out fundamental truths about the far more complex real world is another matter altogether.

We saw how Pythagoras' equation is related to the physical universe, but what is the true nature of this relationship? If we were to take an empirical standpoint, we would say the equation is a handy tool that describes an aspect of the physical world.

However, if we were to take deduction as seriously as a Pythagorean philosopher, we might suppose that Number does more than describe reality. It is reality. We might then claim that what we can deduce from a rational contemplation of Number must be a superior form of understanding compared to unreliable experiment and observation. If we insist we are right to think that, we might then insist that 'truths' derived through the deductive method must remain true, and if reality is in disagreement, then rather than us changing our minds it must be 'reality' itself that should be modified or rejected.

In some sense the eternal nature of maths seems self-evident. It's impossible to imagine a world in which parallel lines drawn on flat space would meet, or where one plus one does not equal two. Such things do seem like logical necessities that were facts before we discovered them and which therefore exist independently of human opinion.

Number appealed to the Pythagorean mind because it seemed to produce such clear, precise and definitive answers. But, actually, even the realm of Number was not quite as well-defined as Pythagoras wanted to believe. When he said that the world was governed by

Number, he was thinking of whole numbers or fractions of whole numbers. These are known as ‘rational’ numbers, and they can be precisely written down. True, there were what are known as ‘recurring decimals’, such as 0.111.... where the pattern of repeating ones goes on forever, but that’s just equivalent to ‘one ninth’ which can be expressed as a whole number fraction.

However, when they turned their minds to the study of circles, the Pythagoreans made a shocking discovery. There seemed to be something very troubling about the ratio between the circumference of a circle and its diameter. This ratio is known as ‘Pi’, which can be approximately written as 3.1459265… What was troubling was the fact that ‘Pi’ can only ever be written approximately. Unlike with the simple pattern of recurring fractions, ‘Pi’ can never be written down exactly because the decimal places go on forever without any pattern. If you calculate Pi to 39 decimal places you would have a number sufficient to calculate the circumference of the known universe, accurate to the width of a hydrogen atom, but nevertheless you would be nowhere close to having determined the exact value of Pi itself. A number such as ‘Pi’, one which cannot be expressed as a whole number or a fraction of a whole number, is known as an ‘Irrational Number’.

We now know that Pi is a useful mathematical tool that describes a variety of natural phenomenon. For example, if you calculate the actual length of a river from its source to its mouth, and the direct length if the river were to flow in a straight line rather than meandering, the ratio you end up with varies from river to river, but on average the value is always slightly larger than 3. In other words, the actual length of a river is always slightly larger than three times the distance it would be if the water travelled to its source as the crow flies. In fact, the ratio turns out to be 3.14, the first three digits of Pi.

But although Pi has turned out to be a mathematical rule underlying all kinds of natural phenomenon, Pythagoras simply couldn’t accept that there could be such a thing as an irrational number. In fact, it was such an abhorrent concept to him that he denied the existence of irrational numbers altogether.

You can see the potential problem with authoritarianism. Pythagoras wanted to believe in a mathematically ordered, neat, and perfect world, but the fact that irrational numbers can only ever be written down approximately suggested the world is not at all perfectly neat and ordered. Rather than accept this truth about the world, Pythagoras was prepared to kill in order to suppress such a revelation (according to legend, he drowned a student of his, one Hipparchus of Tarentum, after he revealed the existence of irrational numbers to the outside world).

And then there were the mathematical truths he did believe. For example, Pythagoras believed ‘justice’ was the number 4 because that is a square number. That’s like saying the answer to life, the universe and everything is 42, it’s a meaningless answer. But had you challenged Pythagoras, I would imagine his reply would be something like “I know that 4 is justice and if you can’t see why it must be, you are just not smart enough to ‘get’ it”.

Thus does Reason and logic slide into ‘mathematical mysticism’. We should always bear in mind that, no matter how much precision it might bring to our explanations when properly applied, mathematics remains a tool we created, not some infallible oracle revealing objective Truth to those fluent in its language. Indeed, in the 20th Century master mathematicians like Kurt Gödel (1906-1978) and Alan Turing (1912-1954) proved there are limits to maths' ability to deliver unambiguous 'right' or 'wrong' answers. There is no Platonic world of absolute truths, written in the language of Number. Unfortunately, the Pythagoreans mistakenly believed there was.

Fantasy Circles In The Heavens

To the Pythagorean mind, the circle was the geometric shape that got as close as anything could to representing perfection. So when Plato (427-348 bce) and his disciples turned their attention to the heavens they looked for some manifestation of that perfection, and came to believe they had found it.

The planets seemed to trace out circular paths as they moved against the backdrop of the stars. Plato's students took astronomical observations and attempted to match those with the Platonic ideal of perfect, circular motion. A disciple of Plato's called Eudoxus (390-340 bce) modelled the planetary system as a system of nested 'crystal' spheres, rotating around the Earth which lay at the centre. One sphere carried the moon, another the Sun, and there were also spheres for the six known planets. In this context, the word 'crystal' really meant 'invisible', so it was imagined that the heavenly bodies moved in a circular pattern around the Earth as they were carried on their rotating invisible spheres.

It's important to emphasise that this cosmological model was not derived at via an empirical approach, whereby observations and experiment guide us toward a model that best matches whatever data we have. No, it was a product of the deductive method, whereby we begin with a priori assumptions of how things must be, guided by some presumption of 'perfection', and then construct a model that conforms to our expectations.

As plasma physicist Eric Lerner (b1947) explained, "A theory of the universe based on ideal mathematical forms relies on the authority of a priesthood of reason that can dictate which mathematical forms are the most ideal, most beautiful, most perfect… Maths can make the myth more impressive, but not more objective".

The problem was that as astronomical observations were refined, this greater accuracy did not seem to re-enforce the underlying assumptions of these models but rather gave cause to doubt their validity.

For example, Aristarchus of Samos (210-230 bce) used Euclidean geometry to estimate the size of the sun compared to the Earth, along with how far apart they were. His estimate was that the Sun was five or six times larger than the Earth and five million miles away. It didn't seem sensible to him that a much larger sun should circle at so great a distance around a far smaller earth.

We now know that his estimates were way off. The Sun is actually ninety million miles away and its diameter is a hundred times larger than the Earth's. But that only strengthens his argument that such a huge and distant object cannot realistically be orbiting our tiny planet.

The merchants who were travelling to distant lands also had to make use of practical astronomical observations, since such data was essential in plotting trade routes. They too noted discrepancies between the ideal cosmological model and observations. According to Eric Lerner, “while Greece generated two methods of learning about the cosmos, two cosmologies [one based on empiricism, one based on deduction] it was a mongrel synthesis of mathematical myth with observational method that triumphed. The reason again lay in social development. Neither authoritarian Sparta nor free Ionia became the model for the social development of the Mediterranean. Instead, slavery, free labour and expanded trade all co-existed in the century that followed the fall of Athens”.

This awkward co-existence between two ways of looking at the world was reflected in the cosmological models that were invented during this period. On one hand you had the cosmology based on Platonic dualism which used pure reason to deduce a heavenly realm of perfect, circular motion and a worldview that justified Plato’s ideal of a hierarchical society, but not quite enough political dominance to make this a cosmology that was universally accepted. On the other hand there were Ionian free traders using the empirical method for the practical purpose of navigating the world and who could therefore not accept Plato’s disdain for observation, but who lacked the political strength to do away with geocentrism and the Platonic ideal it was based on.

Instead, as Lerner said, there was a mongrel synthesis, an awkward compromise between the deductive method and empirical data. In other words, all data was interpreted on the basis that the geocentric model’s a priori assumptions had to be correct. If any observations disagreed with those assumptions, ad-hoc new assumptions were to be added to the model in order to close the gap between theory and observation.

So, a model that started off as an elegant system of spheres had complexities added to it, such as circles within circles (‘epicycles’) or ‘deferents’, in which an orbit’s centre is itself placed on an orbit, or the addition of additional tilted spheres.

This was not so much a model whose assumptions were confirmed by later observations, but rather one in which subsequent observations warranted additional complexities being added so the model could be retrofitted to fit the facts. It was, as Lerner said, “a fantastic clockwork”, a Neoplatonic Rube Goldberg invention that was forced into being compatible with what was really falsifying data, data that could never quite debunk the model because the political and philosophical ideology it was based on was too strong.

In fact, the ideology underlying the model was so strong it survived the accumulation of falsifying data for many centuries, most famously in the case of the Catholic Church threatening torture, execution and life imprisonment on anyone who questioned the validity of geocentrism.

To those of us now very familiar with the solar system model and how well it matches observations, it may seem bizarre that our ancestors should cling so stubbornly to a failed theory for so long. But we should not be so quick to mock our ancestors for their dogmatism, for the possibility of the deductive method to become mathematical mysticism, forcing evidence to match a priori assumptions, did not disappear with the eventual abandonment of geocentrism. No, it lives on even in modern theories, most especially the Big Bang and mainstream theories of markets.

CHAPTER FIVE

The weird way in which mainstream cosmology developed, becoming one of the most dominant mythstakes of our time, will come to make more sense once an understanding of historical developments, with various myths and mythstakes, is in place. Hence, it's really a topic best left until the final volume of this work, when we'll have a clearer understanding of how religion, philosophy, science and myth have evolved in complex ways, sometimes complimentary, sometimes antagonistically, to create our mainstream worldviews.

Einstein's Universe

But still, I want to say a little about its strange career here. Some time between 1915 and 1919, Albert Einstein (1879-1955) took his General Theory of Relativity and applied it to the universe as a whole. Before applying the mathematical principles of relativity theory, Einstein assumed that matter was spread evenly throughout space. That is to say, he assumed that the universe is homogenous. This homogenous universe appealed to Einstein for purely aesthetic, philosophical reasons. But, in reality, it was in wild contradiction with observation.

Rather than being spread evenly throughout space, matter was observed as clumping inhomogenously together. This is important, because General Relativity does not just describe our universe; it describes infinite possible universes. The sort of universe you get out of the theory depends on the 'initial conditions' you plug into the equations. One of the basic principles of general relativity is that mass causes space to curve. The larger a mass of a given density you have, the more curvature of space you get. A large enough mass would curve space so much it curves entirely around onto itself. Given a universe that is homogenous, then, with matter of the same density everywhere, such a universe would be finite in space. So, if you travelled far enough into space, you would come across a boundary, beyond which is…well…nothing. So, what happens when you reach out and put your arm across this boundary? What a philosophical headscratcher! Then again, maybe if you travel far enough you just find yourself back at the start, just as you can sail right around the world, never falling off the edge of our finite globe.

Actually, the globe analogy provides a handy way of showing how Einstein justified his assumption when all available evidence suggested it was wrong. From the perspective of a tiny human, the curvature of the earth is so large it appears flat. Our ancestors thought it was flat, because it sure looked like it was. But then, as our measurements improved, the belief that it was flat became less valid, and now that we can view our planet from space we can see it's more like a globe than a flat disc.

Similarly, Einstein assumed (purely for aesthetic reasons) that matter was only clumpy and inhomogenous on 'local' levels, and that future telescopes able to look further than was currently possible, would reveal the universe to be homogenous on larger scales.

When Einstein's ideas concerning general relativity were first tested, his work was elevated to the status of 'theory' on the basis of just two observations- one to do with how light bends around the Sun, and the other to do with Mercury's orbit. This was an unusual move in science. Normally, a hypothesis is elevated to the status of 'theory' after having been verified by hundreds if not thousands of independent observations. So, to grant general relativity that exulted status on the basis of just two experiments was premature, to say the least.

Not to worry, though, because since then Relativity theory has been tested a great many times, passing so successfully we can now say, almost unquestionably, that it is an accurate theory of gravitation. For example, in order for it to work properly, GPS has to take into consideration the weird time distortions that must necessarily be, according to Einstein's theory. So, we can be sure Relativity theory is a valid theory.

Or, at least, it's valid on scales up to a galaxy, but what about beyond that? Could it 'break down', just as Newton's theory passed hundreds and maybe even thousands of tests before it was found it could not quite handle the extreme gravitational conditions Mercury experiences, orbiting so close to the Sun?

Well, if we went along with observations and assume the universe is inhomogenous, general relativity and its whole mathematical approach would be a mere nuance on the cosmological scale. But, when Einstein plugged 'homogeneity' into his model, the results he got back were very disturbing. It predicted that the universe would collapse. So, according to general relativity and Einstein's 'initial conditions', not only was the universe finite in space, it was finite in time, too.

The reason this was disturbing was because the general belief in science back then was one of a universe that had always existed and always would, forever evolving. In order to preserve this conception of the Universe, Einstein searched his theory and determined that there could be a hypothetical, repulsive force that, provided it were not too weak or too strong, would counter the attractive force of gravity and prevent any collapse. He called this hypothetical force the 'Cosmological Constant'. Now, Einstein's model had all the initial conditions set up in a way that led to a universe that was philosophically satisfying to him.

Evidence Refutes Einstein's Universe

But then, from 1929 onwards, subsequent observations profoundly challenged this picture. Astronomers were discovering that light coming from distant stars was shifted slightly to the red end of the spectrum. When a German astronomer called Carl Wirtz (1876-1939) put all such observations together, an interesting correlation emerged. The fainter the galaxy, the further its spectra was shifted to the red.

What was going on? The simplest explanation appeared to be this. Imagine you had a wavy line drawn on a rubber band. Now, as you stretch that rubber band, the wavy line will elongate. If that wavy line represents the peaks and troughs of an electromagnetic wave, and the two ends of the band represent, say, an observer at one end looking at a galaxy way over there at the other end, then the elongating wavy line represents spectra from the galaxy's stars shifting to the red as the galaxy moves away from us.

As these astronomical observations were refined, it became clear that galaxies were not moving in a random fashion, but instead all seemed to be moving away from us. Moreover, the more distant they were, the faster they seemed to be moving. By now, other theoreticians with the mathematical skills required to work with general relativity were discovering that it actually allowed for infinite possible universes, depending on how you set the initial conditions (which now included that cosmological constant). 'Einstein's Universe', these theoreticians found, required an extraordinarily precise balance between gravity and this hypothetical 'constant'. If either the cosmological constant was even a tiny bit weaker/stronger, and ditto for gravity, the universe would either blow itself apart or collapse. Indeed, depending on how you set the parameters of the model, the result could be a hypothetical universe that, mathematically-speaking, collapsed into, or emerged from, a point of zero dimensions. Eventually, the redshift data was held up as proof that this must have been what happened in our universe, and Einstein later denounced his own model, with its perpetual balance between expansion and collapse, as his "greatest blunder".

But, maybe Einstein was a bit too hard on himself? It takes courage to own up to the fact that something you have worked so hard on may actually be invalid. In 1934, Einstein wrote about how he saw 'science' developing. "The theoretical scientist is compelled in an increasing degree to be guided by purely mathematical, formal considerations in his search for a theory, because the physical experience of the experimenter cannot lift him into the regions of highest abstraction". As a theoretician working at such an abstract level, Einstein could have chosen to save his model like the Ptolemaic astronomers had tried to do. But he did not do that. Empirical results suggested his model should be rejected, so rejected it was.

Structures Too Old For The Universe

Another thing to bear in mind is that, when it comes to making failed predictions in cosmology, Einstein is hardly alone. In fact, Big Bang cosmology has may what be the worst track record, in terms of predictive success, of all major scientific theories.

You may recall how Einstein anticipated astronomers finding matter evenly distributed once sci-tech developed sufficiently to enable us to carry out large enough sky surveys. Sci-tech did indeed advance, but instead of revealing the expected homogeneity, we instead discovered matter organised into structures on a truly stupendous scale, so large that entire galaxies are but pinpricks in comparison.

Not only are these structures unimaginably big, they are also unbelievably old. After all, natural forces can only compel matter to move so fast, so it takes time to build up structures like this. So, how old are they? Somewhere between 80 and 100 billion years old.

In a universe of infinite or indeterminate age, it would be of no great importance to discover the existence of something with such a grand old age. But, in a Big Bang universe it leads to absurd results. After all, Big Bang cosmology estimates the age of the universe to be no more than 20 billion years old. Indeed, many Big Bang cosmologists assert confidently that the universe is 13.7 billion years old. To have structures that are over 80 billion years old in a universe that has only been in existence for less than 14 billion years is a total contradiction, of a kind that usually leads to the downfall of a theory.

But not Big Bang cosmology, the history of which goes something like this. Theoreticians make certain predictions based on what the model says must be, and wait for empirical science to advance to the point where those predictions can be tested. When the tests are carried out, the predictions turn out to be wrong, often by orders of magnitude.

The theoreticians express surprise and shock. This was not the results they predicted at all. But then they decide that this is actually exciting news, because the contradictory results mean we must search for 'new physics'. They go off and invent weird abstractions, such as unknown forms of matter, exotic types of energy, hidden dimensions contorted into geometries that are unimaginable for minds not as gifted at abstract mathematics. By plugging such abstractions into the model, they are able to retrofit it so that it appears to fit observational data. Things then seem to be progressing well, for a while. The model they have seems to agree with observations (and it kind of gets ignored that the model was retrofitted to fit data, rather than one that predicted observations that were later verified).

Often, those hypothetical energies/ matter/ dimensions etc are beyond current sci-tech's ability to detect. Sometimes, though, sci-tech advances to the point where such hypotheticals can be tested. The result? The model is even more wrong than was previously assumed. Cue the familiar shock and surprise from the theoreticians, and then that familiar assertion that 'new physics' must await discovery, and even weirder abstractions are made up that would be even harder to verify empirically, but which can be shoehorned into the model so that, theoretically at least, it appears to match results.

The thing is, is this kind of approach really 'science'? Not really, no. These theoreticians are more like mystics, reading arcane texts written in a language too obscure for lesser minds to comprehend, describing in exacting detail how imaginary past events must have played out, but with an increasingly hazy understanding of how such hypothetical events could have led to the universe that is actually revealed to us through empirical science.

The Cosmic Microwave Background

The contradiction between the age of these gigantic structures and the supposed age of the universe (according to Big Bang cosmology) is one of the biggest problems for the theory, but it is not the only one. I shall give one more example, this time regarding the so-called 'cosmic microwave background'. From pop science accounts people learn how the Big Bang theory showed that the universe must have been filled with hot radiation during its birth, and that this heat then cooled down over time. But even after 13.7 billion years it should still have some detectable heat, pervading the universe with a blackbody radiation. When radio telescopes capable of picking up that tell-tale signature were pointed at the sky, they did indeed detect what became known as the 'cosmic microwave background'. Therefore, the Big Bang must have happened.

But this way of telling the story leaves out some crucial details. Firstly, Big Bang cosmologists were by no means the only ones who hypothesised that space would be filled with blackbody radiation. Others did, too, but for reasons that have nothing to do with the Big Bang. For example, in 1933 Erich Regener (1881-1955) expected to find space permeated with a blackbody radiation at 2.8 degrees Kelvin; in 1937 Walther Nernst (1864-1941) predicted 2.8 degrees Kelvin, and in 1954 Erwin Finlay-Freundlich (1885-1964) predicted temperatures between 1.9 and 6.0 degrees Kelvin.

So, that's what non-Big Bang cosmologists predicted. But what did the Big Bang cosmologists predict? Well, in 1961, George Gamow (1904-1968), who was a major figure in the development of Big Bang cosmology, wrote a book called 'Evolution of the Cosmos', and in it we find the following prediction. "Thus when the universe was one second old, one year old, one million years old, its temperature was 15 billion, 3 million, and 3 thousand degrees absolute, respectively. Inserting the present age of the universe into that formula, we find Tpresent equals 50 degrees absolute".

As you can see, then, while cosmologists not working on the assumption that there was a Big Bang predicted blackbody radiation of between 1.0 and 6 degrees K (with most opting for 2.8 degrees K) the Big Bang cosmologists predicted a blackbody radiation of fifty degrees K.

Five years later, a radio telescope capable of detecting that heat signature was pointed at the sky, and the results were as they usually are in Big Bang cosmology. The predictions of the Big Bangers were hopelessly wrong. Rather than matching the prediction of fifty degrees kelvin, or being in the ballpark of that figure, the recorded measurement came in at 2.7 degrees kelvin. Once they had the actual temperature, Big Bang cosmologists were able to make use of seven free parameters in the model in order to tweak it so that it could be retrofitted to the observations.

What is a 'free parameter?'. Well, returning to our puzzle analogy, think of actual puzzle pieces. An actual puzzle piece is of a specific size and shape. It has specific colours and patterns painted on its surface. It either belongs in the picture you imagine the completed puzzle to be, or it does not. This is nothing like what a 'free parameter' is. A 'free parameter' is more like an imaginary puzzle piece. What size, what shape, what colouring, what patterns, does an imaginary puzzle piece have? Well, being imaginary it has whatever property you want it to have. As plasma cosmologist Eric Lerner commented, "the curve that was fitted to the data had seven adjustable parameters, the majority of which could not be checked by other observations. Fitting a body of data with an arbitrarily large number of free parameters is not difficult and can be done independently of the validity of any underlying theory".

Now, it's true that when radio telescopes are pointed at the sky, they do return results that show something like a cosmic microwave background exists. But what is it that these instruments are really picking up? One idea from non Big Bangers is that early stars released radiation during the process of making a certain type of helium that we now observe in our universe. We now know that the intergalactic medium is filled with magnetically confined plasma filaments. As the radiation from that helium-making process passes through those plasma filaments, a fundamental law of radiation, Kirchofff's Law, comes into effect. According to this law, any object emitting radiation of a given frequency is able to absorb the same frequency. So, if the electrons in those filaments absorb photons from the background and then radiate them in another, random direction, this would cause the energy to become thermalised and isotropised. Thus, what we are detecting may not be the afterglow of the Big Bang at all, but rather a diffuse glow from a fog of plasma filaments.

What this hypothesis gives us, is results that accurately match the spectrum of the observed blackbody radiation, according to the best-quality data set from the COBE satellite (a space-based instrument sent up to verify the Big Bang, but which instead returned results that strongly conflicted with the theory, for reasons I won't get into at this stage). The fit involved three free parameters and achieves a probability of 85 percent.

"85 percent?", you might be thinking, "that hardly sounds like a perfect, 100% result". That is true, but compare it to the Big Bang 'CMB' results, where, even with seven free parameters there is still not a good statistical fit. Indeed, the probability that the curve actually fits the data comes in at under 5 percent.

It's not just the so-called cosmic microwave background that has serious problems (only a few of which have been mentioned here). Everything to do with the Big Bang, whether it be the size of structures in the universe, the relative abundance of light elements, and even redshifted spectra (the phenomenon that convinced Einstein to junk his favoured model) all are in at least some (and often violent) conflict with the hypothesis that our universe began 13.7 billion years ago. The fact is that, empirically speaking, our universe actually looks nothing like how a universe would look, if indeed it had been born in a Big Bang. When these cosmologists say they can achieve a fantastically accurate fit, this has nothing to do with prediction, but instead all to do with them retrofitting that data with hypothetical phenomenon made up after results came in to show their hypothesis is fundamentally flawed. The hypothetical phenomenon comes in three kinds. Either it is imaginary phenomenon that is completely beyond any ability to test; or its direct existence (not observations we can make and from which the existence of this mysterious thing is inferred) has some way of being tested but the expected results have never been found, even though in some cases we have run billions of experiments using very sensitive and expensive equipment that should be capable of picking up those tell-tale signs if in fact they existed, or we have detected phenomenon…but it is actually phenomenon that we should NOT be able to detect if the Big Bang and/ or the hypothetical phenomenon it depends on ever really existed.

All in all, as of the 2020s, the idea that our universe began with a Big Bang is in disagreement with sixteen independent datasets, and in agreement with just one. And yet, despite this litany of failure, we are asked to believe in the validity of this hypothesis, as if its existence is as certain as that of the existence of Mount Everest, or that the battle of Hastings took place in 1066. The Big Bang Theory is, in other words, a perfect example of a 'Mythstake'.

Now, it should be remembered that this is only a brief overview of the strange career of Big Bang Cosmology, and such a quick summary of a couple of its anomalies and convenient retellings of history do not do justice to the sheer intricacy and complexity of a model that has been tweaked and modified by hundreds of experts over many decades. A more thorough examination of this model would reveal how it is a complex network of mutually-supporting concepts, some empirically grounded, some inferred from other observations, and some that are totally speculative, all put together to form what is basically a grand circular argument that is immune to any conflicting evidence.

CHAPTER SIX

How could a situation like the one mentioned just now come about? There are a couple of explanations. Firstly, the ratio of theoretical and practical scientists in mainstream cosmology is unusual. In most scientific fields, the vast majority of experts are doing the practical work of running experiments and making observations- gathering the puzzle pieces to return to that analogy. Then, you have relatively fewer theoreticians whose job it is to philosophise about what it all means; how the jigsaw pieces should fit together and what picture you would have if only all the pieces needed to complete the picture were available (an ideal which is never fully realised). Because theoreticians are so outnumbered, if empirical results show their models are wrong, they have to cave in under the pressure and begin the search for a whole new theory.

But, in mainstream cosmology, the vast majority of practitioners in this field are engaged in purely theoretical work. They do not look through telescopes, but instead hunch over paper, manipulating equations. One such theoretician, the fundamental physicist Anthony Zee (b. 1945) said of such theoretical work, “the system of aesthetics used by physicists in judging nature draws its inspiration from the austere finality of geometry. Following the ancient Greeks, who waxed eloquent on the perfect beauty of the spheres…I will continue to equate symmetry with beauty”.

The real scientific work, from this point of view, involves the construction of equations that are ‘beautiful’. Not in any way that is perceivable to most people, mind you; such austere beauty is only revealed to those minds trained to work at the highest levels of mathematical abstraction. When the relatively few practical scientists come up with empirical results that show all these theoreticians are wrong, it’s easy for those theoreticians (who, after all, control all the peer-review systems and access to instruments needed to do astronomy and particle physics at a professional level) to say those experimenters are obviously mistaken- too incompetent to get the right results or still too primitive to gather the sort of data that would confirm the theoreticians ‘beautiful’ theories.

Now, this is not to say that pointing out contradictions between observation and theory is forbidden. Rather, the situation is best compared to a familiar fairy tale. Imagine that a king is due to parade past a crowd of people, and that this monarch will be wearing splendid new clothes. Along comes that king, and the folk in the crowd are at liberty to shout out what they actually see. “I can see the king’s nipples!”, shouts one. “I can see the king’s belly button!”, yells another. A third even exclaims, “I can quite clearly see our monarch’s big hairy backside!”. But, woe betide anyone who draws the obvious conclusion from such observations, pointing out, “but…surely this means the king is naked!”. Those who dare make that suggestion are branded as fools who have no business being in the crowd. They are ejected, and meanwhile the “really clever people” invent elaborate hypotheses about how a king who looks very much like he is naked is actually splendidly clothed.

Dominant Theories and Their Connection to Society

The other reason has to do with the connection between theory and society. Why do we form the conceptions of reality that we do? Why do some such conceptions rise in popularity to become part of mainstream consciousness? The simple answer would be, “because these ideas are true!”, but the existence of mythstakes requires a more subtle answer. The society we live in influences the way we view reality; and our models of reality serve to justify the societies we have built for ourselves.

For example, Medieval society with its socioeconomic model of Feudalism, was a deeply hierarchical society. Learned people in this society gazed at the heavens and imagined it to be organised into a hierarchy of spheres, each lower sphere ruled by the outer one. Just as the heavens were justly organised into a hierarchy of angels, archangels, and, at the very apex, the Catholic God, so too was society rightly organised, with peasants ruled by lords, who were subordinate to higher lords, who answered to the King or Queen.

Our dominant economic system is not feudalism but Capitalism. Whereas feudalism aimed to maintain a steady-state economy, Capitalism depends upon an economic system that is perpetually growing and expanding. Actually, it fundamentally has two contradictory imperatives, these being to aim for infinite growth while also perpetuating some degree of scarcity. But we’re just interested in the ‘growth’ part here.

As models show, capitalism is an inherently unstable and quite possibly unsustainable system. As it inexorably grows, it continually concentrates wealth, always increasing the gap between the majority and a small elite group who appropriate ever more wealth, a group who by the rules of the game can never be satisfied no matter how rich they become. It may also lift the prosperity of lower classes somewhat, including the very poorest classes, but only at the expense of increasing environmental harm. As it grows and grows and grows, like a cancer, toxic social problems and environmental pollution accumulate until, unless increasingly miraculous technological ‘fixes’ are brought online in good time, the whole crazy, cancerous system undergoes catastrophic collapse.

But, if such a collapse is a future event, how is it fair to blame ‘capitalism’ for this tragedy? Failure is built in to the very laws that govern our universe and birthed it 13.7 billion years ago. Wind the clock back to that time, and everything begins with the theoreticians’ Eden, which was not a pretty, fruitful garden but all the forces of Nature existing in a state of perfect symmetry, an austere and beautiful mathematical concept.

But this state of symmetrical perfection did not last. The Fall came ten to the power of minus thirty-five seconds after the moment of creation. Not because of sin, but because symmetry began to break down, so that there was no longer one grand unified force but many forces that could no longer be expressed with the most beautiful equations but rather using uglier, non-symmetrical equations for separate forces: Gravity, Electromagnetism, the Weak Nuclear Force and the Strong Nuclear Force. The supreme energies required to bring about the theoreticians’ Eden was cooling down, breaking the symmetry and starting the Doomsday Clock inexorably ticking as entropic decay and disorder spread, until all of humankind’s and Nature’s work would be undone, decayed, like the cold embers of a fire that once burned so brightly before being extinguished, leaving nothing but an endless cold, dead night.

So, inevitably (or so the Big Bang story goes) everything must come to ruin. So if we happen to have a cancerous ‘economic’ system putting unsustainable strain on our finite world, it’s not really a fault that can be blamed on Capitalism. Such is the way things must be, according to the dominant cosmology of our age.

Given this connection between popular theories and society, one would expect to find concepts from the dominant cosmology becoming adopted in the dominant economic system, and this is exactly what we find.

For example, the dominant form of money used today is a kind of credit-based currency known as ‘Fiat currency’. ‘Fiat’ comes from the Latin phrase ‘Fiat Lux’, or “let there be light”, that familiar phrase from the first chapter of Genesis. Just as God was said to have created the world out of nothing, through an effortless act of will, earthly authorities bring money into existence by performing the necessary rituals and incantations, as laid out by our systems of politics, banking and finance. Truth be told, all they really do is pretend the money is there (just as when they claim “there’s not enough money”, they are pretending it’s not there). Creating money is not very hard; the difficulty lies in getting sufficient numbers of people to behave as though this is money, too. Preferably, they should believe it is money and not merely go along with some pretence. In other words, ‘Fiat money’ is a creation of intersubjectivity. It exists because so many believe it exists and adjust their behaviours to fit such a belief.

In the mid 80s, financial reforms swept through the financial and banking centre in the city of London. The purpose of these reforms was to do away with fixed commissions for buying and selling shares on the London stock exchange. The reforms also included the introduction of something called “dual capacity”, meaning market makers could now also be stock brokers and vice versa. These reforms were called “the Big Bang”.

In the USA, changes to the regulatory structure for banking and finance and the tax system occurred throughout the 80s and 90s. During the Clinton Administration, the then head of the Federal Reserve, Alan Greenspan (b 1926), met President Clinton (b 1946) and warned that government spending was becoming unsustainably large. Clinton had been elected on promises of social reform, but if his administration was to ‘borrow’ the necessary funds, interest rates would go up and the fundamental imperative of capitalism- growth- would be harmed.

What the Clinton Administration should do, Greenspan recommended, was the exact opposite. Don’t increase government spending, cut it. That would lower interest rates and free the market to do its magic.

Clinton did as he was told and just as Greenspan predicted, markets boomed. Share prices started to rise, and kept on rising. Some optimists began to believe that this boom in share prices would not collapse like every boom in the past. They believed this because now computers were helping speculators manage and hedge risk in a way that would sustain the good times forever. It was, so the optimists proclaimed, the dawn of a “new economy”.

Greenspan, however, was worried. Share prices were indeed going up and up, but there was no increase in productivity. It was looking very much like a speculative bubble. But then (after his warnings that a speculative bubble might have arisen was met with intense criticism from major players in the financial sector) a startling revelation came to Greenspan. This was no speculative bubble. Rather, the introduction of powerful, networked computers had so transformed business, productivity was now increasing in ways that were so new, current economic models could not see it. At the time, Greenspan described this revelation as “like discovering a new planet”, but really a better term for it would be “financial dark matter”.

It was during the noughties, though, that the growth of this ‘financial dark matter’ really took off. During the height of the subprime mortgage bubble, there was talk of financial instruments of such dizzying complexity, only great geniuses could grasp how they could manifest such explosive growth in property value.

Who created these exotic new financial instruments? Well, many of the brilliant minds behind these immensely complex mathematical abstractions were theoretical physicists. In the past, thinkers of this calibre may have been drawn to pure research, unlocking the mysteries of the cosmos and maybe making discoveries that could one day lead to remarkable new technologies. But now they were leaving higher education with a huge burden of debt that had to be paid off, and the high rewards offered by banking and finance proved a very tempting bait.

And so these minds went to work for the financial sector, creating ‘consolidated debt obligations’, ‘synthetic consolidated debt obligations’, ‘naked credit default swaps’ and other bizarre forms of credit instruments.

In short, the subprime mortgage bubble was the result of a marriage between Big Bang cosmology and the capitalist economy. Why? Because both had evolved to be utterly dependent on speculation. The same theoreticians who dreamed up weird abstractions to be shoehorned into mainstream cosmological models, always with the claim that future observations would ultimately justify their inclusion and show them to be actual natural phenomenon and not just fancies of the theoreticians’ imagination, were the same ‘geniuses’ who were building up increasingly large towers of debt, promising that tomorrow it would somehow transform into genuine value.

I think maybe the most telling evidence for this marriage between Big Bang cosmology and the subprime mortgage fiasco is the following quote. Somebody once said, “these models were both very precise, and very wrong”. But what were they talking about? Frankly, this quote would serve equally well as a criticism of both the Big Bang and what the economy had become during the subprime mortgage bubble, because it sums up the nature of both of these speculation-dependent creations. Actually, it was Andy Haldane (b 1967) of the Bank of England, who was quoted.

We’re going to leave cosmology and speculations regarding the origins of the universe now , and turn our attention to something many might regard as more to do with their daily reality: Money. That is something created by us and, since it is our invention and not a miraculous creation of God or the result of natural phenomena beyond our understanding, one would be forgiven for supposing we know how money originated. The mainstream theory of money's origins must be an accurate story supported by evidence, right?

Wrong.

CHAPTER SEVEN

Mainstream cosmology and economics have succeeded in taking that which is, on the one hand, intimately familiar, and then making it seem profoundly strange on the other hand. On a holistic level we are at one with the universe, in no way separate from it as reductionist materialism would have us believe. Yet, how strange, how alien, the universe seems when viewed through the myths of modern cosmology. The same thing is true of money, so familiar and yet so strange. As Stuart Chase (1888- 1985) said, "money is not edible. It is not wearable. It is a symbol without industrial utility…on the tenth of the month, I take out my check book, and I mail around some scraps of paper with my name on it…and the tradesmen profess themselves satisfied. It's all very strange, but there you are. We all agree to take money even if we cannot agree as to what the word means".

When it comes to the universe, it's not too difficult to understand how come it should be so mysterious. How could something so unimaginably large and old, which existed for at least billions of years before any lifeform so much as divided a cell in two, not be profoundly unknowable? But money, well, that's different. We invented money, it is a product of our imagination. So why can we not all agree as to what that word- 'money'- actually refers to? Why do we not have one handy definition that neatly describes what money is and what money does?

The quick answer is this: Money was not invented, and money is not a 'thing'. You can hold a coin, a banknote or a credit card in your hand, but those are physical representations of money, not money itself. Money is an abstraction that evolved and, just as is the case with biological adaptations, where things like organs and limbs get adapted for purposes far removed from their original purpose, many of the current economic practices originated in practices far removed from modern forms.

We are used to handling cash, although it does seem to be on its last legs as more and more we are pushed towards online banking, using digital currencies traded on smartphone apps. It may feel like a brave or, perhaps, scary new world, this 'cashless society'. But, really, a proper review of money's history reveals there's nothing new about this virtualisation of money at all.

For most of human history, even when we had established the first cities, the vast majority of people did not use cash in their daily lives but instead calculated debt repayment though credit networks.

Indeed, money and debt are so closely related they are essentially one and the same. This is because a debt is defined as an obligation that has been quantified so that a precise sum is owed to a specific person or group. Implicit in this assumption is the idea that a debt can be repaid (if not, we really shouldn't be calling it a debt) and repayment demands a means to calculate the relative costs of goods and services. Whether it comes in credit form or bullion, money always is that form of measurement we use to quantify and compare the relative costs and values of anything that can be quantified. So, for as long as such a concept can be said to have existed, money is debt and debt is money.

From this, it follows that if anyone wants to understand the history of money, how it began, what forms it evolved into and the political and philosophical debates that accompanied this evolution, the most effective way to do so would be to investigate debt and what it meant to people down through the ages. As for cash, we really shouldn't pay too much attention to it, for the simple reason that it hasn't figured in most people's lives for most of history.

But, incredibly, this is not the approach taken by economists at all, who instead prefer a method that runs contrary to historical evidence. Most accounts of money's history emphasise the development of coinage, and there is a clear implication that coinage and money are one and the same. As for debt, it's treated as an afterthought, and in fact most economists' accounts of money's origins begin in a world in which debt has been erased.

Adam Smith's Tale of Money's Origin

In order to understand how this strange pseudohistory came about, let's look at the work of the man most often credited with founding the science of 'Economics': Adam Smith (1723-90). It helps to know something of Smith's history, especially the assumptions that framed his way of thinking and the limitations he was obliged to work under.

As far as limitations are concerned, Smith was an 18th Century philosopher who was writing at a time when monetary history went back no further than the time of Homer (b circa 8th century bce) Egyptian hieroglyphs and Mesopotamian cuneiform had not yet been translated, and so there was literally thousands of years of monetary history that was not available to Smith. Also, Scottish libraries were lacking in ethnographic studies of aboriginal North American cultures, so when Smith attempted to write the origins of money as beginning in such a culture, he had no real case studies to base his assumptions on.

At that time all the societies anyone knew about had governments, and since all governments issued money, it was assumed that this had always been the case. In other words, it was just taken as given that, historically, all cultures lived in states and all such societies would necessarily have their own forms of coinage.

Being an heir of the libertarian tradition, this assumption- that money was essentially a creation of the State- was one that Smith was determined to do away with. If he could successfully argue that money and markets pre-existed states, Smith could then establish the position that if government should have any role in monetary affairs, it should be limited to guaranteeing the soundness of the currency.

So how did Smith go about arguing his case? Well, it all begins with some assumptions regarding people. Smith urged us to forget about groups and instead focus on individuals. Suppose an individual should encounter another. What would happen next? He suggested that such an encounter would invariably result in our hypothetical individuals comparing and swapping things. Why? Because it is “a certain propensity in human nature....the propensity to truck, barter, and exchange one thing for another”.

According to Smith, then, the tendency to engage in exchange is the preeminent human trait. We should even include logic and conversation as aspects of this tendency, this assumption claims, since it sees those as forms of trading too. Smith put it like this: “If we should enquire into the principle of human mind on which this disposition of trucking is founded, it is clearly the natural inclination that everyone has to persuade. The offering of a shilling, which to us appears to have so plain and simple a meaning, is in reality offering an argument to persuade one to do so and so is for his interest”.

So, according to this view, whether we are exchanging goods or exchanging words, the motives are always the same: each individual is trying to seek their own best advantage, which is to say (if we were to put it in monetary terms) seeking the maximum possible profit from every exchange.

Smith argued that the propensity to engage in barter, exchanging stuff back and forth between individuals, was a uniquely human trait. “Nobody ever saw a dog make a fair and deliberate exchange of one bone for another with another dog”, he wrote. As we shall see in subsequent books in this series, he was not actually the first thinker to make such an observation.

So, for Smith, everything begins with barter. In order to participate in a barter exchange, though, you need stuff you can potentially exchange, and for Smith this need is what drives both the division of labour and the adoption of currency.

Why does Smith believe barter would lead to a division of labour? Because he supposes people’s varied talents, coupled with the search for personal gain, would inevitably result in individuals concentrating on those tasks that yield the best results.

He asks us to imagine a person who is particularly skilled at making arrows. Now, he could obtain meat by hunting prey. But he learns that he is much more able to obtain meat through barter, swapping his much-coveted arrows for protein. With this realisation comes the decision to specialise. “From a regard to his own interest, therefore, the making of bows and arrows grows to be his chief business, and he becomes a sort of armourer”.

Meanwhile, other people are discovering that they can best profit from concentrating on other skills, such as making shoes, and we transition from a world of generalists in which each individual labours to produce all they need, to a world of specialists where each “finds it his interest to dedicate himself entirely to this employment”. Now we have a world of armourers, cobblers, and other such focused professions, and individuals are obtaining the bulk of their goods not by making them but by engaging in swaps with others.

Eventually, the search for greater profit leads to the realisation that greater division of labour leads to greater productivity, and so the task of building bows and arrows and other products gets broken down into many simple micro-tasks that together make up the production line of a factory.

However, before that stage of specialisation is reached, the people will have become increasingly aware of the difficulties of barter. What we have been describing so far is a world without debt, because whatever debt can be said to exist between individuals when they chance to meet and eye up each other's stuff gets cancelled out as soon as an exchange is made. But you may have noticed a potential problem with the kind of exchange we are talking about here. It depends upon each person wanting what the other person has. There has to be, as economists say, a 'double coincidence of wants'.

What to do in those situations where one person doesn't need what the other has? Smith believed people would get around this problem by noticing some commodities were more commonly exchanged than others, and would try to make sure they had some of that ready to hand for use as a medium of exchange.

Now, normally, as more people possess a commodity the less valuable it becomes, since it becomes less scarce. But, for these commonly-exchanged commodities, the situation is different, because being commonly exchanged means it is essentially currency. According to Smith, "salt is said to be the common instrument of commerce and exchanges in Abyssinia...dried cod at Newfoundland...and there is at this day a village in Scotland where it is not uncommon, I am told, for a workman to carry nails instead of money to the baker's shop or the ale-house".

To function effectively as a medium of exchange, this 'commodity-money' would have to satisfy several conditions. Firstly, as we have seen, it would have to be commonly perceived as valuable. Perhaps the very next person you meet would not need it right now, but since both of you understand that very soon you will meet somebody who does covet it, you accept it right now as a kind of intermediary. Eventually the mere fact that it is universally accepted as an intermediary makes it valuable for that very reason.

Secondly, it would need to be something one can carry without difficulty, in other words be portable. You would not want it to spoil but rather remain in a state that is pristine enough to ensure it keeps its value. It would need to be 'durable'. And finally, given that you'll be wanting to buy a variety of goods of different values with this commodity-money, it would be best if you could break it into smaller pieces. It would need to be 'divisible'.

So, swaps carried out using a commodity-money as medium of exchange would compel people to seek out something universally valuable, portable, durable, and capable of being endlessly subdivided into identical portions. The materials that best fit such conditions are precious metals like gold or silver.

According to Smith, "those metals seem originally to have been made for this purpose in rude bars...The use of metals in this rude state was attended with two very considerable inconveniences; first with the trouble of weighing; and, secondly, with that of assaying them".

In other words, carrying around small lumps of silver or gold makes exchange easier than reliance on pure barter. But it would be even more convenient if everyone could rely on those gold lumps being a uniform weight and purity. The way to go about achieving that is to stamp the metal into uniform shapes, along with designations that guarantee the weight and fineness of each such object, and also to ensure there are different denominations of such objects. At this point, commodity-money has become coinage.

It's only at this point, according to Smith, that the government needed to figure into the workings of markets at all, since they generally ran the mints in his day, meaning nobody was better-placed to issue the necessary quantities of coins. In other words, the one legitimate role of government when it comes to 'the market', is to guarantee the money supply along with the weight and purity of every coin.

So now everyone is using cash in their daily transactions. The next stage comes when people realise you don't actually need gold on your person at all times. You can write out IOUs that others can later redeem for gold, and such 'promissory notes' circulate as currency, their value ultimately backed by gold. Banks realise that they can make out loans in excess of the gold they actually possess, by issuing promissory notes backed by gold they don't actually have. The system works fine so long as everyone has faith that the bank is good for its money and don't all try to demand their gold at once. "Belief the bank is good for its money" is another way of saying the bank has credit or that those promissory notes represent the bank's credit.

And so we end up more or less at modern fractional-reserve banking. According to the anthropologist David Graeber (1961-2020) "this story has become simple common sense for most people...'Once upon a time, there was barter. It was difficult. So people invented money. Then came the development of banking and credit'. It all forms a perfectly simple straightforward progression, a process of increasing sophistication and abstraction that has carried humanity, logically and inexorably, from the Stone Age exchange of mastodon tusks to stock markets, hedge funds and securitised derivatives".

By the time money has reached this level of sophistication, the world of banking, finance, and the various currencies flowing through its circuits takes on an almost bewildering level of complexity. But still, so long as you believe in the tale of money's origins in barter exchanges, it can also be believed that such apparent complexity functions on top of a truth that is actually very simple. And the truth, according to this worldview, is that the market, properly speaking, is no creation of the State. The market needs no bureaucrats to bring it into being, because 'the market' naturally exists.

Or, to be more precise, the market naturally exists as an inevitable consequence of what human beings are. And what are human beings, according to this worldview? Human beings are individual rational agents who interact with other such individuals for one purpose, and that is to gain a material advantage through the medium of exchange. Ideally, these individual rational agents would remain just that- individuals- never owing anything to anybody. But, the complexities that develop out of barter being what they are, that ideal is hardly practical. Therefore, networks of debt, social security systems and other evil necessities get added, which unfortunately provides opportunities for governments (which should only protect borders from invaders and guarantee the soundness of the money supply) to screw everything up through well-meaning interventions into the logic of the market. But, fundamentally, you can strip all of that away and see that, at the root of everything it's all about barter.

Running with that idea, economists discovered that their economic models could be radically simplified. As we shall see in subsequent books in this series, the discipline of economics evolved from theology, but now those sort of arguments and debates no longer seemed necessary. Nor for that matter was the presence or absence of money all that important. This idea, the ‘unimportance of money’, was described by Graeber as “the final apotheosis of economics as common sense”. When individuals meet, individuals barter. It’s in our nature to behave this way. Thus, whenever you see an image of one person passing something to another, whether that be the placing of silver in the palm of a hand, a ring slipped onto a finger, or a crown placed on a head, then regardless of what customs or ceremonies might have you believe, it all reduces to barter.

This belief was summed up by Paul Samuelson (1915-2009), a neoclassical economist, in 1958. “Even in the most advanced industrial economies, if we strip exchange down to its barest essentials and peel off the obscuring level of money, we find that trade between individuals and nations largely boils down to barter”.

CHAPTER EIGHT

While conducting his fieldwork in Madagascar, David Graeber had the opportunity to interview what was supposedly a 'Kalanoro', a kind of ghost. This interview consisted of the anthropologist asking questions and receiving replies from an unseen source, hidden behind a screen. At one point he asked this 'spirit' (of course he knew it was just some person acting out a role) what people had used for money in ancient times, a past the Kalanoro claimed to have personally witnessed. This prompted the following reply. "We didn't use money. In ancient times we used to barter commodities directly, one for the other".

This anecdote just goes to show how widespread the assumption that money's origins lie in barter is. But the popularity of this tale and the fact that it is accepted by so many people has to do with the fact that it has been repeated so often, and because most people don't stop to scrutinise it and see that it doesn't really make sense. But the clues are there if you look. For example, a textbook by the economists Joseph Stiglitz (b 1943) and John Driffil contains the following:

"One can imagine an old-style farmer bartering with the blacksmith, the tailor, the grocer, and the doctor in his small town. For simple barter to work, however, there must be a double coincidence of wants...If Henry has firewood, and Joshua does not need any of that, then bartering for Joshua's shoes requires one or both of them to go searching for more people in the hope of making a multilateral exchange". And so, we're on the familiar path from commodity-money to coinage to credit.

Here's another example, from 'Economics' by Karl Case (1946-2016) , Ray C, Fair (b 1942), Manfred Gartner and Ken Heather:

"Money is vital to the working of a market economy. Imagine what life would be like without it. The alternative to a monetary economy is barter..." And again we're told of the problem of the double coincidence of wants and how coinage and later credit make things so much more convenient.

One could even find stories of this kind in factual books written as late as 2014, as can be seen from this excerpt taken from 'Sapiens' by Yuval Noah Harari (b 1976)

"In order to understand the limitations of barter, imagine that you own an apple orchard in the hill country…You work so hard that your shoes wear out. So you harness up your donkey cart and head to the market town down by the river…You find the shoemaker's shop and offer to barter some apples in exchange for the shoes you need.

The shoemaker hesitates. How many apples should he ask for in payment? Every day he encounters dozens of customers, a few of whom bring sacks of apples, while others carry wheat, goats or cloth- all of varying quality…" There then follows the usual analysis of how awkward this barter economy would be.

What are we to make of explanations like these? Well, one thing quickly becomes clear, which is that this sort of 'origins of money' tale very much depends on readers who do not pay any attention to the absurdity of the premise. So long as you ignore that, the story has some logic to it. "Yes", the naive reader thinks, "it is true that barter would entail all kinds of complications and that money would be a far more effective way of conducting such affairs".

But, if you do happen to notice the absurdity, the whole tale falls apart and cannot be taken seriously as an explanation for money's origin. Take that last version from 'Sapiens'. Readers are asked to place themselves in the role of a person (let's call him 'Fred') who has never heard of money. We are then told that Fred owns an apple orchard. Phrased that way, we assume Fred has some sort of property entitlement to this orchard. How can that be? Claiming ownership of land entails legal and bureaucratic arrangements that are a good deal more complex than swapping some apples for a pair of shoes. Fred, remember, is a person who lives in a world where money does not exist. So how did he ever arrange the loan required to buy the property rights we're told he owns?

Maybe he did not acquire this orchard through property entitlement? Maybe it was just there and Fred was the first to stumble upon it? If that were the case you can be sure that this wild, untamed environment would require substantial work before it looked anything like an orchard. Fred would need seeds, fertiliser, and would have to install some kind of irrigation in order to water his trees. Furthermore, various tools would be needed: pruning shears and saws to remove unruly branches, hoses to deliver water, or at least a bucket so he could fetch water from the river and then laboriously carry it back to his orchard to soak the soil the trees are rooted in. These are just some of the tools and equipment Fred would have to acquire in order to become a farmer running an apple orchard.

Not that this tale mentions much of the equipment needed. All that is referred to is a worn-out pair of shoes and a donkey cart. But, even with these two items we have a vast increase in complexity of exchanges that we are supposed to just ignore. All these people, remember, have never heard of money, and cannot figure out how many apples are equivalent in value to a new pair of shoes. And yet, apparently they have no difficulty figuring out the monetary calculations involved in running their businesses.

Who made those shoes that Fred has worn out (perhaps from trudging all the way to the river to fetch pails of water?) and what did they use to make them? They would have had to obtain the requisite materials and all the tools a cobbler needs in order to turn materials into shoes. Whoever made the donkey cart would have had to obtain the materials and tools necessary to complete that job. And, of course, they would need to develop the skills such jobs entail, which could only be done through training. How did the cobbler and the wainwright manage to get the training, the materials and the tools they needed, when the only mode of exchange they know of is barter?

Fred harnesses up his donkey cart and makes for the market town. The market town! How many businesses are required to turn a hippy collective or a tribe of hunter-gatherers into a market town? At least hundreds, I would imagine, and probably more like thousands of people. Just think of the complexity involved in all the commercial exchanges (arrangement of property rights, negotiating employee compensation, making deals with suppliers, ensuring the requisite utilities are there as and when needed, to mention just a few).

The folk in Harari's tale managed to figure all of this out and established a market town for themselves. Yet, somehow, they have never heard of money and the problem of "how many apples from orchard X is equivalent to the value of a new pair of shoes" is a calculation too challenging for Fred and the cobbler to figure out!

The Mythical Land of Barter

Clearly, this is an entirely unrealistic tale, one that is about as accurate a portrayal of money's origin, as the Big Bang theory is an accurate tale of the origins of a universe known to be at least 80 billion years old (there is actually reasonable evidence that the universe is at least trillions of years old). But pointing out the absurdity of the premise leads to the question as to why all these authors ask us to dream up an imaginary town with blacksmiths and tailors but no money, where everyday transactions are conducted through barter? Why not inform the reader of an actual town, village or settlement where people really did rely on barter?

In the case of Smith, as we saw, he lacked information about the Aboriginal North Americans that he used as his example. But after Smith published his thoughts on economics and the origins of money, a great many explorers, missionaries, and colonial administrators set out, travelling all over the world, bringing his book with them. They expected to find 'primitive' people relying on barter, but they never did. According to Graeber, "they discovered an almost endless variety of economic systems. But to this day, no one has been able to locate a part of the world where the ordinary mode of economic transaction between neighbours takes the form of 'I'll give you twenty chickens for that cow'".

Indeed, the definitive anthropological work on barter, by Cambridge's Caroline Humphrey (b 1943), completely rejects the story of money's origins in barter. "No example of a barter economy, pure and simple, has ever been described, let alone the emergence from it of money; all available ethnography suggests that there has never been such a thing".

Furthermore, Ann Chapman (1937-2009) has pointed out that if we define pure barter as something concerned only with swapping objects, and not with re-arranging relations between people, then the notion that barter has ever existed becomes unclear.

The Limited and Messy Reality of Barter

That would suggest that barter might exist in some situations (otherwise, barter's non-existence would not be 'unclear'). Indeed, it does exist in some situations. What has been definitively rejected by anthropologists (but not economists it would seem) is the idea that barter was the main mode of exchange between neighbours. However, there is evidence of barter sometimes happening when strangers encounter one another.

What is actually documented, though, is quite different to how barter is imagined to be conducted. Supposedly, when two strangers meet the following scenario plays out:

Person A: “Hi there. Say, that’s some nice venison you have”.

Person B: “Do you want some? I will trade you some for a few of those arrows you are carrying”.

Person A: “Ok it’s a deal. Thank you and have a nice day”.

In reality, barter exchanges between strangers are not this simple and impersonal. A case in point is how such exchanges are conducted by the Nambikwara of Brazil. If one band spots another, the first thing that happens is that emissaries are sent to negotiate a meeting for purposes of trade. Once such a meeting is agreed upon, the women and children are hidden in the forest before the men of the other band are invited to visit camp.

Each band’s chief gives a formal speech once everyone is assembled, a speech that praises the other party and belittles his own. Everyone else puts aside their weapons and engage in song, and dance in a way that mimics military confrontation. With that formality out of the way, individuals from each side approach one another and initiate trade.

The individual who covets an object conveys his desire by saying how fine it is. If his rival values the object in his possession, he actually signals his desire to keep it not by agreeing that it is indeed a fine object, but rather by denigrating it, saying things like “this necklace is very dull”.

According to Claude Levi-Strauss (1908-2008) who witnessed such exchanges, “this argument is carried on in an angry tone of voice until a settlement is reached. When agreement has been reached each snatches the object out of the other’s hand. If a man has bartered a necklace, instead of taking it off and handing it over, the other person must take it off with a show of force. Disputes, often leading to fights, occur when one party is a little premature and snatches the object before the other has finished arguing”.

Once all such exchanges are completed, business concludes with a great feast. The women are included in this feast, leading to the possibility for seductions amidst all that singing and feasting, and of course the possibility of jealous quarrels that might grow heated enough to result in people getting killed.

You can see how, for the Namibkwara, barter is not conducted in a dispassionate, impersonal manner. Instead, exchange takes place amidst festivities like singing and feasting, and rituals that mimic conflict, as in those dances that mimic military confrontation, angry exchange of words, and the symbolic act of grabbing the object from the other person’s possession.

Why the need for so much custom and ritual? The answer lies in the kind of situation we are talking about. This is an exchange that involves a meeting between strangers who have no interest in developing ongoing relations. All each party in the exchange is interested in is getting the best deal and there's no particular reason why they shouldn't try and take advantage of their opponent. The warlike dancing, the angry negotiations, and the snatching, all serve to remind everyone that this is an exchange close to that most impersonal of encounters where strangers sweep in and simply steal what they want. The festivities help to ensure exchanges don't become quite as blunt as that. As Graeber explained, such barter exchanges are "made possible by laying down an initial mantle of sociability in the form of shared pleasures, music and dance- the usual base of conviviality on which trade must always be built".

Now, you might be thinking, "but, hang on, when I go shopping I don't need to perform ritualistic dances or go through customary speeches. I just make an exchange, say 'thank you' and leave the store". Yes, but in that case impersonal exchange takes place in a market that includes a lot of legal infrastructure in the form of laws, police, courts, bailiffs and so on, ensuring that even if we don't want to have anything to do with someone and are just seeking maximum material advantage from a temporary interaction, we don't do the obvious thing, which is to hit the shopkeeper over the head and grab whatever we want. This provides further reasons for supposing barter exchanges could never have been commonly practiced. As Graeber explained, "such a society could only be one in which everybody was an inch away from everybody else's throat; but nonetheless hovering there, poised to strike, forever. True, barter does sometimes occur between people who do not consider each other strangers, but they're usually people who might as well be strangers- that is, who feel no sense of mutual responsibility or trust, or the desire to develop ongoing relations".

There's etymological evidence that unscrupulous practices are common to barter exchanges. After all, in Indo-European languages, the words 'truck and barter', in the century or two before Smith's time, literally meant "to trick, bamboozle, and rip off".

We seem to be painting a very negative picture of humanity, one that resembles Thomas Hobbes's (1588-1679) portrayal of mankind as nasty and brutish, only restrained from our worst actions by the power of the State.

But it should be remembered that we are talking about one-off interactions between strangers, which is a fairly exceptional type of human interaction. It's far more common for us to interact with people we have ongoing relationships with, and a complex history. We spend most of our lives with family, friends, neighbours and work colleagues. Ongoing relationships like these provide alternatives to barter that are so obvious when pointed out, it really is remarkable that so many economic textbooks fail to recognise them.

You will recall how Stiglitz and Driffield asked us to imagine 'Joshua' and 'Henry'. Henry needed a pair of shoes and Joshua had a pair, but Henry was not in possession of anything Joshua needed at the time their paths crossed. An on-the-spot exchange was not possible. The authors seemed convinced that this presented a problem that was insurmountable to anything except the introduction of cash or paper money.

However, if Henry had been a member of the Iroquois, another solution to his shoe problem would have been available. You will recall how Smith supposed money's origins lay in Aboriginal North Americans swapping arrowheads for meat. However, when Lewis Henry Morgan (1818-1881) subsequently investigated the way the Six Nations of the Iroquois (among others) conducted their daily affairs, he found Smith was wrong and nobody ever traded arrowheads for meat. Instead, the Iroquois' main economic institution were longhouses where goods were stockpiled before being allocated by women's councils.

So, if there happened to be such a longhouse in Henry's community, Joshua wouldn't need to figure in this tale at all. Instead, Henry would let his wife know he needed shoes, she would pass this on to the other matrons, and if they approved, she would fetch whatever materials she needed from the collective store, and sew her husband some moccasins.

Even if we imagine Joshua and Henry living somewhere less communal, like a small town (strangely, one where nobody has heard of money) there would still be an obvious solution that does not involve barter exchange or cash. Henry lets it be known that he could really do with a pair of shoes and Joshua gives him a pair. Why? Well, who knows, it depends on their mutual history. When it comes to impersonal exchanges we're not supposed to be interested in anything but the value of the objects up for exchange but in most human interactions many more factors need to be considered. Are Henry and Joshua closely related, like brothers or uncle and nephew? Are they friends? Is there any kind of antagonistic history between them? Maybe Joshua wronged Henry in the past, and by handing him a pair of shoes he appeases him. Or maybe Henry has nothing Joshua needs right now, but in giving him shoes, Joshua registers a credit. Henry 'owes him one', and can do or give something to return the favour at a later date.

Obviously, anyone who has an ongoing relationship with someone else wouldn't have to rely on on-the-spot exchanges but could choose deferred payments instead. Smith suggested that people would stockpile commonly-traded items and use them as a sort of currency. But now we can see this is not necessary, either. In any small community, the folk simply keep track of who owes what to whom, thereby maintaining and updating credit networks.

In The Beginning There Was Credit

Still, even the scenario in which payment is deferred and Henry 'owes Joshua one' implies something like money has to exist. After all, 'money' is not just a medium of exchange, but also a store of value and, crucially, a unit of account. That's crucial in this scenario because if Joshua is to pay what he owes there has to be some way to establish what materials, products, tasks or what-have-you are equivalent to a pair of shoes.

On that note, it would be worth returning to Smith's examples of 'commodity currency'. Recall how he said fish, or nails, were once used as money. Well, when the British diplomat Alfred Mitchell Innes (1864-1956) did some research on the Newfoundland fishing industry, he discovered that they never really used fish as money at all.

His investigations showed that there was no permanent European population in the early days of the Newfoundland fishing industry. Instead, fishers were only there during the fishing season. According to Mitchell-Innes, "those who were not fishers were traders who bought the dried fish and sold to the fishers their daily supplies. The latter sold their catch to the traders at the market price in pounds, shilling and pence, and obtained in return a credit on their books, with which they paid for their supplies. Balances due by the traders were paid for by drafts on England or France".

So, rather than using fish as money, this was instead a credit arrangement keeping track of who owed what to whom.

And what about the nails? Recall how Smith wrote, “there is at this day a village in Scotland where it is not uncommon, I am told, for a workman to carry nails instead of money...to the ale-house”.

This suggests the following scenario. A workman enters the ale-house.

Workman: “Barkeep, I am thirsty! Give me a pint of your fine ale”.

Barkeep: “Certainly. That will be five nails”.

That should strike you as rather silly. Of course nobody really used nails as money. You have to understand that workers receiving regular wages was not always the expected thing. In Smith’s day, employers often lacked the cash to pay their employees. Indeed, an employee might have had to wait for over a year before he actually received his wages. So what did those cashless employees do in the meantime?

According to Graeber, “it was considered acceptable for employees to carry off either some of their own products or leftover work materials, lumber, fabric, cord and so on. The nails were de facto interest on what their employers owed them. So they went to the pub, ran up a tab, and when occasion permitted, brought in a bag of nails to charge off against the debt”.

So, once again, what we’re really talking about here is a credit arrangement.

Indeed, this is what is revealed to be going on in almost every case. It is often said that when empires or kingdoms collapsed in ages past and the currency collapsed with them, people ‘reverted to barter’. We have two implications here. Firstly, that people had relied on barter before (how else could they revert to it?). Secondly, that the absence of cash necessarily means the absence of money.

We now know the latter assumption is simply wrong. The absence of cash in no way prevents people from using money. For example, after the collapse of the Roman Empire, people continued keeping accounts in the old imperial currency, calculating credits, debts and balancing their books using the equivalent of pounds and pence as units of account. Or, to give a more recent example, we might turn to 20th century Ireland. During the decade between 1966 and 1977, the country experienced three separate bank strikes. For a total of twelve months, the banks were completely shut and people were prevented from carrying out any banking transaction.

It was predicted that strike would cause such disruption that the banks’ demands would have to be granted. But it turned out that the people of Ireland didn’t care. No, they just carried on using money, writing cheques and circulating them through credit networks, demonstrating that while communities require banking they don’t necessarily need banks.

According to Antoin E. Murphy (economics professor of Trinity College, Dublin), “the nature of the economy greatly facilitated the emergence of this new system...The small size of the population meant that there was a high degree of personal contact amongst members of the community. Where information was lacking at the personal level, a substitute collective information existed in the form of retail shops numbering around 12,000 and that well-known Irish institution, the Public House, 11,000 of which existed in the Republic”.

So, in Ireland at that time there were all these communities where people had ongoing relationships and an understanding of ‘credit’ not as cold, impersonal cash but a neighbour’s good reputation. Where you could not rely on your own understanding of a person’s good name, you could turn to the barman who, through his capacity as mein host, could tell you who was good for her money and who you should steer clear of (as Murphy said, “one does not, after all, serve drinks to someone for years without discovering something of his liquid resources”).

So once again, the absence of cash did not force anyone to ‘revert to barter’, simply because there was nothing to stop communities from continuing to use money as a unit of account. As Murphy said, “there was nobody in charge and people took the checks they liked and didn’t take the checks they didn’t like. So the whole world just revolved around that fact”.

This is not to say that barter systems never crop up in the aftermath of economic collapse, because this has happened on occasion. For example, it happened quite recently in Russia in the 1990s and in Argentina around 2002. There are also reports of inmates in prisoner-of-war camps and prisons using ‘commodity money’ in the form of cigarettes.

In all such cases, we are talking about people who are familiar with money but find themselves in circumstances where they can no longer access cash, making them rather like those ‘origins of money’ scenarios where cobblers and farmers spontaneously appear and start swapping things. So there is some evidence that this sort of thing can happen, it’s just that there is no reason to believe barter is an ancient phenomenon.

As Graeber pointed out, “in most of the cases we know about, it takes place between people who are familiar with the use of money but, for one reason or another, don’t have a lot of it around”. Again, though, it must be stressed that the far more frequent solution is to revert to some sort of anarchistic credit system.

Can we really talk of ‘reverting to credit’, as if doing so recalls how our ancestors conducted their daily lives? Well, in saying so we certainly stand on much firmer ground than if we talk about ‘reverting to barter’.

You will recall how, in Smith’s time, knowledge of monetary history went back no further than circa 800 BC, the time of the Homeric epics. But once Egyptian hieroglyphs and Mesopotamian cuneiform were translated, we gained access to a further three thousand years of history, enabling us to learn about the daily economic lives of people who lived as far back as 3,500 BC. Such records leave no doubt: Credit came first, not barter.

But Still the Belief Goes On

I think it's fair to say that the standard theory of money's origins as evolving from barter, must stand as one of the most completely refuted and debunked theories of all time. There is hardly a single aspect of this story that does not collapse once the disciplines of archeology, anthropology and properly interpreted history are brought to bear on its claims.

You would think, then, that since this theory is so absolutely refuted, it would be rejected and economists would be writing a true history of money as something that evolved out of primeval credit arrangements. This revision of monetary history was indeed attempted by Mitchell-Innes, the person who, you may recall, debunked Smith's examples of commodity currency. In essays published in 1913 and 1914 he wrote:

"One of the popular fallacies in connection with commerce is that in modern days a money-saving device has been introduced called credit and that, before this device was known, all purchases were paid in cash, in other words, in coins. A careful investigation shows that the precise reverse is true. In olden days, coins played a far smaller part in commerce than they do today...So unimportant indeed was coinage that sometimes kings did not hesitate to call it all in for re-minting and re-issue and still commerce went on just the same".

So, he was quite clear that credit came first; that for most of history the use of coinage spread unevenly and never completely replaced credit, and that if barter happened at all it did so only in fairly recent times, being mainly what strangers do when they are used to cash but suddenly cannot access coinage.

Strange though it may seem, the revision never happened. Think back to those quotes that tell us the only alternative to cash is barter. Stiglitz and Driffield were writing in the year 2000. Yuval Noah Harari, 2011. So, over 91 years after Mitchell-Innes laid down the groundwork for a rewriting of monetary history that actually agrees with the evidence, economists responded by ignoring him and continued to write as though the barter theory of money was valid.

Why Does This False Origin Story Persist?

What is it about the myth of barter that makes it so convincing even in the face of so much refuting evidence? Here, we must appeal to the assumptions that drive the creation and perpetuation of 'mythstakes'. Whenever people refuse to change their assumptions, even when faced with a great deal of evidence that those assumptions are wrong, you can be sure that an ideology is in operation. That was the main reason why the geocentric model survived for so long, even as centuries of observations contradicted its premises, and why the Big Bang theory dominates today, despite its awful track record in terms of predictive success. So, what ideology lurks beneath the myth of barter?

Perhaps it is significant that Smith's 'Wealth of Nations' was published just eighty-nine years after Isaac Newton (1642-1726) published his monumental 'Principia', most famous for its three laws of motion and inverse square law of gravity. Newton's theory of physics was considered our best cosmological model until the twentieth century, and even now the predictions derived from it are valid in all but the most extreme cosmic situations.

So, Newton's cosmology had been a part of society for almost a century by the time Smith put his ideas down on paper, and that is enough time for ideas in one discipline to influence thoughts in others.

According to John Gribbin (b 1946), 'Principcia's' biggest impact on society lay in the way it showed, via rigorous experiment, data gathering and math, how the whole universe could be understood using essentially mechanical principles.

Understandably, then, the Newtonian universe is often compared to a great clockwork device. As Gribbin said, "think of a great church clock of Newton's time, not just with hands marking off time, but with wooden figures that emerge from the interior on the hour...a great complexity of surface activity, but all happening as the result of the tick-tock of a simple pendulum".

So one could imagine the Creator setting that pendulum in motion, or analogously, pronouncing some simple equations, and from that moment onwards all else would be set in motion. This is a picture of a universe that is not governed by magic and the whims of capricious gods, but rather a mechanistic cosmos built by a divine watchmaker which would run all by itself, ultimately reducible to a set of physical laws that are, in principle, understandable to human minds.

Well, if you were a libertarian like Smith and were determined to show that an economy could run like a well-built machine, then taking a Newtonian viewpoint must have been the way to do it. After all, if, as Newton argued, God had arranged matter just so in order to ensure an eternal, harmonious universe despite all the chaos we seem to witness (all those supernovae, asteroid strikes and so on) why not also suppose providence would have arranged things so that a balanced, harmonious economy would result from the selfish pursuit of material gain?

The problem is that Newton's theories were concerned with relatively very simple things and phenomenon, such as the paths planets must follow if we assume an inverse-square law. But Smith's field of study was the most complex thing in the known universe, namely humans and human behaviour. It's inherent to the deductive approach to break surface complexity down into its underlying simple foundations. The danger lies in the potential to ignore factors you shouldn't really dismiss.

In the case of Smith's theory, and indeed of anyone whose economic model is based on the myth of barter, the flawed assumption is that anyone and everyone who is lending and borrowing does so based on purely 'economic' motivations. This is another way of saying that credit and debt are intrinsically impersonal and that therefore we treat an obligation a cousin owes as no different to a debt owed by a complete stranger.

Of course that's not really true. In reality, we treat people differently depending on what relationships and history we have built up, and there are all kinds of conflicting emotions, behaviours, morals and so on, influencing our decisions. We lend, borrow, and repay not just out of cold economic logic but out of friendship, animosity, love, spite, altruism, jealousy, solidarity, selfishness...the list of possible reasons why we might do favours, roll over a debt or demand repayment now go on and on.

All these contradictory moral principles, emotions and beliefs are necessary aspects of any theory of human behaviour, but it all makes for an inconveniently messy and confusing subject of inquiry. A lot of what people do is beyond quantification, making it particularly challenging for those who would reduce human behaviour to a set of equations. For those determined to do so, it is preferable to ignore all the complexities involved in real human exchanges and to begin instead with an imaginary past where there is no credit and there is no debt and then to imagine a way in which purely-competitive markets where nobody cares about anything but the value of material goods can arise. The temptation of barter lies in the way it presents an idealised beginning in which rational agents make on-the-spot exchanges, thereby implying a world of individuals who don't owe anything to anyone and who have nothing influencing such exchanges except the best-possible price.

As Graeber said, "for there to even be a discipline called 'Economics' that concerns itself first and foremost with how individuals seek the most advantageous arrangement for the exchange of goods, it must assume that such goods need have nothing to do with war, passion, mystery, sex or death. Economists assume a division between different spheres of human behaviour that simply doesn't exist".

Conclusion

In this book, we have argued that the most fitting definition for human beings would be to describe us as the 'Storytelling Animal'. All perceptions of the world that we have do not come directly from objective reality, but rather are indirect interpretations of what is 'out there' beyond the "cave of the mind", a metaphor that reminds us that our brains- and therefore our minds- are locked up inside our skulls, where no light or sound or smells ever penetrate. All such sensations exist only as subjective states.

But, since we have language we are not, each and every one of us, isolated beings existing in seven billion individual 'caves'. Although the objective universe existing beyond the confines of our collective skulls is, presumably, infinitely older and larger than all of human existence, there is a sense in which the world of intersubjectivity, the mass beliefs, assumptions and other forms of imagination shared and shaped across large networks of human relationships, is the universe we live in; the only reality we, the storytelling animal, ever know.

It is understood that our ancestors believed in things that evidence really could not support, such as the belief that we live in a Geocentric system, meaning the Sun orbits the Earth. Even as evidence to the contrary had accumulated to the point where it was obvious this was wrong, the majority of the most skilled thinkers of the age clung to the belief that Geocentrism had to be a valid model of our reality, and mapped out increasingly complex planetary orbits in an attempt to retrofit the fundamental principles of their assumptions to measurements of actual orbits.

Everybody now accepts that Geocentrism had all the defining features of a mythstake: popularly, and sincerely, believed to be true, but with little evidence to support such firm beliefs and a great deal of evidence pointing to its falsity.

It’s easier to believe our ancestors, living in less sophisticated times when the scientific method was in its infancy, could cling to false beliefs for so long. But we should not suppose that a civilisation equipped with modern scientific tools and methods is necessarily immune to the creation and perpetuation of mythstakes. Indeed, it has been argued in this book that a form of scientific method- ‘Deduction-, in which we attempt to arrive at our reality by starting from idealised assumptions and working forwards from this imaginary point of origin, can, when such narratives spin a tale that is convenient to the dominant forces shaping society, be just as liable of perpetuating mythstakes.

Hopefully, in the case of the barter story of money’s origins, sufficient evidence has been presented to persuade readers that this story has almost nothing to do with how money and markets actually evolved. Having established that there can never have been a ‘Land of Barter’ in this book, the next book in this series will look at theories of value creation which, since they mostly assume the barter story is a true one, have developed economic models of markets that never correspond to how messy human life is actually experienced.

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