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The Muon and the Green Great Dragon

Part One: In a Hole In a Hole Dwelt a Nothingness?

by Gwydion M Williams

Why Muons were real, even when no one had believed they should exist. Or could explain why they did exist.

Why any native English speaker would know that a 'green great dragon' was bad English, but would be unlikely to know why.

How the question 'why' is very different for human matters and for the physical universe.

How religions came in waves of ideas, and gave us ways to organise our thinking that had not existed before.

How religions show their human origin, by always supposing that it was a universe made as a dwelling for humans and similar creatures

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The Muon and the Green Great Dragon

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Your Life In Two Worlds

On the edge of space, a naked proton that has wandered the universe for hundreds of millions of years slams into Earth's atmosphere. It hits an atom that is part of our atmosphere: which atom barely matters. Proton meets proton with enough energy to abolish the unobservable quarks within each proton. There is a moment of pure undefined energy, similar to the very first moments after the Big Bang. Then it becomes something more regular: a rare particle called a pion.

The pion rapidly decays into something stranger but less unstable; a muon, along with a neutrino. The neutrino is likely to pass undisturbed through the entire solid Earth and out into interstellar space, never again encountering normal matter. The muon will pass through the atmosphere; pass through you if you happen to be in the way. Mostly it will perish deep underground: not because it hits anything but because it is unstable. It will end its brief existence by becoming an electron and two more neutrinos.

The existence of muons also refutes the common notion that we somehow create the subatomic world by observing it. Muons were particles that should not have existed, and yet are real.

In this article, I talk about rules, and how to break them. Whether they *can* be broken by a mere human. Whether even an entire human society or civilisation could remould them. And the importance of knowing what can be changed and what can't.

Why would a typical native English speaker never talk of a 'green great dragon'? Why can't they explain why this would be wrong? Why we talk of dragons at all, since we know they never existed? And why do phenomena like muons forced us to accept them as facts of life, even though our original world-view said that they should not exist?

As a human reading this philosophical essay, you personally interact with the wider world at two levels. One social: the vastly complex material and social world that humans have built for themselves, *and which humans collectively can rebuild or revise*. Another that is much more alien and surprising: the physical world which human understanding has tried to formalise as physics, geology, chemistry, biology etc. These persist and apply to our lives, *whether we want to believe in them or not*.

This second world includes many more possibilities than are expressed in the tiny bubble of biosphere that our lives depend on. People who've not been educated in science tend to badly misunderstand it, importing ideas

from the human and social world to a domain where they do not belong. Even biologists will occasionally ask about the *purpose* of some group of plants or animals, or some biological adaptation. Their own evolutionary science tells them it is all down to Natural Selection, where things that are good at self-preservation tend to survive, with no reason or purpose beyond the fact that they can. A sense of purpose exists only among humans, and maybe also some of the most clever animals. Inanimate objects exist just because they happen to exist. Plants, animals and other living organisms appear clever at self-preservation, because biological systems that mindlessly show this apparent cleverness remain in existence for us to observe.

Evolution in the strict sense is an exceptional and lucky outcome of Natural Selection. The *normal* product of Natural Selection is change without notably progress, Organisms slowly becoming better at living the type of life they already live. Getting a tighter grip on their 'ecological niche', in the language of biology. It would be better to speak of Biological History, with 'evolution' in the sense of progressive development recognised as a very small part of it.

The particular outbreak of Evolution that led to humans is a remarkable story. We are naturally more inclined to talk about it, just as an individual would tell their own story if they'd participated in World War Two, or in 1960s radicalism, or some other set of events much larger than them and largely independent of them. This is fine so long as we map our personal experiences onto wider events. But we must also remember that our own story is just one of many.

World War Two and 1960s radicalism were obviously driven by rival patterns of human culture and intention. Biological History shows every sign of being purposeless: something that only accidentally let us emerge. The same is true of the vastly older history of the solar system, and the entire universe before that. There are also respectable theories of cosmology that say that our universe is suitable for life only by accident. That it co-exists with uncountable numbers of universes with different physical laws and where life could never have developed.

(It is hardly a fluke that we should around to notice our existence, rather than not being around to somehow notice our non-existence: it is surprising how many thinkers get confused over this simple truth. By analogy, if someone has had a huge win at gambling, this does not mean that large gambling wins are likely. Here indeed the matter is stronger than in the natural world: casinos are run by clever humans who accept the necessity for winners so as to lure in vast numbers of losers. Those losers fund both the exceptional winners and the highly profitable operation of the casino. They go there and lose, because they believe that they are among the few destined to win.

(In the apparently purposeless natural world, we *might* be living in a universe that somehow *required* life to exist. Or a universe make by some powerful but callous intelligence, willing to create a universe full of random suffering. I doubt both these viewpoints, but they remain sensible options that might turn out to be true.)

Below the level of the entire universe and its cosmological mysteries, we can be confident about the truths that science has learned since it took off in the 17th century. Facts of science remain facts, regardless of human opinions. They were facts before humans emerged as the lucky little exception in an otherwise purposeless natural world. Nature rambles and the moon don't care.

Confusion between the natural world and the human world can also lead to something much more serious. Far too many people think that it is scientific or objective for people to treat each other as if they were objects to be used. This error gets made by scientists and those well educated in science. It is the inverse error to the error of seeing Natural Selection etc. as purposeful. I'll explain in a future article why such thinking is deeply mistaken.

What's God Got To Do With It?

Two levels for living in the world. Some people would add a third level, a 'spiritual' or metaphysical level which all else depends on. Yet wherever such notions led to claims or opinions that have been testable, religions have turned out to be wildly wrong.

Theologians sometimes boast that they had already asked questions about the whole nature of the universe, before the cosmologists got there. What they don't mention is that they almost always got a completely wrong answer. And not even the *same* wrong answer: a theologian's 'truth' mostly derived from the religious tradition they had been raised in.

Christian theologians originally believed in a universe that was absurdly small and young, rejecting some sensible Pagan Greek notions

on the matter. Hinduism and its Buddhist and Jain offshoots were superior in seeing the world as enormously old. But by playing with large numbers that reduced everyday life to insignificance, they sometimes went way beyond the age of the known universe.

More importantly, no one in any religious tradition imagined that the Earth might have had enormously long periods of existence with land-plants and animals, but no humans or other intelligent creatures. Such a thing would be purposeless, and for them the universe could not be like that. Yet we know from science that something of the sort has existed for about 470 million years, with a more alien but equally purposeless world before that. And if humans go extinct, this purposeless natural order may well continue for the hundreds of millions of years for which the Earth is expected to remain habitable.

(The upper limit to a habitable world would be the sun running out of hydrogen at its core and becoming a Red Giant star, four to five billion years from now. But we know from physics and from observations of other similar stars that it is also getting steadily brighter. This could cause more evaporation, more water-vapour in the air, and it is a greenhouse gas. In maybe a billion years, it could end with the oceans boiling away and the planet becoming uninhabitable for anything except some of the tougher bacteria and archaea.[1]

(Note that this is distinct from the lesser crisis of Climate Change, which is already serious. Which might become drastic within the lifetimes of the young. The current changed could well drown many coastal cities. Might entirely wreck our civilisation.[2] But the worst forecasts would not take the world beyond extremes of heat that it has been through before. The world would remain habitable. Almost certainly some humans would survive to rebuild after such a disaster. But a world in which all humans perished could also carry on just fine without us.)

Looking back to the Deep Past: the slightly less alien world of Jurassic and Cretaceous dinosaurs which existed contentedly from 200 million years ago to their spectacular extinction 65 million years ago. Mammals emerged as a distinct type of animal at about the same time as the early dinosaurs. Reptiles ancestral to mammals and distinct from dinosaur relatives had at times dominated land life. But in a straightforward competition, the dinosaurs won easily. Mammals remained insignificant until a cosmic accident conveniently removed the dinosaurs and all of their close relatives, apart from birds.

The first creatures that might be called human appeared less than 3 million years ago. To judge from the slow development of sophisticated stone tools, our ancestors before half a million years ago had inferior minds. Would seem moronic if we had a time machine and could talk with them.

Religions sometimes had notions of a formless chaos before the world we know it emerged. But it never occurred to them to imaging a world entirely suitable for humans to live within, and yet without humans or other intelligences for the vast bulk of its existence.

So if religions are wrong, why do we have them? My answer is that religions are highly suitable for letting enormous numbers of humans live together without intolerable violence. Lets us to walk peacefully among complete strangers, which is not possible among any of the social animals. Not possible even among most tribal humans, unless you arrive with signs of being vastly more powerful and are also a known source of valuable gifts.

Humans with something like the modern concept of deities and temples show no signs of having existed before the first agricultural societies, some 10,000 years ago. What probably existed before that was the muddle of superstitions, ancestor-worship and fear of imaginary monsters found in modern tribal societies. Tribes are normally suspicious of each other, with war being the standard relationship and peace requiring careful agreements.

Unlike Professor Dawkins, I do not see religion as some bizarre parasite that was inflicted on 'rational' humans. People who presumably would otherwise have lived spontaneously according to Professor Dawkins's slightly old-fashioned notion of rationality. I know history, so I know that the modern Europe's notion of rationality is a grand innovation that grew out of Christianity. And I see ancient religions like that of the Babylonians and Pharaohs and Classical Greeks as bringing a degree of order and rationality to the superstitious muddle that is the default human understanding.

I also don't lump the various religions together. I accept the standard notion of a further huge advance in the 6th and 5th centuries before Jesus Christ, with waves of

[1] https://en.wikipedia.org/wiki/Runaway_greenhouse_effect#Earth

[2] https://en.wikipedia.org/wiki/Runaway_climate_change

religious-philosophical ideas in Greece, India, China, and maybe also Persia. (Zoroaster as a religious reformer might have lived then, or might have lived centuries earlier.) It would have been just about possible for a single individual to have seen many of the major figures within a standard lifetime. Gore Vidal in a highly readable novel called *Creation* imagines just that, though he omits the Hebrew prophets[3]. Imagines a Persian/Greek grandson of Zoroaster, who is sent east as an ambassador. Who encounters Buddha, Lao Tzu, Confucius, and other lesser-known or part-fictional thinkers. Also Socrates as an incompetent stone-mason and the early materialist Democritus as his grandson. It can be inaccurate, particularly about early China. But it gives you a vision of what was going on.

Why did all of these thinkers emerge? Did ideas flow along the trade routes that we know existed? Were there perhaps hundreds of unrecorded names, along with the handful of famous thinkers? We know of a scattering of other names, from polemics against them by the famous names. This includes some materialists and some who perhaps were close to modern scientific thinking, though we can only guess at their views based on the fragments we have. Regardless, human thinking was changed fundamentally.

One could sensibly think of this as a Second Wave of religion and religious philosophy, merging with and partly replacing the First Wave religions that had regularised tribal beliefs. And this Second Wave was notable in laying down general obligations to be kind and just, whereas the gods and goddesses of First Wave religions were just as emotional and fallible as human beings.

It is also notable that the creeds that won out assumed a hierarchy of wealth and power. That they merely urged superiors to be nice to inferiors. Hinduism, Jainism and Buddhism also have a category of religious specialists practicing Holy Poverty: but they sit outside the hierarchy of wealth and power. They do not really challenge it, even when pure and un-corrupt. And a lot of them do get corrupted and become part of the ruling class, of course. This was particularly true of Tibetan Buddhism, where monks could eat meat[4] and practice non-penetrative sex with teenage boys.[5] But even the uncorrupted forms saw the world as an illusion. In as far as they were concerned with social justice, it was justice within an assumed hierarchy of inequality.

In my view, a Third Wave occurred with first Christianity and then Islam. Christianity emerged out of the once-obscure religion of the Jews, which had impressed its neighbours ever since the successful Jewish revolt of the Maccabees. (A revolt against one of the Greek-dominated states created by Alexander's successful conquest of the Persian Empire, which had provoked them by trying to impose Greek values incompatible with their faith.) Judaism had great intellectual clarity compared to Greek religion. But it also included many survivals of ancient tribal oddities, such as circumcision and some vastly complex and awkward rules about what you could eat. And some of the Hebrew prophets had taken the side of the poor: but the dominant powers in the religion accepted hierarchies and just asked the rich to be generous and well-behaved.

Christianity was originally a creed of total collectivism and economic equality of believers – though there was great inequality of authority, and all authority was male. It also initially retained Judaism's ancient tribal oddities: but as revised by Saint Paul, it was happy for non-Jewish believers to drop these customs. This proved a winner. An official and corrupted version of Christianity became dominant in the Byzantine Empire.

The second half of the Third Wave came when Islam emerged under Christian and Jewish influence – regarding itself as a purified and corrected version of what Jesus had originally taught. It gained vast importance, because it was the creed of a wave of Arabic-speaking tribalists. These tribalists repeated an ancient and world-wide pattern whereby tribalists from fringe areas overthrow exhausted and corrupt empires and impose something of their own way of life. But unlike earlier invaders, and unlike the later Mongols, they also brought with them a wholly new world-view.

Both of these new creeds included a radical notion of equality for all men (though not women, who were protected but kept subordinate). That is something that wasn't really there in the 'Second Wave' religions. Hinduism, Buddhism and Jainism had poverty and equality for its monks and nuns, but

[3] Most were earlier, but some overlap. See https://en.wikipedia.org/wiki/Timeline_of_the_Hebrew_prophets

[4] https://gwydionwilliams.com/42-china/tibet/the-truth-about-the-dalai-lama/#_Toc417132737

[5] Detailed in *The Struggle for Modern Tibet*, by Melvyn Goldstein, William Siebenschuh and Tashi Tsering.

normally didn't question inequalities among those outside the religious life. Those creeds could be seen as endorsing them as differences based on good or bad deeds in the previous lives that everyone was supposed to have lived. By contrast, both Christianity and Islam include a possible tension and radicalism. And insisted that there was just one life followed by Heaven or Hell – but that part of the belief was old, going at least as far back as the very hierarchical religion of Ancient Egypt.

These new 'Third Wave' creeds also lacked the sharp split between intellectual and physical work that older creeds had expressed in practice, whether or not it was the original belief. This split was particularly acute in China. Traditional China was a land of many inventions, but most artisans were illiterate. Most intellectuals had a very strong aversion to any sort of manual labour. Christianity saw no contradiction between being learned and being skilled with your hands.

Modern science with its Experimental Method and its insistence on a single discoverable body of solid facts emerged from Christian culture. it was not initially anti-religious: Galileo and Newton were devout. So too was Robert Boyle, a pioneering chemist and physicists who was also a sincere Anglican. Scientists mostly stopped being religious, when their science showed them a universe that remained mysterious, but was very clearly different from the Earth-centered universe described by conventional religions.

For Christians and also for Jews, there were also vast problems raised when the Sacred Texts were looked at with the same sort of analytical methods that had found rationality in the natural world. It became clear that the Sacred Texts were a muddle of semi-accurate history and historic fiction that had been worked and reworked by many different authors. The *Book of Genesis* was an amalgam of at least two separate accounts that used different names for the Hebrew God and often had similar but significantly different accounts of the same event. Humans were created in large numbers on the Sixth Day of Creation, and also as Adam followed by Eve created alone in the Garden of Eden: with no explanation as to who their sons might have married, or who was supposed to be warned by the Mark of Cain. And later on, Noah took two of every animal, and also Noah took seven of every *clean* animal.

Many such contradictions existed. They make sense as two different Sacred Histories compiled together in some unrecorded Historic Compromise between rival traditions within the Hebrew faith.

For Christians, Protestants preachers had already shown that many of the traditions of Roman Catholicism were not based on the Bible. This included the existence of a Christian priesthood: the early Christians had recognised no priests other than the corrupt priesthood of the Jerusalem Temple, whom however they still viewed as valid pending a proper cleansing and reform of the Temple. A majority of Protestants didn't care to follow the logic of this: they rejected the Pope but kept both priests and bishops. (Officials called episcopes, 'overseers' or 'guardians', did exist: but they were very different from the high officials that bishops became.) A minority of Protestants dropped the names of priest and bishop and much of the system, with power mostly being transferred to preachers with skills in oratory.

Almost all Protestants made the error of transferring Jewish Sabbath rules to the Roman Sunday, which both Late Roman Pagans and Dark-Age Christians had treated as a day of celebration and worship. The Jewish Sabbath is Saturday: but for Orthodox Jews the day begins at sunset. You find them going home early on what Christians regard as still Friday, and out again on what people raised in the Christian tradition would regard as Saturday evening. Of course this is not *really* a Christian tradition: it was something that Christians absorbed from the Roman Empire, whose month-system with its pagan deities and deified emperors we still use.[6] But the continuous arguments between Protestant and Catholic and the additional arguments among rival Protestants spread doubt.

The destructive nature of the 17th century Wars of Religion and the lack of any clear outcome helped convince many of the ruling class that it was all nonsense. Nonsense useful to keep the lower orders obedient, as Edmund Burke noted, though he put it more politely and evasively in his published works. Hence the European Enlightenment – which mostly involved the privileged and was not originally intended to be democratic. Enlightened Despots who ignored the ignorant views of the majority were the preference of most Enlightenment thinkers: some of them still seem to think this privately.

(Note also that an Enlightened Despot is a very different being from a Populist Dictator,

[6] See *Appendix B* for details

who would claim to be the true representative of the will of The People, and may actually be such. Enlightened Despots were generally monarchs: Populist Dictators are mostly from very ordinary beginnings. Either or both may rule in a way that broadly pleases a majority, whereas mutli-party elected governments can get deadlocked and produce nothing that anyone much wanted.)

We needed religion as part of the process of becoming better humans: humans who more fully expressed our human potential. We are in an era of outgrowing the need for religion and of raising the human potential to new heights – probably not the highest obtainable. But to carry out our current tasks successfully – and to avoid the negatives introduced by excessive reliance on money, profit and power – we need to work out what was mistaken in the old creeds, and what was correct.

Many post-Christian thinkers have an unrealistic belief in the efficiency of privatised violence and trickery. Such methods can give individuals an unfair advantage over their rivals, if applied with a cleverness and modesty. (A modesty that is very often missing.) But even when the tricksters get just what they want, the society as a whole will be damaged by them. I will deal with this at length in a future article.

We current have problems with shifting our moral codes during an era of massive transformations. Religions mostly get in the way. But this is no reason to ignore the usefulness of religions in past eras. Radicals have a coherent program of shifting to a new moral code that is relaxed about sex but still strict about honesty, kindliness and duty – wanting in fact to extend those things. Sadly, the New Right has dominated since the 1980s. It has accommodated sexual freedom by letting everything drift and suggesting than no morals are needed. Their cherished phrase *laissez fair* could be translated into 'let things drift': and this is certainly what it has meant in practice.

Professor Dawkins is assuredly part of the New Right. If he didn't want to be lumped with them, he should have refrained from making loud-mouthed condemnations of 'the Left', mostly ignoring the vast range of existing left-wing opinions.

I see Professor Dawkins as fitting the classical remark about there being a variety of atheists who doesn't so much disbelieve in God as personally resent Him. His own attitudes could be disputed. But I found just this sentiment unambiguously expressed by George Orwell, who said of his early schooldays:

> "You were supposed to love God, and I did not question this. Till the age of about fourteen I believed in God, and believed that the accounts given of him were true. But I was well aware that I did not love him. On the contrary, I hated him, just as I hated Jesus and the Hebrew patriarchs. If I had sympathetic feelings towards any character in the Old Testament, it was towards such people as Cain, Jezebel, Haman, Agag, Sisera: in the New Testament my friends, if any, were Ananias, Caiaphas, Judas and Pontius Pilate. But the whole business of religion seemed to be strewn with psychological impossibilities. The Prayer Book told you, for example, to love God and fear him: but how could you love someone whom you feared ? With your private affections it was the same. What you ought to feel was usually clear enough, but the appropriate emotion could not be commanded. Obviously it was my duty to feel grateful towards [his school teachers] Flip and Sambo; but I was not grateful. It was equally clear that one ought to love one's father, but I knew very well that I merely disliked my own father, whom I had barely seen before I was eight and who appeared to me simply as a gruff-voiced elderly man forever saying 'Don't".[7]

Fourth-Wave Beliefs

Having grown tired of resenting God, who was anyway unfashionable among the people he'd have mixed with, Orwell shifted his emotional core to a deep-down resentment of Joseph Stalin. Everyone agrees that the vision of *1984*'s dictator as a strong-faced man with a moustache was inspired by Stalin. What I suddenly noticed was that it would also fit Orwell's father. Not a *strong* resemblance, certainly. But the man's superficial similarity to Stalin as ruler of the Soviet Union was stronger than to any other major political figure that Orwell might have been concerned with.[8]

From the standard view of Orwell, you might have expected him to have hated Hitler and Mussolini at least as much as he hated Stalin. Plenty of others had exactly those feelings. But Orwell was surprisingly soft on the Fascist dictators:

> "I should like to put it on record that I have never been able to dislike Hitler. Ever since he came to

[7] Orwell, George. *The Collected Essays, Journalism and Letters of George Orwell* Volume 4. Penguin Books 1970. Page 412

[8] Poland's Pilsudski also vaguely resembled Orwell's father, but he had died in 1935. I don't think Poland ever interested Orwell.

> power — till then, like nearly everyone, I had been deceived into thinking that he did not matter — I have reflected that I would certainly kill him if I could get within reach of him, but that I could feel no personal animosity. The fact is that there is something deeply appealing about him."[9]

When the anti-Fascist war was clearly won, he said:

> "If it were left to me, my verdict on both Hitler and Mussolini would be: not death, unless in is inflicted in some hurried unspectacular way. If the Germans and Italians feel like giving them a summary court-martial and then a firing-squad, let them do it. Or better still, let the pair of them escape with a suitcaseful of bearer securities and settle down as the accredited bores of some Swiss pension. But no martyrizing, no St Helena business. And, above all, no solemn hypocritical 'trial of war criminals', with all the slow cruel pageantry of the law, which after a lapse of time has so strange a way of focusing a romantic light on the accused and turning a scoundrel into a hero."[10]

Both men had done enough to have merited a death penalty by 1940s standards. Various less-guilty subordinates were indeed executed, with general public approval. Britain even hung the pathetic 'Lord Haw-Haw', William Joyce. Joyce was hung for treason against Britain, despite having being born a US citizen and never a British subject. Despite having clearly and publicly switched his allegiance to Germany well before the war started. Joyce should indeed have been allowed to lapse into obscurity and ridicule, since most Britons had found his propaganda broadcasts comical. But at a time when ordinary murderers were regularly executed, sparing either Mussolini or Hitler would have been absurd.

As it happened, none of the dead fascists became martyrs to any significant number of people. The vast successes of the post-1945 world discredited them with all but a right-wing fringe. And this era of success very much included the Soviet Union; the Soviets only started to weaken and fall apart when they bungled a series of reforms attempted from the mid-1950s to the late 1960s. When they then opted for timid stagnation under the suffocating regime of Leonid Brezhnev. Before the 1970s, when the Soviet Union had launched Sputnik and then put the first man into space, it seemed part of the brilliantly successful modern world. By any reasonable reading of history, it was indeed just that.

Reasonable readings of history are inhibited by the intellectual dominance of the official line taken by almost all Western Marxists since 1956. The ruthlessness of Stalin's policies are presented as quite pointless, rather than a reasonable reaction to a situation of extreme danger. Success supposedly happened despite Stalin rather than because of him. But there was no apology for other forms of ruthlessness, including the crushing by Lenin of all opposition, including non-Bolshevik socialists. This intellectually weak position was easily demolished by Solzhenitsyn, who showed the strong continuity in *The Gulag Archipelago.*

Had Soviet success happened despite Stalin rather than because of him, you would have expected anti-Stalin Leninists to have had many successes once freed from his baleful influence. In fact they have been notable for frittering away the extremely strong position which they had when Stalin died in 1953. Virtually every movement they have been associated with since then has also withered and died. The main exception has been South Africa, where Communist influence on the ANC was always strong. But Nelson Mandela managed to think out his own independent political position: one which seems little concerned with Stalin or the Leninist heritage.

It is notable that the Chinese leadership from Deng onwards never repudiated Stalin, though they say his China policy was mistaken. They retain Mao as the symbol of their rule, while saying he was mistaken in his attempts to democratise the system with the Great Leap Forward and then the Cultural Revolution. President Xi seems to be strengthening the continuity with Mao.

Another possible conclusion would be that Stalinist ruthlessness was excessive despite the dangers. Or that the broad aim of a Wellsian socialist world state was not the best possible aim. You can think coherently on that basis: it's a matter of how you think the broad flow of 20th century history would have gone. How it might have been without Stalin or someone very much like him. Myself, I think that anyone milder or more tolerant would have been much more likely to lose the war.

If some time traveller could remove Stalin, they would most likely create a Fascist future that we would probably still be living in. Most likely the United States would have remained unconquered, but would have been unlikely to drop the racial segregation that Roosevelt did

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[9] Orwell, George. *The Collected Essays, Journalism and Letters of George Orwell* Volume 2. Penguin Books 1970. Pages 28-9. Review of *Mein Kampf*, March 1940.

[10] Ibid., Page 369. October 1943.

little to change: might have moved closer to a triumphant European fascism. And it would be interesting to do a survey of whether people would encourage or discourage such a time traveller, supposing such a thing were possible. (Which I strongly doubt, but it makes for an interesting thought-experiment.)

What about the failure to realise a Wellsian socialist world state? It would have avoided a lot of human suffering had it come off. But in the wider sweep of history, I see it now as no bad thing. There turn out to be better options: the prospect of a more pluralist world in which human diversity can be more fully explored.

I now think of Marxism and Leninism as part of a much larger Fourth Wave of beliefs. A shift in consciousness that began with the European Enlightenment, and is still on-going. A collection of creeds, mostly atheist but sometimes deist, that are upgrading our view of the world in the way that religion used to do. Marxism was not the *Final Answer*, as many people once believed, including myself. Yet it was an amazingly successful philosophical creed. In its Leninist form, it was able to get world civilisation back on track after mainstream politics had derailed it with the First World War. Leninism alone had both the power and the will to defeat Fascism, an alternative and malignant Fourth Wave philosophy that was frighteningly viable.

(Thankfully, attempts at a revived Fascism have come to little. The changes made after World War Two shifted mainstream human consciousness away from anything they can relate to. Right-wing success has come from very different belief systems. The New Right and Libertarianism in the West, and a revival of a surprising blend of modernism and a narrow version of traditional beliefs among Muslims, and also among Hindus.)

Seeing Marxism and Leninism in that light, it becomes obvious what went wrong in the Soviet Union. You can't suddenly reshuffle and redefine your cultural heroes and expect popular belief to remain strong and honest. I'm sure that most Soviet citizens wanted some sort of relaxation after Stalin's death. But suddenly changing Stalin from hero to villain was a blow against the faithful. Suggesting that he was a bungler who inflicted needless suffering on his people cast everything else into doubt. Suggesting he only accidentally destroyed the previously-undefeated German war-machine was *demoralising*, in all senses of the term.

It also made no sense to claim a gigantic difference between the Soviet Union under Lenin, the Soviet Union under a leadership team including Stalin and then finally the Soviet Union under Stalin as undisputed leader. All of them were repressive, as Solzhenitsyn neatly demonstrated. But the positive achievements were largely made with Stalin in charge, and Solzhenitsyn's overall position made little sense. Solzhenitsyn felt that Russia should have turned its back on the West, but could not sensibly explain why this failed to happen under Tsarism. Nor why the Bolsheviks went from being a small hard-left party to the dominant political force during the crisis of defeat in war and the overthrow of Tsarism.[11]

When Solzhenitsyn lost faith in Marxism, he reverted to Orthodox Christianity, a Third Wave creed that had successfully avoided making any adjustments to the modern world. This made him more coherent than the anti-Stalin Leninists. And Orthodox has been a useful creed to satisfy the populace while the elite believe something else. But it's not great for understanding the modern world.

Remarkably, no Soviet citizen was allowed to dispute Solzhenitsyn's viewpoint on a sensible basis while the Soviet Union still existed. No one could write from a viewpoint that was not blindly hostile to Stalin, or else obviously evasive. The norm was to pretended he did not matter, which was ridiculous. Only after the fall of the Soviet Union did debate become free, and then it was decisively won by those who saw Stalin as a hero of Russian history. Almost all Western commentators find this baffling. And they seem content to say 'it's baffling'. rather than wondering whether there might be some logic to it.

You'd have thought that the decay of the post-Stalin Soviet Union and the flourishing of post-Mao China would be a strong clue. But the combined influence of Trotskyism and Khrushchev were wonderfully successful in impressing their vision on the Anglosphere's intellectuals. They also managed to thrown away the enormously strong position that the Marxist left once possesses: yet people seem unable to break free of their legacy.

Of course the Soviet Union in the late 1920s and 1930s did itself no good by casting Trotsky out of the newly-created pantheon of Revolutionary Heroes. It was absurd to deny that he'd been enormously useful and successful when taking orders from Lenin.

[11] He's also been accused of anti-semitism: I'll discuss this in a future article.

They quite sensibly have portrayed him as a vain and ambitious man who refused to work with others. A man who would not accept the disciplined politics of Leninism, where Oppositionists were expected to keep quiet between the five-yearly Party Congresses.[12] Instead they portrayed him as a cartoon villain, and lost some of their most intelligent early supporters. Still, it was Stalin's version of Leninism that had the main historic achievements. The hopeful attempts to develop a New Left in Western Europe and the USA was tragically swamped by the remnants of versions of Leninism that were out of touch with reality.

Model yourself on losers in the power-game and you too will lose. It's as simple as that.

To get back to what's wrong with religion, both Second-Wave and Third-Wave. It never occurred to even the most advanced religious thinkers that there might be entire worlds that have either no life or nothing more than microbial life. For that matter, I don't think they had the least notion that microbial life even existed, even though risks of infection were the rational basis for Hinduism's complex rules of cast and pollution in a hot and unhealthy climate. Nor could the Devout have accepted that there were vast areas of knowledge that operated by alien rules. Vast parts of the universe that were unrelated to their moral values, or anyone else's moral values.

Religion offers answers to the riddle of human existence. For purely human matters, it often has useful things to say. On matters of sex and the status of women, what it says no longer suits, and people get baffled as to why these views were ever held. But here, a knowledge of science and history helps. Before modern medicine and hygiene, it was a tough struggle for an individual kin-group to ensure the birth and survival to adulthood of enough babies within the group to keep up and perhaps expand their numbers. City-dwellers tended to produce less surviving babies than there were adults. Their numbers shrank, and they depended on new arrivals from the countryside: particularly in Europe where Christianity during the Dark Ages had come to see cleanliness as morally doubtful. But in both city and country, tying women to child-raising did produce more babies and more healthy adults than a more liberal creed could have managed. Likewise an intolerance of homosexuality and strong social pressure to marry helped each individual kin-group to expand its numbers.

Even in modern times, it tends to be the more religious who have large families and have the possibility of outbreeding the rest. But in Europe and the USA, the religious often breed new recruits to militant atheism. Religion continues to decline.

Most traditional religions also kept education for a few selected males. They excluded almost all females. This is one point on which Protestantism and in particular its main Puritan varieties had an advantage. They expected their women to be subordinate: but women were also encouraged to read and write and become knowledgeable about those subjects deemed fitting for them. They could attend public lectures on any topic considered respectable, which was a useful source of income for many impoverished men of learning. Not many women managed to get beyond this and make useful contributions in their own right. But they formed a body of opinion useful to the spread of science.

(Novel-writing was a notable exception to the exclusion of females from serious thinking. But even there, a lot of lady novelists used male names, or else initials that did not give away their sex. All three Bronte sisters did this. And weirdly, the works of Mary Ann Evans still appear under her pen-name George Eliot, used because she feared that works by a recognisable female would not be seen as intellectually serious. In our own time, the Harry Potter fantasy-novels of Joanne Rowling appeared as J. K. Rowling, because the publisher thought fantasy works would be less popular with a visibly female author.)

Women were for a long time hampered in their efforts to personally contribute to the growing world of science. But if they were individually frustrated, their sons had the great advantage of having educated mothers, aunts and sisters. Women who passed on to them a modern view, rather than the superstitions that burdened most societies. Paved the way for the rise of both science and Fourth-Wave philosophies, which tend to go together. Individual scientists may have almost any political opinion, but as a group they have been far more on the left. Far more positive towards educated women than the bulk of the society. Also far more inclined to skepticism or atheism than people with no education or a non-scientific education.

For scientists, the core facts were not reconcilable with Faith. On matters of the Earth, sun, planets and stars, traditional

[12] See https://gwydionwilliams.com/history-and-philosophy/why-trotksys-politics-achieved-nothing-solid/

religions were flatly wrong. Likewise on the mysterious vast ages of the universe before our own solar system and planet were formed.

Within science, physicists often incline to Theist or Deist views. Biologists are much more likely to be atheists and militant materialists. I'd see this as reflecting the surprisingly harmonious design of the universe as a whole. The mess and muddle you find among and within living organisms.

On the wider universe, religions gave answers to the same questions that science is now asking, but not *useful* answers. Anyone can give the *wrong* answer to a complex question. If you asked me, I could give you an entirely random and unreliable forecast for the likely winner of an upcoming horse race or major sporting fixture. I could give you a thoroughly wrong prediction of the likely winners of the next set of Oscars, or Nobel Prizes, or anything else where I lack useful knowledge. But of course I don't do this, and anyway no one would listen if I did.

(I actually make predictions mostly on politics and occasionally on science, where I think I know something useful.[13] Among other things, I was one of those who predicted the failure of the intervention in Iraq when it seemed to be succeeding. I said "*nothing [in Iraq] is closer to the Western viewpoint than Saddam*".)[14]

Philosophy detached from the study of the material world hasn't been very useful. Classical Greek thinkers included people with a notion of both atoms and of planets going round the sun: Plato and Aristotle rejected both and got them excluded from respectable thinking. Aristotle also mentions someone who had ideas about biology that were close to the modern notion of evolution: but once again he pushed aside a correct idea in favour of what he wanted to believe. Most supposed 'spiritual values' have an uncanny similarity to wishful thinking.

An accurate knowledge of our physical existence is important for understanding everything else. So please follow me while I continue to outline the differences between these two domains of existence. If you don't know at least the basics of the physical world, you could easily be fooled by the whole 'Post-Truthful' viewpoint that is so fashionable nowadays. The nonsense that is enthusiastically pushed by those who only familiar with their own little section of the human social world.

(Itself just one of many possible social worlds. Something that people have built to adapt the existing material and biological world to their varying needs and desires.)

[13] You can check my monthly comments from as far back as 1998 https://gwydionwilliams.com/newsnotes-historic/.

[14] https://gwydionwilliams.com/history-and-philosophy/10-2-further-ideas/reflections-on-the-start-of-the-iraq-war/

Muons as Miracles

I began with the brief life and strange death of a single muon. I'll now repeat that story in more detail. And with reliable references for the these hard-to-believe events.

On the edge of space, a naked proton that has wandered the universe for hundreds of millions of years manages by a statistical fluke to pass through the relatively tiny target that is the Inner Solar System. The average distance of the Earth from the Sun is 8.32 light-minutes: gaps between stars are typically three or four light-years in our region of the galaxy. The Inner Solar System is 0.0000000174% of the stellar neighbourhood, or about than 1 in 5,760 million.

It is rare for an individual wandering proton to pass through the Inner Solar System. Even more flukish for it to happen to hit our planet. The Earth viewed a circular target is just 0.000000000659% of the Inner Solar System, or less than 1 in 157 billion.[15] And yet free protons manage to hit us all the time. They do this because they exist in enormous numbers, despite space being a better vacuum that the one you'd find in the vacuum flasks that we use to keep drinks warm. Atoms are *small*. Vast numbers of them exist in what is a vacuum from a human viewpoint.

Our everyday world contains far more atoms than most people realise. A litre of water contains 130,000,000,000,000,000,000,000,000 atoms.[16] A litre of air at the Earth's surface contains 26,520,000,000,000,000,000,000. Outer space, though relatively empty, still contains enough free particles for some of them to hit us.

This proton – identical to the atomic nucleus of an atom of ordinary hydrogen, but in this context called a Cosmic Ray – slams into the atmosphere at very high velocity. It hits the nucleus of another atom that is part of our atmosphere. Which atom it hits barely matters: proton meets proton with enough energy to disrupt or abolish the unobservable quarks within each proton.

The velocity of cosmic rays vary a lot,[17] but can come close to the speed of light.[18] Let's say that this one comes in at about 200,000 kilometres per second. That's a speed way outside of human experience: the famous supersonic Concorde aircraft flew at less than one kilometre per second.[19] Humans returning from the moon broke all previous speed records by moving at just over 11 kps. Cosmic rays – which are various things, but most commonly protons – go a lot faster than

[15] See Appendix A for details of my calculations.

[16] http://www.wolframalpha.com/input/?i=how+many+atoms+are+in+a+liter+of+water

[17] http://helios.gsfc.nasa.gov/qa_cr.html#crvel

[18] The speed of light in a vacuum – actually a much deeper constant that photons are obliged to confirm to – is nearly 300,000 kps. 299,792.458, to be exact.

[19] One kps is 3600 kilometres per hour. Concorde's top speed was 2,179 km/h.

that.

The result of the proton-proton collision is an infinitesimal moment of pure undefined energy, similar to the very first moments after the Origin Event (Big Bang). Then it transforms into something more regular: specifically, a bizarre particle called a pion. The pion rapidly decays into something stranger but less unstable; a muon, along with a neutrino.

The neutrino will almost certainly pass undisturbed through the entire solid Earth and out into interstellar space, most likely never again encountering normal matter. The muon will pass through the atmosphere; pass through you if you happen to be in the way. Solid rock or metal will occasionally stop it, but mostly not. It will normally perish deep underground, not because it hits anything but because it is unstable. Its proper lifetime is 2.2 microseconds, but its speed is close enough to light-speed that time slows for it: from our viewpoint it lasts much longer. The muon that derived from a pion that derived from an impacting cosmic ray will end its brief existence by becoming an electron and two more neutrinos.

How often does this happen? Continuously. Some ten thousand muons reach every square meter of the earth's surface every minute. Each has an energy of more than a hundred million electronvolts.[20] But don't let that worry you: the kinetic energy of a single flying mosquito is much larger, a full trillion electronvolts.[21] It would take the entire energy of a million million muons to light a modern bicycle lamp for a second.[22] Muons and other subatomic particles are amazingly tiny. Muons from cosmic rays are part of the background radioactivity that we evolved with. Radiation that sometimes damaged the DNA of living creatures and caused random mutations, a few of which were useful for the eventual emergence of complex life and then ourselves.

It is possibly that without muons or something similar, we would not be here. There are of course other sources of radiation: one is ordinary potassium, which makes bananas measurably but harmlessly radioactive. It might be that the extra radiation from muons was necessary to tip the balance in favour of complex life. More probably not, but no one truly knows.

Muons must have existed ever since the universe became cool enough to allow them. (They can be created by other processes besides the one described above.) But they made no sense before the Standard Model of subatomic particles was put together in the 1960s and 1970s. Until then they were an oddity. An anomaly that produced the famously comic comment 'Who ordered that?' from a noted subatomic theorist.[23]

No one 'ordered' the muon: it was unexpected and unwanted. As surprising as if a dish of fried rabbits-ears arrived at the table of a group of British or US friends having a celebration in a Chinese restaurant.[24] But restaurant dishes only appear if the menu offers them and then someone orders them (unless the restaurant is pulling a spoof). That's human culture: muons come from the other side of reality, the things that existed long before we did. Things which are also utterly independent of our observations, and would be exactly the same if we had never existed.

Some aspects of subatomic physics have been interpreted as meaning that they require a human observer to be real: I'll go into this in detail later on. For now, I want to emphasise that many things in subatomic physics were not looked-for or expected. Yet they were real. They forced themselves into our vision of reality by their surprising and mostly unwelcome existence.

Dragons and Cheshire Cats

What about dragons? Dragons, green or otherwise, are a peculiar notion arising from a number of interacting human cultures. For no clear reasons, they are much the best-known of a vast number of chimeras that we have imagined. Creatures that blend the real features of several actual animals, and which are mostly given near-human minds.

Attempts to put dragons on a scientific basis are ridiculous. They are nothing like the fearsome two-legged flesh-eating dinosaurs that perished a very long time before we emerged.

In English, if we wish to talk of a dragon that is both green in colour and large in size, we would call it a 'great green dragon'. Native speakers who are past childhood would never call it a 'green great dragon', as Professor Tolkien once did while still quite young. His mother corrected him, as he describes in his letters:

> "I first tried to write a story when I was about seven. It was about a dragon. I remember nothing about it except a philological fact. My mother said nothing about dragons, but pointed out that one could not say 'a green great dragon', but had to say 'a great green dragon'. **I wondered why, and still do**. The fact that I remember this is possibly significant, and I do not think I ever tried to write a story again for many years, and was taken up with language."[25]

Thanks to mothers and others, native English-speakers grow up able to reject phrases like *'a green great dragon'* as wrong. They would do this without hesitation – but would almost always be unable to explain just *why* it was wrong. It 'sounds wrong': they could put it no more clearly than that.

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[20] https://en.wikipedia.org/wiki/Muon as at 24th July 2014.

[21] https://en.wikipedia.org/wiki/Electronvolt, 21/7/2014.

[22] http://www.quora.com/How-large-is-an-electronvolt-expressed-in-terms-of-something-more-familiar

[23] Isidor Isaac Rabi, Nobel Prize winner in 1944.

[24] Fried rabbits-ears are a real Chinese dish, served in China at grand banquets. I doubt I'd eat them, though they are said to be tasty.

[25] From a letter to W.H. Auden, 7 June 1955. Published in *The Letters of J. R. R. Tolkien*, edited by Humphrey Carpenter and Christopher Tolkien. Emphasis added.

That Tolkien himself does not give the rules is surprising. It may be that he could have easily given the formal rules, but was still wondering how those rules had come to be. Regardless, I will detail later how native English speakers follow a complex set of rules for the order of adjectives; rules that we normally apply perfectly without being consciously aware of them. But that's just English: French does it differently, often putting the adjective after the noun and in some cases changing the meaning depending on the adjective's position. And there are languages in which the order of adjectives is unimportant. Where there is no 'right' or 'wrong' for this aspect of grammar.

I must add that a subtly different set of rules apply to English songs and poetry. Tolkien's *The Hobbit* has the dwarves sing a song beginning:

> "Far over the misty mountains cold
> "To dungeons deep and caverns old"

In prose, this would have to be "far over the cold misty mountains, going to deep dungeons and old caverns", which sounds far flatter. The poem used an iambic tetrameter, thought with the occasional mismatch. Most lines (though not the first) break into two halves. And the pattern is:

> far **OV**er the **MIST**y **MOUNT**ains **COLD**
> to **DUN**eons **DEEP** and **CAV**erns **OLD**[26]

This isn't quiet iambic, but much closer than if the natural word order had been used. And I'll say more about Green Great Dragons later on. I've been working on the idea for some years, trying with little success to get others interested. It recently seems to have taken off on the internet, quite independently of my efforts.

I was also curious as to how Tolkien at seven could make such an error. From a talk given a few years back at a Tolkienian gathering called Oxonmoot, I have a suspicion that Tolkien's 'green great dragon' may have belonged in a poem. But we were particularly asked not to repeat the details, bland though they were. I assume a book on the matter is planned, though apparently not yet published. The significant point is, poetry or song might allow the irregular form. Maybe you could get away with a song like:

> On merry days we raise a flagon
> To celebrate a green great dragon

It sounds better because it follows a "da DUM" pattern, an unstressed syllable followed by a stressed syllable, known technically as an iambic. On this matter, I remembered someone saying:

> "The point is that not only is it quite easy to write in iambic pentameters, it is often quite difficult to avoid it. **ORD**in**AR**y **PROSE** is **OFT**en **IN** i**AM**bics."[27]

In English poetry, there is greater tolerance for unusual word order when it helps the sounds to fit a pattern, iambic or something close to it, as with Tolkien's dwarf song. Perhaps Tolkien's mother was being over-fussy; perhaps not. It's unlikely we'll ever have the luck to find Tolkien's original. Regardless, all native English speakers would reject a 'green great dragon' in ordinary speech or prose writing. But could not explain just why.

Whatever Professor Tolkien may have thought, I found myself drawn to the phrase as a nice illustration of how our lives can be built around rules we do not notice. That could be Post-Modernism: but the muon was an example of the opposite process. Things that exist in defiance of human expectations.

This essay speaks of things that only exist because people believe in them. And of things that exist because people have beliefs that they don't know they have. And things that exist regardless of belief and would still be there even if people were unaware of them. Philosophy continuously muddles these things, as with the famous Schrödinger's Cat. (Itself maybe linked to the even more famous Cheshire Cat of *Alice in Wonderland*, as I detail later.) I speak mostly of remote matters, but also come back to the familiar world and hopefully help you see it more clearly. Defend this clarity against the current generation of Coolhearts and Futilitarians: the post-truthful thinkers who think that the superficial human social formations of money, fame and power are the prime realities.

The strange story of an ancient wandering proton that changes briefly into a pion and then falls to earth as a doomed muon would have seemed much less likely than dragons to an educated Western person in the 19th century. They'd have believed that atoms were unbreakable: that's what the name *means*, after all. Decades of chemistry had apparently shown that atoms were unchanging, whatever molecules they might be part of. And if they'd speculated that atoms might break under extreme conditions, they'd never have expected the story to be as complex and as contrary to common sense as it has turned out it be.

The real story was disentangled step by step in the 20th century. It included the bizarre twist that pions were expected and predicted, whereas muons were utterly unexpected and baffling for several decades. It's as if someone who'd observed humans but was unfamiliar with our domestic animals had cleverly deduced the existence of dogs, but then found a cat. And then had to look further before they found dogs. Been puzzled until they worked out that cats and dogs were two very different types of animal, only one of which had the predicted dog-like pattern of behaviour.

This particular 'cat' was known as a mu-meson

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[26] Thanks to everyone at https://www.facebook.com/groups/TheTolkienSociety.EducationalCharity/permalink/10154443863071068/?comment_id=10154444480946068&ref=notif&notif_t=group_comment&notif_id=1476788274627097. This is from a Tolkienian Facebook group that anyone interested can join.

[27] This was by a man called Peter Brooke, and is long out of print. You can find other very interesting articles by him at http://www.peterbrooke.org/

before it got its current name. (More properly "meson" preceded by the Greek letter mu: but computer software almost always makes a hash of such things.) The 'dog' – the particle that was deduced to exist – was the pion, known for a time as the pi-meson. But before I tell that story, I need to tell the complex history and adventures of how humans got to know the basics of what atoms are. And to dispose of the dismal 'hole within a hole' view of matter.

All such thinking, I would class as depressing images that were spawned by members of the intelligentsia who think that the relative social decline of their own little privileged stratum must mean that there is something seriously wrong with the universe. I borrow a phrase from Douglas Adams: but he is representative of a much wider pattern of conceited and depressive thinking. I enjoyed the *Hitchhiker* series, but I can't see any substance to it.

Holes Within Holes?

In a hole in a hole dwelt a nothingness. Not a comfortable sort of hole, and not a comfortable nothingness either. This was a scientific sort of nothing, and that means intellectual discomfort.

For those who don't recognise it, I am parodying Tolkien's famous opening to *The Hobbit*. I do this mostly for my own amusement, and in the hope of getting across some complex ideas with a dash of humour. Tolkien wonderfully described the comfortable hole that Bilbo the hobbit lived in before being sent off to confront first the loathsome Gollum and then the fierce and alarmingly clever dragon Smaug, each with his own hole that he comfortably dwells in. And you too should also be able to imagine a comfortable nothing, as in 'nothing wrong'. Or as in '*Nothing to report: spectre no longer haunting Room 13: "We haven't had that spirit here since 1969", says manager of the Hotel California*'. (That's another parody, this time of a strange and famous pop song.)[28]

The notion that science had found 'a hole inside a hole through a hole' comes from SF author James Blish. A knowledgeable man with a successful popular writing style, Blish also coined the useful term 'gas giant', which has migrated from science fiction to real astronomy. His notion of matter as hollow is part of the dismal vision in a dismal book called *A Case of Conscience*. It starts out as Space Opera, and raises some interesting moral questions. Sadly, it ends with the extermination of the alien race who have dared to be successfully virtuous without religion – all too similar to real history.

The 'a hole inside a hole through a hole' is Blish's interpretation of what subatomic physics had found. And is true up to a point: gaps between atoms are typically huge compared to the atoms themselves; atoms are mostly empty with a tiny nucleus at the centre; the nucleus is made up of protons and neutrons. Blish wrote in 1958, before the realisation that tiny particles called quarks were the subcomponents of protons, neutrons and various exotic particles (including pions but not muons). But SF writers had long speculated about such things. Before World War Two, E. E. 'Doc' Smith in his '*Skylark*' SF adventure novels had his fictional scientists discovering many layers of sub-components within electrons. No one has yet found evidence that electrons have sub-components. but the possibility is not absurd.

So do we have 'a hole inside a hole through a hole'? A complete nothingness within that? *Not really.* What science actually found is atoms where most of the mass is in something small and hugely substantial. That's not so dismal, though scientist don't help by mostly using dry emotion-free imagery. They are often self-defeating by being hostile to the popularisations that win them whatever mass support that they possess. Few of them will accept the world of Science Fiction as useful, even though a lot of them read it.

The language used is also often unhelpful. To speak of the atomic nucleus as 'a fly in the cathedral' does give a good impression of the actual sizes. But speaking of 'a wren in the cathedral' would have sounded much more human and connected with the normal world. And would reference Sir Christopher Wren, who designed London's St. Paul's Cathedral

So how did we get to this modern vision?

Ancient peoples wondered a lot about the universe. Some of them had good insights. From Classical Greece and Ancient India, we have fragmentary records of thinkers who believed that the most basic component of matter would be what the Greeks called an atom, an 'uncuttable', 'indivisible' or 'unbreakable'.[29] In Greece, at least, this view tended towards materialism and atheism – though since we mostly know about them from what their enemies wrote, this may have been exaggerated or misunderstood. There were also bitter objections in Western philosophy and theology to the notion of a void between atoms. It was said to imply atheism, though I can see no logical connection, even if the same people happened to assert both. In Hinduism, where religion is happy to co-exist with unfathomable mysteries, there were orthodox schools of Hindu thought that accepted atoms. In any case, the pathetically small fragments we have of early materialist and atomistic beliefs in Pagan Greece and Pagan Rome seem quite close to modern science.

Sadly, these good beginnings lost out to the more mystical and dogmatic beliefs of Plato and Aristotle. These in turn hybridised with some strands of early Christianity to produce the Official Christianity that Emperor Constantine imposed on the whole Empire. But knowledge of this early science survived, mostly in the form of Plato and

[28] https://en.wikipedia.org/wiki/Hotel_California

[29] See https://en.wikipedia.org/wiki/Atomism for details.

Aristotle's criticisms. A style of thinking that was capable of being revived as one of many strands of thought within the European Renaissance, like a long-dormant seed sprouting to brilliant new life.

By stages, the modern scientific method was developed. This insists that truth comes mostly from observations of the world, not the niceness of arguments or from how comfortably the explanations sits with existing social or religious ideas. Observations can include experiments, but Popper was wrong when he claimed that real science has to be falsifiable. Real science merely has to look sensible when tested against the real world. A theory that ties together a number of disconnected facts has to be taken seriously, though it will be unconfirmed science until it successfully predicts something new. And if it then fails, it still might have been a reasonable idea.

There was no possible experiment that could have confirmed Copernicus's revival of the Ancient Greek notion that had the Earth orbiting the sun. At least not until the space age, when it had long ceased to be disputed. (Though I have a hazy memory of a television program about the Jain religion, which includes one of their theologians having a crisis of faith because a satellite was in orbit: this was not reconcilable with their vision of a flat earth centred on an immense world-mountain.) Regardless, there were a mass of observations that made the sun-centred view overwhelmingly likely, particularly when people followed Galileo's lead and used telescopes to study the planets and stars. Sadly, in Italy the religious authorities decided to silence any scientific or mathematic thinker who dared come up with discoveries that did not sit nicely with existing social or religious ideas. It wasn't just Galileo: it also applied to some new mathematical insights that later allowed Newton to work out that gravity applied in the heavens as well as down here on Earth.[30]

Theologians who had the power to give their dogmas the force of law successfully extinguished original thinking in Italy, and everywhere else where the Catholic Church had full intellectual hegemony. In Catholic France, the monarchs were happy to allow free-thinking on matters that didn't appear to challenge royal authority, which meant that a great deal of excellent science was produced. This also applied in Protestant countries, even though Protestant theologians strongly denounced Galileo's re-assertion of Copernicus's view. Copernicus had been ignored by Catholic theologians in his own time, partly because his published work included the qualification that his sun-centred system was just a mathematical trick and not reality. Protestant theologians disliked sun-centred systems, but the political authorities did not allow them power of suppression over anything that wasn't an overt challenge to popular faith.

At the same time as the sun was being made the centre, chemistry made progress by initially refusing to tie itself to any one theory. The early 'sceptical chemists' concentrating on finding out the details of what actually existed. By weighing and other exact measurements, a body of reliable data was slowly built up. It was realised that 'air' was actually a mix of several 'airs', soon re-named gases. And deduced by stages that these were somehow associated with particular liquids or solids. Some of these gases were lighter than air, and some heavier.

It was realised that everything made sense if distinct chemical elements existed, and kept their identity through whatever chemical violence might be thrown at them. And that the chemical elements were each composed of a distinct type of atom, with definite rules for how these atoms combined. Combinations that mostly made molecules very different from their constituent atoms.

One simple example: common salt is sodium chloride, and essential to life. Pure sodium is a metal which reacts violently with water. Chlorine is a green and poisonous gas. In a salty solution, sodium chloride exists as a slew of separate sodium and chlorine ions: but the ionisation (gain or loss of electrons) will have changed the atoms so that the violent reactivity of the un-ionised elements is lost. Indeed, the violent reactivity is based on having a spare electron that the atom can readily lose (sodium) or an outer shell of electrons with a free spot for one more (chlorine). Ionisation makes them safe and suitable to be part of organic life.

Most gases (but not helium, neon, argon etc.) are composed of atoms combined as molecules. Helpfully for the progress of chemistry, it was found by careful measurements that a given volume of gas at a given temperature and pressure would contain the same number of atoms or molecules. Physicists took this idea and developed Kinetic Theory, which assumed that molecules in a gas were relatively small and bounced off of each other at random. The maths was complex, but the results were a strikingly good match for what experimenters had already found as unexplained empirical laws.

Understanding atoms also made sense of the traditional 'elements' of Greek philosophy: Earth and Fire and Air and Water. It turned out that these were not elemental entities, but simply different relationships of atoms:

- 'Air' is a mix of gases, with molecules or atoms freely bouncing off each other.
- 'Water' is the best-known and most common of many molecules that are liquid at temperatures comfortable to humans. Molten metals are also liquids. Mercury happens to be 'molten' within the human range of comfort. Liquids are more densely packed molecules or atoms than gases, and these may also be significantly attracted to each other. But they are also constantly shifting their combinations. The shape of a liquid is ever-changing, even though its volume is

[30] *Infinitesimal: How a Dangerous Mathematical Theory Shaped the Modern World*, by Amir Alexander.

constant at a particular temperature and pressure.

- 'Earth' is a collection of various solids. Liquids become solid when they are cold enough, as with water becoming ice. Solids mostly melt when hot enough, with even iron flowing in a really hot fire. In solids, 'Earth', molecules form permanent bonds and resist being set asunder.
- 'Fire' is a product of some chemical reactions that release a lot of energy. Fires have to keep on taking in new material, or else burn out.
- 'Aether' or Quintessence is a fifth element that later thinkers added to the original Greek system. It is actually a mixed bag of things seen in the sky above the clouds. The sun and other stars are plasma, much hotter than any gas. The EarthMoon, Mars and Mercury are rock. For the other planets, we see just clouds. Venus has a solid surface beneath its clouds. Jupiter and the other giant planets are believed to have solid cores, but very deep down and invisible to us.

In human terms, you can imagine a gas as a crowd in which no one knows each other and each goes their own way. A liquid like a party in which people stop to talk but then circulate. A solid is like a military formation in which everyone has their place, or like a crowd who have linked arms and intend not to be moved. Fire is like a stampede, a destructive force. All very explicable: but I remember my father telling me that university students on the arts side would come to believe in these 'elements' as real after being taught them as an aid to understanding ancient literature.

It is worth adding that the ancient Chinese had a completely different system of 'elements': Wood, Earth, Water, Fire, and Metal. This ignores air, but does correctly recognise the fundamental difference between metals, inorganic non-metals and everything organic. It has also been argued that these were never seen as 'elements' in the Western sense: not fundamental components. In any case, it was another dead end. Part of a pattern of ingenuity within a traditional Chinese culture that existed across at least 3000 years, but never moved towards real science. As I've explained elsewhere,[31] Traditional China *did* produce several vital inventions that were almost certainly necessary to allow Europe's spectacular rise. These included printing, gunpowder and the magnetic compass, which Francis Bacon (Lord Verulam) noted as major advances that Classical Europe had known nothing of. But the same traditional culture that made China the best pre-industrial society also smothered the possibility of something radically new. Only Marxism as a 'Fourth Wave' creed derived from first principles allowed Chinese to truly grasp the modern world. The European Enlightenment and European Liberalism were full of assumptions about the world: notions that were true for European culture, but mostly not valid for humans in general.

A world made of atoms was much closer to the deep truths of the world than a world made of four elements, or five elements, or made of whatever you chose to think it was made of. But towards the end of the 19th century, it was gradually realised that atoms could occasionally be broken apart and were actually composed of smaller units. First they found the electron. Then Ernest Rutherford showed that the mysterious energy that seemingly came from nowhere in radioactivity was actually caused by atoms breaking down and changing into other atoms, different chemical elements. Which was not a wildly new idea: as far back as 1815, it had been suggested that the hydrogen atom was the fundamental unit and that other atoms were made by combinations of this unit. A lot of elements had atomic weights that were close to being multiples of the atomic weight of hydrogen, so the idea was plausible. But only in 1919 did Rutherford shoot alpha particles into pure nitrogen and demonstrate that he had created oxygen and hydrogen. This confirmed what he already suspected: that the different chemical elements were composed of something more fundamental. And the basic one-for-hydrogen unit became known from 1920 as a *proton*.

Separately from this, researchers guided by Rutherford had discovered in 1911 that atoms had an immense concentration of positive charge at their core. J. J. Thomson had discovered the electron back in 1897, and had proposed the 'plum pudding model' of the atom: electrons set in a sea of positive charge. Rutherford had the idea of shooting alpha particles at gold foil, to test this. Unexpectedly, some of these were deflected at very large angles. Detailed measurements showed that the atomic nucleus was a tiny thing compared to the atom, sometimes compared to a fly in a cathedral. As I said earlier, a wren in a cathedral would have been a better image.

Does this mean that solids are not really solid? Actually no. Solids are solid because their atoms link to other atoms by strong chemical bonds. Both solids and liquids are hard to compress, because atoms normally have a definite size and there is no spare space between them, as there is in a gas. The nucleus of an atom hangs on very strongly to most of its electrons, which have a definite structure. Simplifying a little, each atom has an outermost shell containing from one to eight electrons. Carbon has four in the outer shell, while oxygen has six, so a carbon atom can share two electrons each with a pair of oxygen atoms to make carbon dioxide. But when oxygen is scarce, carbon can also form a different sort of bond to form carbon monoxide. This is much more reactive, burning in air to make carbon dioxide. It is also poisonous, forming a strong bond with the blood's haemoglobin and so stopping the normal transport of oxygen round the body: ending organic life for humans and other animals.

Many other chemical possibilities exist. Carbon

[31] https://gwydionwilliams.com/99-problems-magazine/traditional-china-resisted-modernisation/

can also link to itself, sharing one electron each with four other carbon atoms. Each of these in turn can form a bond to three more carbon atoms, creating an immensely strong lattice known to us as diamond. And diamonds aren't for ever: one early chemical experiment used a magnifying glass to focus a burning beam of sunlight onto a small diamond. The diamond vanished completely, and left behind carbon dioxide. But chemical bonds don't break easily, and that's what keeps solids as solids. And it is very much harder to strip an atom of those electrons it possesses below its outermost shell, even though a lot of the atom would count as empty if you count electrons as point particles. Electrons are negatively charged, protons are positive. Their link is enormously strong.

It is however possible for extreme gravity to crush an atom and remove most of the spare space. The fly quits the cathedral and moves into a matchbox, if you like. This happens in White Dwarf Stars, which were recognised from 1910 onwards as extremely small but enormously massive. A matchbox full of white dwarf material would have a mass of about 250 tonnes, the weight of a wide-body passenger aircraft. It was later found that one could go further: dissolve the atoms entirely and have a 'sea' of protons and neutrons in an ultra-compressed body known as a neutron star. A matchbox containing neutron-star material would have a mass of some 5 billion tonnes, the weight of a cubic kilometre of typical Earth rock.

Protons and neutron are not the lowest level. Particle physicists in the early 1960s collided protons with protons at high speeds, even higher than the cosmic-ray collisions I mentioned earlier. They found them bouncing off each other in ways that suggested that each proton contained three much smaller units. Units that were given the name of quarks, from a stray remark in James Joyce's *Finnegans Wake*.

(Which arguably ought to have been called *Finnegan's Wake*: or *Finnegans' Wake* if more than one Finnegan had died. But when it comes to slogans and book titles, English grammar sometimes gets relaxed. I've seen jokes about someone telling California's *Hells Angels* that they really should have an apostrophe. It is indeed *Hell's Angels* in the title of Howard Hughes's 1930 drama about the First World War. But the film shows the slogan, and I'm sure I saw both forms used. And there was considerable irritation when book-chain *Waterstones* chose to waste a lot of money becoming *Waterstone's*: money better spent on keeping some low-turnover books on the shelves. So on this matter (though on very little else) I find myself 'on the side of the Angels'.)

Getting back to quarks. Things get very strange at that level of existence: no one has managed to detect a free quark. There are now sensible theories to explain why they could not exist, except under very special conditions. It could be that some radically different theory will be needed, but more likely not.

Quarks were a major part of the existing Standard Model of particle physics. This was put together in the 1970s and has been wonderfully successful in predicting new particles and their energies. It was completed recently with the discovery of the Higgs Boson. Theories claiming to go beyond this all still need quarks, as far as I know.

Not that neutron-star matter is necessarily the limit. It is believed that things could go still further, with a mix of extreme gravity and temperatures producing a quark–gluon plasma, also known as quark soup.[32] An experiment in 2005 is generally believed to have made a sample. It may exist at the core of neutron stars, and there might also be 'quark stars'. This remains speculative.

Even more speculative is 'String Theory', which has now mostly moved from 'string' to membranes as the ultimate basis for everything. Black holes alarm physicists, because theory implies that some of them could contain a *singularity*, a point of infinite density, which would not make sense. It is even feared that a *naked singularity* could exist, a point of infinite density that was not hidden respectably behind the event horizon of a black hole. But it has also been suggested that matter could be reduced below 'quark soup' and down to the level of 'string', which would be interesting but not alarming.

That's what matter is reckoned to consist of. The central reality isn't a 'hole within a hole'. *Packages containing ultra-dense matter* would be a better summary. If the atomic nucleus is a 'fly in the cathedral', it is also a fly that outweighs the cathedral by a very large margin.

Solid matter as we know it consists of this mix of voids and ultra-dense objects. Ordinary matter is incapable of passing through these voids. Air and other gases are easy to pass through, because the molecules or atoms are only very weakly linked to each other. But the atoms that make up molecules mostly hang together very strongly. Water and other liquids offer resistance, because the molecules keep on making and then abandoning links. Solids stay solid until broken or torn or shattered, because the atoms or molecules make individual links that are very hard to break.

People will be familiar with nets and metal mesh fences. These are mostly just air, but are clearly impossibly to walk through unless you have the force to break them. Just as you could walk through a wall made of paper, or break a soap-bubble with a light touch. But the dismal vision of living in a universe made up of 'holes within holes' is a simple misunderstanding. As is the related idea that one might walk through walls: most of the solid matter is void, but those voids are well protected by electromagnetic ties between objects of extreme density.

[32] https://en.wikipedia.org/wiki/Quark%E2%80%93gluon_plasma as at 19th August 2014.

Moving From Small To Large

Considering the very large as well as the very small, I notice a more general pattern: *density within voids*. The sun makes up the vast bulk of the mass of the solar system. The planets make up most of the rest, with Jupiter having more mass than the rest of them put together. The apparently-crowded asteroid belt is actually almost empty: no spacecraft has yet encountered an asteroid that it was not aiming for. Isaac Asimov notes somewhere that from almost all asteroids, an observer would not see any other asteroid as more than the occasional point of light. Put together, they would not be more than a thousandth of the mass of the Earth. Other solar systems seem to be broadly similar, except some of them consist of two or more stars, some with shared planets revolving round them both. Other binaries have a separate set of planets for each star. But always, the bulk of the mass is in the star or stars.

Stepping up, the Milky Way galaxy is much denser at its core than in its disk (and the disk is where we live). The spiral arms of some galaxies are not in fact coherent objects, and not much denser than the gaps between the arms. There is a black hole at the centre of our galaxy, with a mass of several million suns – not an enormous concentration in a galaxy with at least two thousand million stars. The movements of the stars throughout the galaxy also suggests that the bright stars are set in a much larger disk of Dark Matter. This remains controversial, but the only alternative that can explain the known movements of stars and galaxies is to re-write the law of gravity. A system called Modified Newtonian Dynamics is the best candidate, but still very much a minority view.

Stepping up again, the Milky Way and the Andromeda Galaxy are the heavyweights of a collection of more than 50 galaxies known as the Local Group. Andromeda is the 'boss', with at least twice the mass of our galaxy. It also has a much bigger black hole at the core, part of a double structure that remains mysterious. It is known that galaxies can and do swallow up and absorb other smaller galaxies, but majority opinion among astronomers is now against the double structure being the original core plus a remnant of a swallowed galaxy.

Local groups similar to our own are reckoned to be common throughout the universe, though we only see nearby examples. Much more impressive are Galactic Clusters, made up of thousands of galaxies and with gigantic elliptical galaxies at their centres. The Virgo Cluster has more than a thousand galaxies, and is centred on a galaxy called Messier 87, which has more than 200 times the mass of the Milky Way. But it is only one of several large galaxies in the cluster, and does not dominate it in the way the sun dominates the solar system or the nucleus dominates the atom. And these Galactic Clusters seem to be the largest real objects in the universe – 'objects' in the sense that their mutual gravity is strong enough to bring them together despite the continuing expansion of the universe. [33]

Beyond Clusters are Galactic Superclusters. It used to be believed that Superclusters were coherent objects. That our own Local Group was destined to become part of a more concentrated version of an existing Virgo Supercluster. Further measurements suggest not, particularly now that we know that the expansion of the universe is accelerating.[34] Superclusters are now believed to be loose associations of many Galactic Clusters and Local Groups that will each eventually go its own way. It was also realised in 2014 that the 'Virgo Supercluster' was just one of four components of a truly gigantic Laniakea Supercluster.

Superclusters in turn make up still vaster walls and filaments, with voids between them that contain very few galaxies. This was discovered in the 1980s and was a considerable surprise. In 1989 they found something called the 'Great Wall', over 500 million light-years long, 300 million light-years wide and 16 million light-years thick. It is now known to be one of several such structures, and has been renamed the 'CfA2 Great Wall'. (Astronomers have a way of choosing dull and awkward names for their most astonishing discoveries.)

Nor is the Great Wall the largest thing in the known universe. Even larger concentrations of galaxies have been found, and we are part of one of the larger groupings, the Pisces–Cetus Supercluster Complex.[35] It is a thousand million light-years long, but the current record-holder is ten times bigger.[36] Even vaster structures may be found as we continue to map the universe.

It remains puzzling that these gigantic structures exist. Objects up to the scale of Galactic Clusters or Local Groups can be presumed to have pulled themselves together by mutual gravity, but beyond this? That's the realm of speculative cosmology, the attempt to work out in detail what happened in the Origin Event (Big Bang).

Stars and Constellations

Let's now come back down to Earth. Look up and see the stars, but only a tiny fraction of the entire cosmos.

What we do see, we currently group as constellations: and these are an interesting hybrid of the two worlds I began by defining. The star exist as objective facts. The view from Earth is also an objective fact. The apparent star groupings are imposed by human culture; yet many of the groupings arise naturally from what we see.

With our unaided eyes, we see a few thousand stars. All of them are close neighbours in the

[33] https://en.wikipedia.org/wiki/Galaxy_groups_and_clusters

[34] http://cosmoquest.org/forum/archive/index.php/t-84639.html

[35] https://en.wikipedia.org/wiki/Pisces%E2%80%93Cetus_Supercluster_Complex

[36] https://en.wikipedia.org/wiki/Hercules%E2%80%93Corona_Borealis_Great_Wall as at 19th August 2014.

vastness of the galaxy. Mostly within a few tens or hundreds of light-years of us, within a galaxy with a diameter of at least 100,000 light-years.

Most visible stars are faint: from cities we may not see them at all. The brighter or nearer of the stars strongly outshine the rest and seem to make patterns. The rotation of the earth makes these patterns seem to rise and set every day, though those close to the pole (Earth's axis of rotation) are visible every night. (Also above the horizon during the day: but the sky is too bright for them to be seen.) But since Earth and the other planets developed from a flattened disk of gas and dust, our planet rotates close to what's called the Plane of the Ecliptic, and this determines the pattern of how we see the planets appear to move. From an Earthly viewpoint, the planets are 'wandering stars', which however only wander within a single distinct band of stars.

With geometry, people were able to work out that the sun would also be seen as moving within this narrow band if the daytime stars were not drowned out by the much brighter sky. The Babylonians (or possibly some earlier people) did these calculation, creating the concept of a zodiac. Also creating a tradition of astrology that was absurd nonsense in itself, but did ensure that Western Europe as heir to Babylonian knowledge paid a lot of attention to the apparent movements of planets within that zodiac.

What do these zodiac signs mean? Probably nothing, but just possibly the star-beasts and other concepts assigned to them were not random. The constellation Virgo is one of twelve traditional signs in a zodiac we get from the Greeks, but which the Greeks based on a Babylonian system of which we have just fragments. As I mentioned, the Virgo Cluster is a kind of super-centre for many galaxies including ours. Perhaps Virgo the Virgin was originally some sort of Great Mother – similar transitions happened when Christianity took over populations where some sort of mother-goddess had long been reverenced. Dianna of the Ephesians was reinvented as Mary Mother of Jesus, a woman mentioned only in passing in the actual gospels. But assigning a Mighty Virgin to that interstellar direction fits better than any other constellation-beast would have.

Another zodiac sign is Sagittarius, traditionally a centaur firing an arrow. And it is also the direction of the centre of the galaxy. The location of the galaxy's black hole, which shoots out jets of matter. Also Andromeda (outside of the zodiac) is traditionally a chained-up lady: our Milky Way and the Andromeda Galaxy are in a sense chained together by gravity. The two of them will eventually merge, though since the Andromeda Galaxy is larger it should dominate, whereas the chained Andromeda was due to be eaten by her arriving monster.

Many years ago, it occurred to me that these might be echoes of some alien contact filtered through human misunderstandings. But this seems weaker now that I learn that we've not actually destined to end up as part of a unified Virgo Supercluster. But a multi-limbed centaur firing an arrow is a passable version of what primitive minds might have made of a giant black hole, with its tendency to shoot out jets of plasma. Still, with 48 constellations in Ptolemy's ancient list, a few 'hits' could be expected to occur be sheer chance. It may mean nothing, but I thought it worth recording.

For constellations, numbers and definitions vary a lot. The Babylonians seem to have had 17 or 18 constellations just for the zodiac.[37] Their constellations also do not cover the whole of the sky. Significantly, the area left unnamed is the part of the sky that would not have been visible from Babylon at the time the definitions were probably first devised. Ptolemy reorganised this into 48 constellations, the basis for the modern system. But there were also a number of attempts to either rebuild the system or to slot in extra constellations, as well as mapping new constellations like the Southern Cross in areas that Ptolemy would not have seen.

The official body controlling astronomical names is the International Astronomical Union. Formed in 1919, it settled on a system of 88 constellations covering the whole of the sky. This included three or perhaps four to replace the ancient and over-large *'Argo Navis'*: the Ship of the Greek Argonauts. Carina (the keel, or the hull, of the ship), Puppis (the poop deck, or stern), and Vela (the sails) are the main replacements. The area now known as Pyxis (the mariner's compass) occupies an area which in antiquity was considered part of Argo's mast, though the Greeks knew nothing of compasses. (They were invented in China and arriving much later in the West.)

The magazine *Astronomy Now* recently had an article called *Constellations that ceased to be*.[38] It starts off with successful additions to fill the gaps, from the 16th century onwards. These include Columba (the dove), Monoceros (the unicorn) and Leo Minor (the smaller lion). In Late Roman times, the Emperor Hadrian's male lover Antinous was given a chunk of Aquila (the Eagle) and it almost made the grade as an official constellation, but in the end got rejected. So too did Robur Carolinum (Charles' Oak), invented in 1679 by Edmund Halley and including the famous star now known as Eta Carina. Likewise Taurus Poniatovii (Poniatowski's bull), proposed by a Pole to honour a Polish king.

As I said, constellations are an interesting hybrid of the two worlds I began by defining. The view from Earth is an objective observation of the nearby stars. But our current view lines up stars that often have little connection to each other. And over hundreds of thousands of years, this view will change considerably:

- the stars Castor and Pollux in Gemini (Twins) are not twins at all. Castor is a gravitationally bound group of six stars that include two

[37] https://en.wikipedia.org/wiki/Babylonian_star_catalogues

[38] October 2016 issue, page 56.

bright white suns similar to Sirius. Stars close enough to seem a single star at their distance of 56 light-years away. Pollux by contrast is a single yellow-orange giant 34 light-years from the Sun. It is less massive than either of the two main stars of Castor, but it is also near the end of its lifetime and therefore must be much older. (Large stars burn much hotter and brighter than small stars, and so don't last as long. It is a weird world, as if elephants were born and died in a single day while mayflies lived for centuries.)

The Castor system is reckoned to be 370 million years old: Pollux 724 million years. Like most stars or groups of stars in the galaxy, both have their own distinct orbit around the galaxy. Tens of millions of years ago, they would not have been close to our sun or to each other. Tens of millions of years in the future, they will be far apart again. But Pollux will by then have blow off a Planetary Nebula and will end its days as a White Dwarf. (It is too small to become a supernova.)

- Orion is more of a natural group. Most of its bright stars are probably recent products of the Orion Molecular Cloud Complex, of which the Orion Nebula is just a small part. But the three bright stars of Orion's Belt are not in fact close to each other: their distances are 736, 915 and 1340 light years from Earth. From most viewpoints other than Earth, they would not form the near-perfect straight line we see in our own night sky.
- Ursa Major is dominated by the seven stars of the Plough or Big Dipper. This consists of five stars that are part of the Ursa Major Moving Group, and two unrelated stars at either end that are going somewhere else. The Ursa Major Moving Group is about 300 million years old; stars that formed in a single star-forming region but are now drifting apart. The five brightest stars will maintain the core of the current Plough, but the different motions of the other two means that the overall shape formed by the seven bright stars changes markedly over tens of thousands of years.

  Bram Stoker used this in his novel *The Jewel of Seven Stars*. A mummified Egyptian queen has a jewel showing the Plough as it looks *now*, subtly different from what it would have been in her day. (Being a horror story, she also comes back to life, of course.)
- Centaurus is a southern constellation that most Europeans have heard of, because of the Alpha Centauri system, the three closest stars to Earth. We see a single star, but this is actually a close pair of stars. We do not see Proxima Centauri, which is much dimmer and was only discovered in 1915. Proxima is separated by such a gap that not everyone agrees that it is truly part of the same system as the other two, though their motions in orbit round the galaxy are suspiciously similar.

  When I visited Australia and New Zealand, I was surprised to see that Alpha Centauri had an apparent twin, Beta Centauri. Beta Centauri looks slightly less bright: it is in fact vastly brighter and more distant.
- Cassiopeia: the five brightest stars of this constellation make up a W shape that even a novice can spot. But these are five unrelated stars that just happen to line up from the viewpoint of Earth.

  Interestingly, if humans went to the Alpha Centauri system, we could look back and see our sun making a zigzag patters with the stars of Cassiopeia: a distinctive group of six.[39]

One could give the same treatment to the other 83 officially-recognised constellations. Their bright stars are often not associated with each other: they just happen to line up from the viewpoint of Earth. From other stars in the galaxy, we would see a different pattern. From an Earth-like planet a few thousand light-years away, almost every star we can see with the naked eye would be invisible. The night-sky would consist of a completely different set of stars, arranged in other patterns.

All of this is just Europe's tradition. Other cultures have their own systems. Some also derived from the Greeks or Babylonians. But the patterns are wholly different for the Chinese.

I notice also that most believers in mystic star-signs recycle the same set of ancient ideas, but with extras that have no source and come from their own whims. Doris Lessing did this with great literary skill, improbable politics and a poor knowledge of astronomy in her *Canopus in Argos* novels. Argos is an ancient Greek city: she has confused it with *Argo Navis*, the officially-abolished constellation that I mentioned earlier, which did indeed include Canopus. She also seems to be referencing astrology, where planets that happened to line up with vastly more distant stars are said to be 'in' that constellation of the zodiac. But Canopus is a distant, bright and short-lived star: all of the constellations would have lost their meaning from an Earthly viewpoint long before Canopus would line up with a different set of stars.

To get back to hard facts. The pattern of density and voids has been found to exist at almost all levels of existence, which may mean something. A similar scattering seems to exist for complex biospheres capable of producing a technological species capable of understanding the universe as a whole. We've existed for a very tiny period of time compared to the age of the Earth, though I hope this does not mean we won't last much longer. Definitely, the complex biosphere that allows our existence is now believed to be a great rarity.

[39] http://www.learnastronomyhq.com/articles/how-would-our-sun-look-from-alpha-centauri.html

Science fiction once dreamt of plants, animals and maybe alien peoples on other planets of our solar system. These turned out to be unreal. Simple bacteria-like life may exist on Mars, though there is no solid evidence for it. Speculatively, there might be warm oceans and bacterial life on some of the moons of the outer planet, with Europa a favourite. Even more speculatively, Titan might have life based on some system of life that could operate in its extreme cold. 'Methane breathers' are a science fiction favourite and do indeed seem possible. But a probe dropped onto the surface of Titan saw nothing resembling a living organism.

The nearest life that might exist beyond the solar system would be in the Alpha Centauri system. It has a disputed planet around Alpha Centauri B and a confirmed planet around Proxima Centauri. But this is more than 4 light-years away: the other life that might possibly exist in our solar system is all within a light-day of Earth. A cubic volume of space with sides four light-years long would include over three thousand million cubic light-days. Centred on Earth, it would not quite reach to Alpha Centauri. Life in the universe is thinly scattered: advanced life even more so.

The pattern might even extend further: speculative cosmology includes several versions of a 'multiverse' viewpoint, which has our own universe as one of an enormous number which differing physical laws. It would explain various oddities in the laws of physics that permit our existence, such as the fact that stars can burn hydrogen at much the same level for thousands of millions of years, allowing the amazingly slow processes of Natural Selection to produce both a complex biosphere and intelligent life. Or the oddity that water-ice is less dense than water, whereas almost every other solid is more dense than its liquid. Were ice denser than water, it would sink to the bottom of the ocean and might eventually freeze all of the liquid water.

All of this relates to arguments over the Anthropic Principle,[40] which is too large a topic to include here. A multiverse is one explanation. There might be only tiny islets of universes within the multiverse where the laws of physics allow atoms and chemistry. And within these tiny clusters of universes, just one or two universes suitable for life as we know it to develop for long enough to produce a technological species capable of gaining some understanding the matter.

It would be interesting if someone could devise a common mode of description for these various patterns of voids and concentrations, to see if anything interesting emerges. I'm not a mathematician and I can't see how to do this myself. I make the suggestion in the hope that someone else will pick it up.

When is a Meson not a Meson?

I mentioned earlier how Rutherford had worked out that the atomic nucleus was a collection of protons, positively charged particles. You might have wondered what would hold them together. If you know basic physics, you'd know that identical charges repel. North repels North for magnets. Positive repels positive for electricity. So theorists correctly deduced that some other unknown force held the nucleus together. And that it was probably very short-range. It had to be something that would not be seen in the normal world, so we would not previously have had any hint of its existence.

This was in fact the Strong Nuclear Force. (Confusingly, there was another unrelated force also involved in atomic nuclei, inelegantly known as the Weak Nuclear Force.) Its nature remained obscure until the 1970s, when it was discovered to be just one aspect of something called the Strong Interaction or Colour Force that operates between quarks.[41] But it was possible to work out quite a lot about the Strong Nuclear Force without fully understanding it. Specifically; in 1935 a Japanese physicist called Hideki Yukawa worked out that this force would be carried by a particle with a mass intermediate between the electron and the proton. Electrons have a mass that is about 1/1836 that of the proton, a difference that remains unexplained. But on the basis of the radius of the atomic nucleus, Yukawa worked out that this particle would have a mass somewhere between the two. For this reason the name mesotron was suggested, 'middle particle'. But meson was preferred.

When the oddities now known as muons turned up in cosmic rays, they seemed to be this predicted particle. The mass was about right, so they were called mesons. But further work showed that these 'mesons' were not behaving as expected. As I said earlier, it was as if they had predicted the existence of dogs but then encountered cats. These 'mesons' were not what had been expected. They ignored the Strong Nuclear Force, meaning that they could not be the 'Yukawa particle'.

Then in 1947, careful studies of cosmic rays turned up something else: very short-lived mesons that gave rise to the known mesons. When examined, this new type of meson did fit Yukawa's predictions. The original 'meson' was renamed the mu-meson. The new one became the pi-meson.

The names were later changed again. The 'pi-meson' turned out to be one a large class of particles composed of pairs of quarks. (Protons and neutrons are made of different combinations of three quarks.) The 'pi-meson' is now known as the pion, one of many mesons made of different paired quarks. The muon is no longer called a meson, because it was something quite different; a heavyweight relative of the electron.

The muon was the first human discovery of a portion of something unexpected and unwanted: the Second Generation of Elementary Particles. These are weird overweight alternatives to the ordinary particles that make up the familiar world.

[40] https://en.wikipedia.org/wiki/Anthropic_principle

[41] https://en.wikipedia.org/wiki/Strong_interaction

And there is also a Third Generation, even heavier and much rarer.

As far as anyone can tell, our universe could work fine without these extra 'generations'. It's a puzzle that they exist. To be exact, there is no confirmed theory of particle physics that requires the existence of Second Generation or Third Generation particles in order for a universe like ours to exist. They do influence the behaviour of First Generation particles. It might be that without them, the early universe would have produced exactly equal amounts of matter and anti-matter and would have ended in mutual annihilation with nothing left to form stars or planets. Or some other vital relationship might depend on the extra particles being there. But no one currently knows.

It seems to me that the unexpected appearance of the muon and the entire Second and Third Generations of particles discredits the popular notion that subatomic particles are only there because humans observe them or were expecting them. Things happen in the subatomic realm that contradict our common sense: but that's probably because 'common sense' was developed by people dealing just with solids, liquids and gases on a human scale. The basic notion that things exist whether or not you notice them is fundamental to our understanding of the material world. And it should not be confused with the social world, where everything is more complex and where some things genuinely don't exist unless humans accept them as existing. The pattern of stars seen from Earth in independent of human will: but they could have been 68 constellations or 128 constellations rather than the 88 officially recognised by astronomers.

Standard English insists that adjective relating to size must come before adjective relating to colour: and that adjectives must always come before their noun. English would not allow a 'green great dragon', A 'dragon green great' would be an even worse goof. But the rules are different in other human languages, as I will detail later.

Even for English, we are dealing with a language that was shaped by a series of historic accidents. If the weather in 1066 had been slightly different, England might never have suffered a Norman conquest. Such an England would speak something very different from our English. Maybe more like Dutch. Probably even more like the obscure languages spoken by about 500,000 Frisian people living on the southern fringes of the North Sea in the Netherlands, Germany, and Denmark;[42] but hardly any of us would know anything about Frisian languages. They are different enough to be unintelligible to English-speakers.

The Wiki gives an example of Frisian:

> Us Heit, dy't yn de himelen is
> jins namme wurde hillige.
> Jins keninkryk komme.
> Jins wollen barre,
> allyk yn 'e himel
> sa ek op ierde.

I doubt many English-speakers would recognise this as the first five lines of the Lord's Prayer, even supposing they knew this prayer from childhood or otherwise. Taught at a state school with Anglican religious instruction including the 1662 Anglican *Book of Common Prayer*, I knew it as:

> Our Father, which art in Heaven
> Hallowed be thy Name.
> Thy Kingdom come.
> Thy will be done,
> in earth as it is in Heaven.

In Standard Dutch, the same Aramaic verse known to us via Greek and Latin would be:

> Onze Vader die in de hemelen zijt,
> Uw naam worde geheiligd;
> Uw Koninkrijk kome;
> Uw wil geschiede,
> gelijk in de hemel alzo ook op de aarde.

To get back to the quantum realm: the *Copenhagen Interpretation* of Quantum Mechanics performs some highly complicated mathematical calculations on the assumption that everything is ambiguous until a human experimenter makes a measurement. This copes with the awkward fact that subatomic particles fitted neither the classical idea of particles nor the classical concept of waves. Light can behave as an obvious wave, as shown by interference patterns when light passed through two slits. But light is also made up of individual particles called photons, as shown by the photoelectric effect, which made sense only in terms of photons striking atoms and knocking electrons out of them. There were many more such oddities.

Maths using this assumption does allow for very accurate predictions of what was actually measured. But what does it mean in the wider world? That was the issue behind the famous and widely misunderstood matter of Schrodinger's Cat.[43] As the man himself put it:

> "One can even set up quite ridiculous cases. A cat is penned up in a steel chamber, along with the following device (which must be secured against direct interference by the cat): in a Geiger counter, there is a tiny bit of radioactive substance, so small, that perhaps in the course of the hour one of the atoms decays, but also, with equal probability, perhaps none; if it happens, the counter tube discharges and through a relay releases a hammer that shatters a small flask of hydrocyanic acid. If one has left this entire system to itself for an hour, one would say that the cat still lives if meanwhile no atom has decayed. The psi-function of the entire system would express this by having in it the living and dead cat (pardon the expression) mixed or smeared out in equal parts.
>
> "It is typical of these cases that an indeterminacy originally restricted to the atomic domain becomes

[42] https://en.wikipedia.org/wiki/Frisian_languages

[43] Schrodinger should really have an accent over the "o". But computer systems tend to make a hash of accented characters. So I avoid using them.

transformed into macroscopic indeterminacy, which can then be resolved by direct observation. That prevents us from so naively accepting as valid a 'blurred model' for representing reality. In itself, it would not embody anything unclear or contradictory. There is a difference between a shaky or out-of-focus photograph and a snapshot of clouds and fog banks."[44]

There is in fact a simple common-sense solution – the quantum uncertainty vanishes when the Geiger counter makes the measurement, if it does. This was the view of Niels Bohr, the leading thinker in the development of the Copenhagen interpretation. This common-sense notion was later expanded by a few theorists to include the specific suggestion that quantum uncertainty lasts only for as long as the force of gravity is insignificant. This might plausibly be so, since when it comes to individual atoms, gravity is vastly weaker than the other known forces. (Strong Nuclear, Electromagnetic and Weak Nuclear, with the weakest of them a hundred million million million million times as strong as gravity.)

One could also say that the quantum equations make sense if you view them as accurate forecasts of what is likely to happen. Not as statements of what has actually happened.

Let's do an analogy. Let's imagine someone who has a bad gambling habit. They use an on-line betting system. They place a large bet on a particular horserace, using the quoted odds that are indeed an accurate forecast of several different possible outcomes, allowing for bookie's profits. Then they visit China, where gambling is banned. They find they cannot check the result, because the website is blocked. But they can look at their on-line bank account. They can figure that if they won, a large payment will in due course appear. That's to say, they will only have knowledge of the event some time after it happened. But the event has still happened, and is definite.

Of course horse races are clearly real and definite events, even when we lack knowledge of the outcome. Quantum events *might* be, if there are 'hidden variable' that we still need to discover. But there is also nothing too odd about quantum events being uncertain, provided they resolve themselves before rising to interact with the normal world. Once the Geiger counter measures a decay and the cat is killed, there is no more uncertainty. Likewise if it does not happen. The equations merely gave a forecast. The human experimenter has to open the box to discover the outcome.

There are no great threats to common sense – and few opportunities for philosophical pretentiousness – if we assume that the subatomic realm follows an alien logic. That it instantly loses these features as it builds up into the familiar world. Once we start talking about real objects, even microscopic objects, the nuclear forces stop being relevant and electromagnetism largely cancels out. Gravity dominates, and current theories of gravity imply certainty at least about past events.

I say 'certainty about past events', because the post-Newton Newtonian view of a deterministic cosmos turns out to be false. Newton himself believed in an active interventionist God. When he noticed that observed shifts in the orbits of Jupiter and Saturn were not compatible with Classical Greek observations of those planets in very similar orbits, he assumed that God must occasionally step in to stop the system out of balance.

The work of later scientists showed that the observed shifts were actually long-term cycles which restored the *status quo*. One could expect broad stability lasting for far longer than humans had been observing the planets. There were several contributors, but the French astronomer and mathematician Laplace did the most important work and showed that the solar system needed no outside hand to keep it stable.[45] There is a popular story that when asked about God, he said 'I have no need of that hypothesis'. This is probably not literally true, but it is a fair summary of what he found. The system solidified into Newtonianism, a belief that everything might in principle be known. Both Adam Smith and Karl Marx were trying to be the Newton of economics, and both failed.

The Newtonian view dominated until well into the 20th century. Then the discovery of Chaos Dynamics changed everything. This included lurking instabilities in the solar system that could in the future lead to the expulsion of one of the existing planets, with Mercury and Mars most at risk. It is also possible and even likely that our solar system once contained additional planets, though the notion of the asteroid belt as debris from some ancient collision between entire planets has long been discredited. Asteroid are remnants of early building-blocks that never did form a planet.

Anyone trying to understand the universe should be familiar with at least the basics of Chaos Dynamics. The best place to start is still James Gleick's *Chaos: Making a New Science*. It was written nearly 30 years ago, but no better popular guide has so far been produced.

Note also that no one has yet cracked the problem of 'Quantum Gravity', a theory that would sensibly combine Quantum Mechanics with General Relativity. One out of the cluster of theories known as 'String Theory' might well do this, if it turns out to be true. But nothing has so far been testable by any experiment humans can perform. One out of the cluster of theories known as Supersymmetry would be a huge step forward. But the Large Hadron Collider has so far been unfavourable, failing to find particles that the simpler versions of Supersymmetry had predicted. The issue is still open: something may turn up to vindicate Supersymmetry, with the Large Hadron

[44] https://en.wikipedia.org/wiki/Schrodinger%27s_Cat. This is an English translation: Schrodinger wrote in German.

[45] See https://en.wikipedia.org/wiki/Pierre-Simon_Laplace#Stability_of_the_Solar_System

Collider having been re-started in 2015 with higher power. But there are valid alternatives to both Supersymetry and String Theory.

Given the amount of uncertainty about the basics, the apparent oddities of the quantum realm might sensibly be dismissed as a product of our lack of knowledge. Sadly, theorists are fond of startling new ideas and hate to admit ignorance. The bizarre favourite is the Many-Worlds idea, which requires an entire new universe for each quantum event, which seems excessive. What's much more popular among non-scientists is the notion that quantum events are only real when we notice them. This is one way of understanding the Copenhagen interpretation of Quantum Mechanics – but as I mentioned earlier, Niels Bohr did not accept it. Bohr assumed that the simple act of measurement by a Geiger counter would be enough to settle the fate of Schrodinger's Cat.

There are also valid alternatives to the Copenhagen interpretation, the 'Pilot Wave' or De Broglie–Bohm theory.[46] These restore determinism, at the cost of perhaps suggesting a mysterious connection between distant objects. Some founders of quantum physics – notably Louis de Broglie – championed an alternative interpretation, known as 'pilot-wave theory', which posits that quantum particles are borne along on some type of wave. According to pilot-wave theory, the particles have definite trajectories, but because of the pilot wave's influence, they still exhibit wavelike statistics.[47] There is no necessity to believe that human observation is a key part of the process, which the Copenhagen interpretation seems to suggest.

Having thought a lot about the matter, I suddenly found myself composing a relevant poem:

> Where is the song of a stuffed bird?
> How does a grilled fish swim?
> How can I tell who belled Schrodinger's Cat?
> And why are observers surprised?
> Why was the muon like nothing they ordered
> In the orderly physicist's world?
> Why does a rainbow bring joy to my heart
> While a melon is simply to eat?
> Why do I speak of this joy of my heart
> When I know that it's only a pump?
> Should I decide that my joys ought to fade
> And just sharpen my logic instead?
> Ask a computer and it won't say 'Yes'
> Nor say 'No', since there's no one at home:
> Ask one who programs (and I was one such)
> And they'll tell you "you fell for our tricks"
> "We wrote the code and it blindly obeys –
> "Though we shouldn't say 'blindly' these days".

Why should a subatomic event need our observation to be real? This is incompatible with a vast mass of evidence that both the Earth and the wider universe had an enormously long pre-human history. And the Earth itself formed from a random scatter of materials about two-thirds of the way through the universe's history. So if we find contradictions in theories that never the less make surprising and accurate predictions, it's most likely that our observations are giving us a very incomplete picture of what's really going on.

A stuffed bird won't sing, because the process of catching, killing and stuffing it has massively altered its nature. But before being caught and given such a cruel re-working, it should have sung nicely enough, according to its species.[48] A human who claimed that the bird only sang because it later ended up in the human's collection of stuffed birds would not be taken seriously. It also seems safe to assume that birds sang very nicely long before there were humans around to notice, even the more respectful sort of human who just wants to listen to the song and maybe record it.

Songbirds are believed to have originated some 50 million years ago,[49] long before there was anything human to hear them – though our remote primate ancestors would have heard and perhaps enjoyed that song. The song of extinct birds is lost; but if some unobtrusive alien observers were there to record them, they could be said to still exist. In any case, such lost songs were real at the time, even if there were no such aliens and the specific sounds are lost beyond recovery.

There is a further muddle in popular understanding, in which the passive act of observation is treated as if it depended on the will or knowledge of the observer. People think that Quantum Mechanics means that if you believing something to be so, you make it so. A convenient and rather lazy notion, since it relieves you of any obligation to study objective reality. You can dismiss it as just someone else's preferred beliefs, as President-Elect Trump has been doing with Climate Change.

This idea merges easily with an acceptance of lying as almost the same of truth. Always a popular notion, since an individual who lies cleverly will have some strong immediate advantages over truth-speakers. But a belief in objective reality would also suggest that liars tend to get caught, as indeed they do. Tells you that an acceptance of lies will in the long run poison any society that allows it, as indeed it does. But with subjectivism, you could feel quite relaxed about the matter. Any bad thing that happens is 'just one of those things'. Not the foreseeable consequences of your own selfish and dishonest behaviour.

In the social world, there are indeed many circumstances where believing something can indeed make it so:

- Financial panics can be caused by nothing more than a belief that there is about to be a

[46] https://en.wikipedia.org/wiki/De_Broglie%E2%80%93Bohm_theory

[47] http://www.sciencedaily.com/releases/2014/09/140912120634.htm

[48] Songs vary by species. A few types of bird do not sing, though they generally have some sort of call.

[49] https://en.wikipedia.org/wiki/Songbird as at 23rd September.

panic.

- The current UK flag is commonly called the Union Jack, even though this probably began as a term just for the naval version.[50]
- 'Computer' was originally a term for humans who were did long repetitive arithmetic. Devices initially known as 'electronic computers' soon made this human function obsolete. Those electronic devices then became known just as computers.
- 'Tandem' is a Latin word that means 'at length'. But it was applied to a rather long bicycle with two riders lined up rather than side by side. A Tandem bicycle may in fact have more than two riders.[51] But the word is also used more widely and abstractly as 'in tandem', two working together.

These last three cases are historic changes. The older meanings remain objective facts, though dropped from current usage.

Atoms – Both Identical and Different?

To get back to particle physics, *Schrodinger's Cat* gets vast attention, despite several easy solutions that allow the quantum maths to mesh with observed reality. Mostly overlooked is a much worse oddity: how can identical atoms of an unstable isotope have different lifetimes? There is no known external cause, but the process is far from random. For a decent-sized mass of a given isotope, one can make a very accurate and reliable prediction of the 'half life'; the time for half of the atoms to have decayed.

Each isotope is a unique combinations of protons and neutrons. Carbon-12 is six protons and six neutrons. It is stable, and is the normal form of the carbon that is a major part of our own bodies and everything else alive, as well as coal and diamonds and chalk and cheese. But it's not the only possible carbon. Carbon-13 is 1.1% of all natural carbon on Earth, and is only marginally different from Carbon-12. It is another matter with Carbon-14, an unstable isotope formed by cosmic rays and which then slowly decays. Carbon-14 can give us important truths, since it is used in archaeology for dating organic materials. It has eight neutrons, six protons and a half-life of over 5700 years.

All this is familiar and used routinely – yet it raises a logical problem that I'd see as much more significant than Schrodinger's Cat. A million atoms of an unstable isotope like Carbon-14 are all identical, as far as we know. But some will undergo radioactive decay and others will not, for no apparent reason. Yet this will happen at a wholly predictable rate, with roughly half a million gone when the known half-life has elapsed. Just how can this happen?

One explanation is 'Hidden Variables' – the atoms are not truly identical, even though we can not measure the differences. This certainly operates in the familiar world – insurance companies make very accurate predictions of death rates in human populations, even though each death has a cause, mostly known and sometimes obvious.

The only other answer I can see is that atoms of an isotope are not really separate entities; just expressions of something more basic. That would require a total rethink of what we currently suppose that we know about the universe. But mainstream science is confident that the universe began as a single interconnected entity in the first infinitesimal moments of the Origin Event or Big Bang. That it only later became cool enough for individual atoms to emerge. So perhaps a correct understanding of physics lies beyond the realms we know.

I said earlier that the Cheshire Cat from *Alice In Wonderland* may have inspired *Schrodinger's Cat*. I've not seen anyone else say this. The similarity suddenly occurred to me for no very obvious reason – a classic *inspiration*. I then checked and found that Schrodinger was indeed in Oxford at the time he floated the idea. Lewis Carroll (Charles Dodgson) spent most of his life in Oxford, and wrote his books there. The inspiration for the fictional Alice was Alice Liddell, daughter of the dean of Christ Church. Dodgson held the Christ Church Mathematical Lectureship for much his life, while Schrodinger was a highly mathematical physicist. They also had a shared interesting in underage girls, though Schrodinger was less innocent than Dodgson is presumed to have been. So it seems likely that Schrodinger knew the Alice stories, including the enigmatic Cheshire Cat. Another topic that an historian of science might find it useful to look into.

The phrase 'grinning like a Cheshire Cat' is a traditional saying.[52] The logic behind the phrase is unknown, though it may be related to the abundance of milk and cream in Cheshire's dairy industries. Cats cannot grin, of course. Humans see them as humourless and serious, yet also slightly mystical. 'Enough to make a cat laugh' is a standard phrase for something truly absurd. Dogs are presumed to laugh, and it seems they really can do so. So do our close relatives among the apes.[53] So do rats, surprisingly enough.[54]

Laughing apparently began as a generalised pleasure-sound for some mammals, though not cats. It is now associated with humour by humans, only because humour gives us pleasure. (I'll say more in a future article about why humour may exist as one aspect of a useful pattern of thinking.) For cats, the pleasure-sound is the purr, so laughter would indeed be alien to them. So we

[50] https://en.wikipedia.org/wiki/Union_Jack and http://www.bbc.co.uk/programmes/p01jph1l

[51] https://en.wikipedia.org/wiki/Tandem_bicycle as at 26th September 2014

[52] https://en.wikipedia.org/wiki/Cheshire_Cat

[53] https://en.wikipedia.org/wiki/Laughter_in_animals

[54] http://www.scientificamerican.com/article/rats-laugh-but-not-like-human/

assume they have no sense of humour, while supposing that dogs share something of our own sense of humour.

For a cat to grin as the Cheshire Cat does is for a cat to cease to be a cat and become a chimera, a mix of human and animal elements. A small relative of the dragon, in fact.

And what about hidden variables? The quarks that compose protons and neutrons are stranger than is normally realised:

> "We've known for half a century that protons and neutrons are not fundamental particles, but made of smaller constituents called quarks. There are six types of quark: up, down, strange, charm, bottom and top. The proton has a composition of up-up-down, while the neutron is up-down-down.
>
> "Down quarks are slightly heavier than up quarks, but don't expect that to explain the neutron's sliver of extra mass: both quark masses are tiny. It's hard to tell exactly how tiny, because quarks are never seen singly…, but the up quark has a mass of something like 2 or 3 MeV, and the down quark maybe double that – just a tiny fraction of the total proton or neutron mass…
>
> "Electrically charged particles can bind together by exchanging massless photons. Similarly, colour-charged quarks bind together to form matter such as protons and neutrons by exchanging particles known as gluons. Although gluons have no mass, they do have energy. What's more, thanks to Einstein's famous E = mc2, that energy can be converted into a froth of quarks (and their antimatter equivalents) beyond the three normally said to reside in a proton or neutron. According to the uncertainty principle of quantum physics, these extra particles are constantly popping up and disappearing again…
>
> "To try and make sense of this quantum froth, over the past four decades particle theorists have invented and refined a technique known as lattice QCD. In much the same way that meteorologists and climate scientists attempt to simulate the swirling complexities of Earth's atmosphere by reducing it to a three-dimensional grid of points spaced kilometres apart, lattice QCD reduces a nucleon's interior to a lattice of points in a simulated space-time tens of femtometres across. Quarks sit at the vertices of this lattice, while gluons propagate along the edges. By summing up the interactions along all these edges, and seeing how they evolve step-wise in time, you begin to build up a picture of how the nucleon works as a whole.
>
> "Trouble is, even with a modest number of lattice points – say 100 by 100 by 100 separated by one-tenth of a femtometre – that's an awful lot of interactions, and lattice QCD simulations require a screaming amount of computing power. Complicating things still further, because quantum physics offers no certain outcomes, these simulations must be run thousands of times to arrive at an "average" answer. To work out where the proton and neutron masses come from, Fodor and his colleagues had to harness two IBM Blue Gene supercomputers and two suites of cluster-computing processors…
>
> "The calculation suffered from a glaring omission: the effects of electrical charge, which is another source of energy, and therefore mass. All the transient quarks and antiquarks inside the nucleon are electrically charged, giving them a "self-energy" that makes an additional contribution to their mass. Without taking into account this effect, all bets about quark masses are off."[55]

Could some of the particular configurations of the 'froth of quarks' (and gluons) within protons and neutrons be the 'hidden variables' that explain quantum uncertainty and radioactive decay, at least for particles composed of quarks? The explanation as to why seemingly identical free neutrons will have different lifetimes, yet all conform to a general rule about their half-life? The decay might be hitting one of more unstable configuration within the froth, or one that can generate an electron that is then ejected. (And likewise for the variable behaviour of individual atoms of unstable isotopes.)

The article I quoted does of course say that the variations are also caused by quantum uncertainty. But these might be influenced randomly by slight interactions with nearby charged particles. It would be like the Butterfly Effect in weather forecasting: arising from definite causes but in practice unpredictable.

I'm aware that uncertainty also applies to electrons. But the fact that quarks have very exact fractions of the charge of the electron suggest that electrons too are composed of something more basic. And so too are muons.

Electrons – the Next Generation

I said earlier what a muon is *not*. To say more about what it *is* requires some wider explanations. Starting with more about quarks, the extraordinary objects that are believed to lie behind the normal world of matter, yet never appear directly.

The idea of quarks came from two sets of data. Firstly, experiments known as *'deep inelastic scattering*' (and modelled on Rutherford's original idea of probing the atom with alpha particles). These produced subtle indications that there were smaller and denser objects within each proton. And secondly from the discovery in cosmic rays and in particle colliders of short-lived particles similar to but distinct from the protons and neutrons that made up the atomic nuclei of normal matter. All of these strange particles and their properties could be neatly explained on the basis of three 'flavours' of quark, called *Up*, *Down* and *Strange*. Protons and neutrons and various similar particles were composed of various combinations of three quarks, with protons being two Up quarks and a Down, while a neutron was one Down and two Ups. The other six known 'baryons' had some mix including a Strange quark. Various combinations of quarks could also pair up as mesons, with the Pion being one Up quark and one Down Quark. All very satisfactory and logical, yet baffling because it was unclear why it existed. The man responsible for this system even called it the Eightfold Way,

[55] http://www.newscientist.com/article/mg22630240.400-quark-ages-how-these-particles-are-the-key-to-new-physics.html#.VXQCOEY2aGk

alluding to the Noble Eightfold Path of Buddhism.[56]

Then they found a fourth flavour of quark.

The existence of a fourth quark, the Charmed Quark, was proposed in relation to something called the GIM mechanism.[57] It was then proved to exist when they found something that came to be known as the J/psi meson. This new meson only made sense if you assumed it was composed of a pair of Charmed quarks, one of them an anti-particle. This happened in 1974, and during the 1970s the *Standard Model* of particles was put together from various bits of evidence and some deeper theoretical exploration. The Standard Model tied everything together even more neatly than the three-quark model. But in an unwanted complication that experimental results imposed upon theorists, it was found it had to have three *generations* of particles. I mentioned these earlier: here I need to say more about them.

The First Generation consisted of four components: the Up and Down quarks, the electron and the neutrino. The Second Generation had another four: the Strange and Charmed quarks, along with the muon and its own distinctive variety of neutrino. And beyond this, there was already evidence for a fifth quark, for which the name Beauty was proposed. Scientists typically dislike using soft and romantic terms for their ideas, so instead of Beauty the name Bottom quark became the standard. It had a heavier partner, the Top quark, and also a Tau electron and Tau neutrino, making up the Third Generation.

The muon finally made sense: it was a 'heavy electron' that belonged in the Second Generation, along with the Strange and Charmed quarks.

It is not known why these generations exist ,or why there are exactly three of them. It is pretty definite that three is the limit: a Fourth Generation would produce visible effects on various interactions if it existed, just as the existence of the Second Generation and Third Generation were deduced before direct evidence was found. Since these effects are not observed, it is assumed that there is no Fourth Generation.

(Assumed rather than solidly proven, because it is remotely possible that a fourth generation exists, but manages somehow to avoid being observed. Just as free quarks can not be observed under conditions that humans can create.)

Note also that no one thinks that the Standard Model is the complete answer. It gives accurate answers if one starts from various known facts, but gives no indication as to *why* these are facts. The current position is perhaps similar to 19th century chemistry, when it was known *what* the chemical elements would do, though not *why*. Where unknown elements could be predicted using the Periodic Table. In the 19th century, the rules seemed arbitrary. Only when it was known that atoms were composed of electrons, protons and neutrons did they start to make sense.

(Which is not to say that the subatomic particles are necessarily made up of something still smaller. There are a large collection of theories that try to do this, mostly using the term 'preon' for the supposed subcomponents. {Other suggeted names include prequarks, subquarks, maons, alphons, quinks, rishons, tweedles, helons, haplons, Y-particles and primons.}[58] Since quarks have *exactly* one-third or two-thirds of the charge of an electron, the obvious approach is to believe in 'preons' that have this one-third charge. Logically, three of them would make an electron, or else would make a muon in combination with something else that would explain the muon being more massive. And that's the sort of complication that burdens all attempts at a successful 'Preon Model'. The true answer may be something so radical that no one has yet thought of it.)

Despite the incompleteness of the Standard Model, we do at least know the difference between a pion and a muon. A pion is a meson composed of a quark and an anti-quark. In more detail, a pion is any of four rather similar things: an Up quark paired to a Down anti-quark, an Up anti-quark paired to a Down quark, an Up quark paired to a Up anti-quark, or a or a Down quark paired to a Down anti-quark. Only the first two, Charged Pions, give rise to muons. An Up or Down quark paired with its own anti-particle is a Neutral Pion. A Neutral Pion is much harder to detect, and most likely to decay into a pair of gamma-ray photons, or possibly a photon and two electrons.[59]

(You may be wondering why the quark and the anti-quark do not annihilate each other, since anti-matter annihilates ordinary matter. The answer is that they do, but it takes time. Something else may happen first. Also a quark can engage in mutual annihilation with an antiquark only if they are of the same 'flavor'. An Up quark cannot annihilate an anti-Down quark, for instance.[60])

Pions decay into muons, but the muon is nothing like a pion. Muons and electrons are leptons, as are the tau electron and the three known types of neutrino. Leptons are quite unlike quarks, but quarks and leptons form part of a larger class of particles called fermions. The other known category is bosons, which include photons and the recently discovered Higgs Boson.

Remarkably, subatomic particles readily transmute into other very different particles, if the total energy is similar and values like charge and 'strangeness' can be conserved. A proton (two Up quarks and a Down quark) hits another proton, and the result is a Charged Pion, either an Up quark and a Down anti-quark or else the other way round.

[56] https://en.wikipedia.org/wiki/Eightfold_Way_(physics)

[57] https://en.wikipedia.org/wiki/GIM_mechanism

[58] See https://en.wikipedia.org/wiki/Preon for some of the rival ideas.

[59] https://en.wikipedia.org/wiki/Pion as at 26th September 2014

[60] http://www.quora.com/If-particles-and-antiparticles-destroy-each-other-upon-interaction-how-do-a-quark-and-an-antiquark-create-a-meson

This then decays into something utterly different, the muon, the inexplicable heavy cousin of the electron. Or the original collision may produce a Neutron, which mostly decays into two gamma-ray photons (bosons) or else a photon and two electrons (leptons). These transformations are possible because the product and result both have much the same energy, while conserving qualities like electrical charge.

Why does it work? As far as I know, there is no real explanation: just a knowledge that these exchanges do happen and have a consistent and predictable pattern. It's as if you purchased something from a department store and then they let you exchange it for something quite different that happened to be at the same price. A saucepan for a scarf, say, and then exchanged again for three teaspoons. (Or a brazier for a pair of pillow cases, as in the old joke.)

None of this was at all in line with human expectations. Looking into the depths below the atom, we have found a wholly baffling world. A world much stranger than any of the imagined worlds of myth or magic or legend. Yet this is the basis of our real existence.

'I Have Twin'

Enough for now of physics. Let's look at how humans organised their own social domains: domains broadly suitable for human life.

Complex open-ended speech is assumed to have made us human. A few very clever animals can talk about particular facts: only humans are able to talk about *anything*. Only humans can talk about creatures like dragons, which don't actually exist. This has no obvious purpose, but comes along with a language flexible enough for cultural changes. Ways to pass on discoveries important to hunter-gatherers, such as how to tell a well-fed lion from a hungry one, or where to dig up edible tubers. It would also have enabled some unrecorded genius to persuade their fellow pre-humans that carrying round a set of well-made stone tools would be easier than making a fresh set every time there was a fresh animal carcass to butcher. This last must have allowed humans to spread well beyond regions with useful flint outcrops. Allowed them to obtain fresh flint by gift-exchange with neighbours: but such social complexities are hardly likely without language.

Languages also have grammar. Some people think that Chinese does not: actually it has plenty of grammar, but very little *inflection*. Words normally remain the same whether they are singular or plural. Past, present and future are all the same. You don't have the complexities of he/she/it/they. The Chinese can of course express these things and much more, but usually by adding extra words. And when they learn English, they have problems learning the correct inflections.

One nice example I overheard while working in an open-plan office. A Chinese lady with twin daughters was asked about her daughters' exam results. And she replied 'I have twin'. That's to say, she understood *'daughters''* as meaning *'daughter's'*, a matter relating to a single daughter, and wished to correct the misunderstanding. But she also forgot the proper inflexion for English plurals and did not say 'twins'.

English-speakers trying to master Chinese can do just as badly. Standard Chinese (Mandarin) has four tones, with the tones mostly distinguishing different and unrelated words. Some time back, I came across a story about lady learning Chinese who managed to confess to having sex with cats, when she was only trying to say she had a cold. I asked on the questions-site Quora,[61] and was told that it was probably someone saying *"wo3 gan4 mao1 le"* when they meant *"wo3 gan3 mao4 le".* And that 'had sex' was the polite version. "I fucked a cat" would be closer; but any Chinese would be expecting errors like that from a foreigner. Though even Chinese can get confused between different dialects, as one of my respondents mentioned:

> "A children's song that went 'I'm a little dragon, I have many little smiles, little smiles'
>
> "And I heard it as: 'I'm a little dragon, I have many little boobs, little boobs.' As a weirdo child, I imagined dragons as COWS."

Note that I am using numbers to represent the four tones of Standard Chinese, as they did. Diacritical marks, commonly called accents, would be more scholarly. But I've used them in the past for foreign words, mostly names such as Schrodinger, and then seen computer software turn them into something meaningless. A document may look fine in Microsoft Word, and then turn letters with diacritical marks into weird symbols when posted to the web.

This matter is another example of humans laying down inconsistent rules, decades ago. A lot of early electronic systems stored letters in a code called ASCII, which stands for American Standard Code for Information Interchange. ASCII was originally a set of 128 characters for telecommunication. They included numbers and both upper-case and lower-case letters, but not the diacritical marks that written English mostly refuses to use to clarify its inconsistent and unpredictable spelling. This also meant that computers could store letters as units of seven 'bits', a bit being something with two possible states, normally represented as 0 and 1. Computers normally store their data like that, binary numbers. But computers were also standardised to work with eight-bit units called bytes. I'm old enough to have actually used computers that used six-bit bytes, made by a UK company called International Computers Limited, long since absorbed by Fujitsu. But eight bits soon became the norm.

So, computers could store seven-bit ASCII in eight-bit storage blocks. But this was wasteful,

[61] https://www.quora.com/Is-it-possible-for-a-foreigner-speaking-Mandarin-to-say-that-they-had-sex-with-cats-when-they-were-trying-just-to-say-they-had-a-cold

particularly in the early years when memory was expensive - my first job was with a mainframe computer doing accounts for an electronics company, and it had 48K of memory, using an obsolete technology called core-store. So to meet more complex needs, ASCII was expanded to be a set of 256 characters, conveniently stored in one 'byte' of computer memory. This including some characters with the diacritical marks used by most European languages. But sadly, this was done several times, and inconsistently. The code for an accented letter in one version of ASCII can mean something completely different in another version. This weakness survives in software that was probably developed using different brands of computer. There is a much superior system called Unicode, which uses extra computer memory to encode more than 128,000 characters covering 135 modern and historic scripts and includes all sorts of letters with diacritical marks. It was started for Chinese ideograms, given the need to easily convert between traditional ideograms and the simplified versions that are part of Mao's legacy. But the world of computing and the internet has not so far standardised on Unicode, which is slower and takes up more space when held electronically.

Electronic codes and language can be confusing: human languages are worse. Another case of confusion between foreigners and Chinese hampered the work of missionaries in China. The West after the Opium Wars imposed both Christian missionaries and a system of 'free trade' that was ruinous for China. Missionaries were in China with the explicit aim of drastically changing or perhaps abolishing traditional Chinese culture. This only partly succeeded: Chinese traditions collapsed but the imported Western culture was inadequate and mostly produced chaos.[62] Christianity asked people to swallow absurd beliefs, but the Chinese soon noticed that the rich and powerful in nominally Christian countries didn't act as if Christianity was their core belief, in the way that rulers of China had almost always had a genuine belief in Confucian values.

Most Western writers on China nowadays assume that 'capitalism plus democracy' should have been the answer. Of course the blend they recommend didn't actually exist until the 1980s, and hasn't been very good for the West. In the century before that, secular liberalism had told interested Chinese about all of the faults and inconsistencies within Christianity, but was also unable to remake China. It came loaded with a vast number of assumptions about society that were not true for China. 'Green great dragon rules' that they took for granted, but did not come naturally to people from a wholly different background.

In the end, a modern China was only made possible by Marxism in its Leninist version. Leninism included an awareness that many Western liberal assumptions were assumptions and not always true. But before that, there was some very understandable strong resistance from traditionally-minded Chinese intellectuals. Some of them used dishonest writings to stir up popular fears:

> "The pamphlets were carefully calculated to stir up the mob violence and superstitious hysteria… Christianity was termed throughout 'the pig-grunt religion', a term originally derived from the unfortunate fact that the Roman Catholic word for God was *Tien-chu* (Lord of Heaven) and that *'chu'* when pronounced in a different tone also meant 'pig'."[63]

'Chu' is the older way of expressing in English a Chinese word now written as Zhu, though an English-speaker would probably transcribe it as 'joo'. Zhu1 is pig: Zhu3 is owner, lord or god.

As someone who has taken a lot of interest in Chinese Communism, I could not help thinking of the Chinese words 'mao' and 'zhu' in relationship to Mao Zedong and to Zhu De. Zhu was Mao's partner in creating the original Red Areas in China. Originally his superior, until Mao became unofficial party leader during the Long March. And a vital supporter right up to his death a few months before Mao. It turned out that his name is yet another Chinese word: Zhu4, meaning vermillion.[64] His name could be understood as 'Red Virtue', a curious accident since this was his name long before he became political. Chinese would also probably not take it so literally, just as Britons would not be literal about names like Goldsmith or Ivy Smith. Yet alternative meanings are always there. Agnes Smedley mentions in her biography that at school Zhu De was teased by richer pupils who said his name as Zhu1, pig.[65]

Mao is even more interesting. His name is Mao2, hair, but jokes are occasionally made about it being 'cat' when spoken in a different tone.[66] His full name could be translated as 'Hair Anoints the East', which is rather appropriate. Even more interestingly – and I think I am the first to make this particular link – there is another noted soldier/politician whose name also means something like hair or hairy – *Caesar*.

(It is also worth noting when English-speakers say 'see-sar' for Caesar, this is an error inherited from Italian, which had a number of sound-shifts from the original Latin. I remember one confusing conversation between myself, my brother and his Finnish-born wife, who had no idea who 'see-sar' was until she recognised him as Kaiser. Kaiser, or Tsar in Russian, is probably much more like the name as spoken by Romans in the time of Julius Caesar.)

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[62] See https://gwydionwilliams.com/99-problems-magazine/traditional-china-resisted-modernisation/ and https://gwydionwilliams.com/99-problems-magazine/why-chinas-blue-republic-achived-nothing/

[63] Barr, Pat. *To China with love*, page 159.

[64] https://www.quora.com/What-is-the-literal-meaning-of-the-Chinese-name-Zhu-De

[65] Smedley, Agnes. *The Great Road: The Life and Times of Chu Teh*. Pages 39-40.

[66] https://www.quora.com/Do-foreigners-typically-mispronounce-Maos-name-so-that-it-means-cat-rather-than-hair

One extra: in Mandarin, even Mao2 can be the sound for more than one word, just as English has bear and bare. I'd also recalled a Taiwanese actress called Angela Mao, best known for her short role as the sister of Bruce Lee's character in *Enter the Dragon*. She was also a star in many other lesser kung-fu films, a few of which I watched when I was a fan of the *genre*. But her Mao2 is written with a completely different Chinese character, and means 'spear'. In Standard Chinese the names would sound the same. They are pronounced differently in Cantonese,[67] and perhaps also in other Chinese dialects.

Chinese once had more tones than the four used by Standard Chinese. It keeps some of these in its many dialects. It is believed that the North-Chinese dialect that became dominant was simplified for the benefit of barbarian conquerors of the Chinese Empire: conquerors whose original languages had mostly not been tonal. That's how humans keep shifting realities while communicating with other humans. But muons fall alike on Chinese, English and the rest of the world.

Green Great Dragons and Old Hospitals

But what are the rules for English? Rules that are broken by *Green Great Dragon*? The Wiki says:

> "In many languages, attributive adjectives usually occur in a specific order. In general, the adjective order in English is:
>
> - "Determiners — articles, adverbs, and other limiters.
> - "Observation — postdeterminers and limiter adjectives (e.g., a real hero, a perfect idiot) and adjectives subject to subjective measure (e.g., beautiful, interesting), or objects with a value (e.g., best, cheapest, costly)
> - "Size and shape — adjectives subject to objective measure (e.g., wealthy, large, round), and physical properties such as speed.
> - "Age — adjectives denoting age (e.g., young, old, new, ancient, six-year-old).
> - "Color — adjectives denoting color (e.g., red, black, pale).
> - "Origin — denominal adjectives denoting source of noun (e.g., French, American, Canadian).
> - "Material — denominal adjectives denoting what something is made of (e.g., woollen, metallic, wooden).
> - "Qualifier — final limiter, often regarded as part of the noun (e.g., rocking chair, hunting cabin, passenger car, book cover).
>
> "This means that in English, adjectives pertaining to size precede adjectives pertaining to age ('little old', not 'old little'), which in turn generally precede adjectives pertaining to color ('old white', not 'white old'). So, we would say 'One (quantity) nice (opinion) little (size) round (shape) old (age) white (color) brick (material) house.'
>
> "This order may be more rigid in some languages than others; in some, like Spanish, it may only be a default (unmarked) word order, with other orders being permissible.
>
> "Due partially to borrowings from French, English has some adjectives that follow the noun as postmodifiers, called postpositive adjectives, as in time immemorial and attorney general. Adjectives may even change meaning depending on whether they precede or follow, as in proper: They live in a proper town (a real town, not a village) vs. They live in the town proper (in the town itself, not in the suburbs). All adjectives can follow nouns in certain constructions, such as tell me something new."[68]

A foreigner reading the rules might suppose that 'tell me a new something" was correct, but of course it is not. But our encoded rules are much as the Wiki says: other sources give similar views.[69] But the example of French is very interesting. It is a member of the same language family as English: both are part of the vast Indo-European assemblage. But its grammar is very different. A French account of a Eurostar journey might be literally translated as *'I march along the road of iron to The Paris'*. The actual title of the translation of Tolkien's *The Hobbit* is *Bilbo le Hobbit*,[70] though the Peter Jackson films appear as *Le Hobbit*.

In French, it is normal for adjectives to come after the noun. Putting them before the noun sometimes changes the meaning. Thus *un hospital ancien* is an old hospital, but *un ancien hospital* is a former hospital. And *un grand homme* is a great man, but *un homme grand* is a tall man.

> "Some adjectives can go before or after the noun, depending what they mean. For a literal meaning, place the adjective after the noun; for a more figurative meaning, you place it before."[71]

On *Quora*, I asked about how the rules vary between languages.[72] I was told that in Indonesian, adjectives may be in any order. In Hebrew, the adjectives come after the noun, but in any order. Russian has the same order as English. Chinese has its own rules:

> "If the adjectives are disordered, I will find it kind of weird, but couldn't tell why. The rule is very complex. i.e., it may be related to the rhythm, the emphasis, or just how many characters these words has."

The topic is something that people with a better knowledge of languages than mine could usefully expand on. But what I have shows how a rule

[67] https://www.quora.com/Would-the-surname-of-Taiwanese-actress-Angela-Mao-be-pronounced-differently-from-that-of-Chairman-Mao

[68] https://en.wikipedia.org/wiki/Adjective#Adjective_order

[69] http://www.enchantedlearning.com/grammar/partsofspeech/adjectives/, https://www.englishclub.com/esl-forums/viewtopic.php?t=27289

[70] https://www.amazon.com/Bilbo-Hobbit-French-Pocket/dp/2253049417

[71] http://www.dummies.com/languages/french/how-to-place-of-french-adjectives-correctly/

[72] http://www.quora.com/Learning-English/In-English-a-native-speaker-would-always-speak-of-a-large-green-box-and-never-a-green-large-box-Do-other-languages-have-similar-rules

that's solid in one language may be different in another language, and not observed elsewhere. These are human matters with are no fixed rules. Just rules that large groups of humans have chosen to live by, mostly by custom and habit and cultural influences.

A Universe Without 'Why?'

I've argued that the universe has no apparent meaning. But that it has accidentally permitted human life, where meanings are fundamental. Even if existence was meaningless to begin with, it need not remain so.

Philosophers mostly see things otherwise:

> "Many philosophers have expressed a feeling of awe when they come to address what Martin Heidegger has called the fundamental question of metaphysics: 'why is there something instead of nothing?'."[73]

They mostly assume that what's true for human life must be true for the universe in general, which is just what I've concluded is wholly false. I found nothing useful in Heidegger. Someone who had read right through the most apparently relevant work reported nothing beyond some waffle about the verb 'to be' in Greek and German.

A lot of philosophical thinking reminds me of a kitten chasing its own tail:[74] they chase abstractions of their own devising as if these were objective facts. Or sometimes they chase each other's tails: get involved in long argument as to why a rival philosopher has got it wrong. This is generally more fun, but little more useful. Philosophy can be a source of interesting ideas, but mostly gives no useful answers.

As I see it, we have a why-less universe. There is something, but it probably occurred for no reason and just accidentally produced a creature that could ask 'why'? Or perhaps many such creatures in the vastness of space; yet still a very thin scattering across that vastness.

Within this thin scattering, lives can remain highly meaningful. And as human potential grows, we need not despair of making a positive impact on the universe as a whole.

[73] https://www.hedweb.com/witherall/existence.htm

[74] Shown at https://www.youtube.com/watch?v=pO5V0yFJWtE, if you've not see it yourself.

Appendix A:
Humans On A Cosmic Scale

Cosmic rays – which are usually protons – typically arrive at enormous velocities. I imagined one arriving at a fairly typical 200,000 kilometres per second, about two-thirds of the Speed of Light. (Which is exactly 299,792.458 kps: the second and the metre being now defined in terms of light-speed.) This is gigantic compared to speeds in the solar system, where the Earth orbits at just under 30 kps. The comet that the Rosetta space probe attached itself to in August 2014 was travelling at just over 15 kps: it speeded up as it approached the sun. Jupiter's average orbital speed is just over 13 kps, while Neptune is much slower at 5.43 kps. The universe beyond our Earth is often counter-intuitive: planets further from the sun move more slowly, even though they have much further to go. Mercury, right next to the sun, orbits at more than 47 kps.

All of these speeds are way outside human experience. A typical passenger aircraft will fly at about 900 kilometres per hour. Concorde had a maximum speed of just over 2000 kph. The fastest regular aircraft so far produced, the Lockheed SR-71 Blackbird, set a record with 3,529.6 kph, just short of 3600 kph/1 kps. The fastest-ever manned vehicles were the Apollo missions to the moon, which returned to Earth at just over 11 kps.[75] This was needed to get there and back in sensible times: the moon's own speed relative to the Earth is just over 1 kps. The Space Shuttles were not as fast, moving at less than 8 kps.

Regarding the smallness of the Inner Solar System as a target:

The average distance of the Earth from the sun is known as the Astronomical Unit. It is about 8.32 light-minutes. The Inner Solar System could be sensibly defined by the maximum distance from the sun achieved by the planet Mars: this is 1.666 AU or 13.86 light-minutes. So we might consider the Inner Solar System as a circular target of 603.67 square light-minutes.

And interstellar space? There are 525,960 minutes in a Julian Year – that's a year of 365.25 days, the unit used for light-years. Just now the nearest star is Proxima Centauri at 4.26 light-years: but stars in a galaxy have individual speeds and directions within a general rotation, so our neighbours vary. Think of our neighbourhood before you get to the next stars as a circular target with a radius of two light-years: anything beyond

[75] This was Apollo 10, the flight just before the moon landing. For the reasons why speeds varied, see http://www.quora.com/Why-was-Apollo-10-the-fastest-of-all-the-Apollo-missions

that is the neighbourhood of some other star. That comes to 3,467,000,000 square light-minutes. The Inner Solar System is about 0.0000000174% of the stellar neighbourhood, or about than 1 in 5,760 million.

The Earth as a target is also very small. The Inner Solar System viewed as a circular target is more than 19 trillion square kilometres. The Earth as a circular target is just over 127 million square kilometres. That's a mere 0.000000000659 %, or less than 1 in 157 billion. But as I explained earlier, free protons exist in enormous numbers, despite space being almost a vacuum from a human viewpoint.

Appendix B: The Naming of Months.

The English calendar is customary rather than logical. It is inherited from Classical Rome via the Latin-Christian culture that once controlled education. The Romans originally had a hybrid system, with months matching the actual waxing and waning of the moon, but an extra February added when the system was obviously out of step with the solar year. The Late Republic let this slip, showing a superstitious dread of risking a double dose of a month traditionally considered unlucky.

Julius Caesar's reform broke their link to the moon but kept the month-names. With minor changes, this system is still our system:

- January, from Janus, the god of gates and doorways.
- February, from *Februa*, a Roman festival of purification held then.
- March, from the war-god Mars.
- April, uncertain, maybe based on the opening of flowers.
- May, probably from the Greek goddess Maia. She was identified with the Roman-era goddess of fertility, *Bona Dea*, whose festival was held in May. Alternatively, the month was named for elders.
- June, probably for the goddess Juno, but possibly a month for the young, to follow the celebration of elders in May.
- July from Julius Caesar, who was deified by Emperor Augustus.
- August from Augustus, deified by his successor Emperor Tiberius.
- September, October, November and December – months 7, 8, 9 and 10.

  The Roman system must have been built by a merger of some even older traditions. They used the December/January split for an annual change of Consuls and other important officials. And since they identified years by the ruling Consul, this became the end and beginning of years. But there must also have been a notion that the old year ended in February and begin again in March. So naming months 7, 8, 9 and 10 made sense, as did the former names of July and August as 5 and 6, Quintilis and Sextilis.

  We have Emperor Tiberius to thank, for not having a run of bad English puns between July and September.

An uncertainty over the year's actual beginning lasted some time in the Latin Christian tradition. Many felt it should be March/April, which is still commonly used for the Financial Year. Chaucer's *Canterbury Tales*, *The Merchant's Tale* has 'Old January' married to a young and unfaithful lady called May. Nowadays we'd say May and December for a marriage mismatched by age.

Days of the week also reflect Roman paganism, and a much older tradition going back to the high days of Babylon, or possible before. A seven-day week is derived from the sun, moon and the five planets known to them.

They could have known more. Both Uranus and the asteroid Vesta can be seen as faint stars by someone who has dark skies and knows exactly where to look. But as far as we known, no one did notice them until they were discovered by telescope. After their discovery, it was realised that earlier astronomers had recorded them as faint stars when they were making sketches centred on something else. They failed to notice that this faint star was moving from day to day. No one back then bothered with recording the positions of the fainter and seemingly insignificant stars. This missed opportunity shows why there is great merit in collecting a mass of raw data even without any particular expectation of finding anything.

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