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Cosmic Creation

Bridging Science and Faith

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Contents

Chapter 1 – An Age of Knowledge

Newton

"Nature and Nature's laws lay hid in night:
God said, Let Newton be! And all was light."[1]
— Alexander Pope.

The Reformers and Science

The Age of the Reformation promoted harmony[2] between science and religion. Early scientists including Isaac Newton agreed. Newton[3] believed that all branches of learning grew from a single source of truth. His revolutionary book, The Principia, explained the laws of gravity and motion, but he also aspired to understand the Bible better, respecting[4] its accuracy.

The desire to restore Christian doctrine and worship to its original form drove the Reformation. Newton understood that this rediscovery needed to go forward, seeking a more precise and straightforward faith. His religious writings would draw on the Bible while being carefully researched, original, and contrarian. He was equally courageous when challenging either religious dogmas or scientific assumptions[5]. Today's Christians should have the same confidence, working to integrate scientific and spiritual truth.

We can all be part of the human quest to learn more about life and the universe. Science provides a map that can guide our pilgrimage and reveal new paths to truth. Our assumptions are likely to be challenged as astronomy, biology, palaeontology and geology advances.

Modern science can be difficult to process for those with a conservative approach to scripture. It highlights flaws in biology and chaos in nature's laws and seems to blame God for the consequences. Some ignore or reject science's discoveries, but this is ungrateful. Ignoring new knowledge, when God gifts us with a capacity to figure out nature disrespects the giver.
On the other hand, knowledge does not save us. By accepting the faith of the Bible, we can travel securely. Its moral compass points to God's love for all life, which soars above human emotions and ethics. At the same time, Scripture is more than a spiritual pointer. It is also factual helping us understand our origin and destination. Although the ancient world that gave us Genesis had different concerns[6] than ours. The scientific method was rediscovered in Newton's era, and the Bible translated into many

1 Sir Isaac Newton was acclaimed as a genius and instantly rose to fame after revealing his finding that white light was made up of more fundamental coloured rays. Newton, a multidisciplinary scholar and intellectual giant in many fields, produced ground-breaking, field-defining works that cut across the gamut of science.

2 "*The successes of the new sciences were vitally dependent upon religious considerations, not least of which were the conditions generated by the Protestant Reformation of the 16th century.. Behind these appeals to biblical authority lay the core Protestant principle of Sola Scriptura. This principle involved an elevation of the authority of scripture to a preeminent position, along with an advocacy of reading it in a literal way.*" - Reformation of Science, Peter Harrison, Aeon, 2019.

3 "*His studies of theology and ancient chronology were of equal importance to him, and were pursued in as rigorous a fashion as his scientific work.. he shared the belief, common in the seventeenth century, that natural and divine knowledge could be harmonised and shown to support each other.*" - Newton and the Pipe of Pan, Mcguire J.E., Rattansi, P. M., Royal Society of London, Vol. 21, No. 2, Dec 1966.

4 "*I find more sure marks of the authenticity of the Bible than in any profane history whatever*" - as quoted in an Apology for Christianity, 1776, p. 91.

5 Newton's Religious Life and Work, Robert Iliffe, 2013.

languages. That helped spread the knowledge of God's message to the world[7] and led to new scientific discoveries, but they became competing paths in time.

Creation in a modern context

Genesis includes both practical and theological knowledge, but can be complex to integrate with scientific models. In an honest world, they must do more[8] than coexist. They need to come together without twisting facts or dumping the Bible as a collection of sacred myths. Yet combining them is challenging because our culture assumes science and religion will always fight.

The gap between science and faith is narrower than most people believe. The last century has been an era shaped by new knowledge. Our scientific civilisation rides an ever-rising wave of discoveries. It is in the 21st century seeking to solve some of life's most difficult questions and challenges. Though many discoveries are well-known, some new branches of science have appeared only in the last few decades. Traditional views of nature are sometimes flawed. A better natural theology[9] is needed for the world of science to make sense to Christians.
At a time when our numbers and technology threaten[10] the Earth as never before, science provides insights into our past. Discoveries confirm that nature is often hostile to life and is chaotic out to the most distant star. How did it get this way? The Bible's writers also recognised a shift in the whole of creation. In biology, this profound change to the natural world is the root cause of suffering, parasites, cancer, and death.

To explore scientific truths, we need to focus on cosmic events. The forces of creation that affect whole universes[11] and explain deep time within the Bible. Christian faith is better served by correcting wrong assumptions that lead to conflict, rather than by attacking scientific discoveries. Elements of creationism's worldview belong to Greek philosophy[12] not the Bible. Plato's theory of creation was already 350 years old when Jesus was born. Our explanation of nature must return to its centre. The key to natural law is Jesus – the one who became the last Adam[13], with consequences for every human. The Bible ends the history of creation with flaws in all of nature, and humanity living in a spiritual war zone. Jesus died fulfilling this ancient scripture, following the pattern of its sin offerings, promising to physically return to replace this decaying universe.

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6 We are unlikely to envision the creator, like polytheists, warring with other lesser gods and chaos demons to subdue and rule the universe. Something Genesis totally rejects. Instead, modern civilisation seeks solely rational explanations and often dismisses any supernatural events.

7 Tyndale's translations, for example, into English, like many reformers, he believed in the priesthood of all believers. That meant every Christian was a priest and had the right to read and interpret scripture. As a side effect, this also implied that a primary education was the right of every individual.

8 A completely allegorical understanding of scripture, thinking of it as poetry, avoids this issue but at great cost.

9 See Natural Theology and Natural Religion

10 According to a global environmental assessment by twelve international scientists published in the journal Bioscience in 2023, 20 out of 35 planetary vital signs are at record extremes, threatening all life on Earth. Humanity is now in completely uncharted territory. "*By 2100, as many as 3 billion to 6 billion people may find themselves outside Earth's livable regions*".

11 There is more than one physical universe as I will demonstrate. This is required both from a creationist perspective where the laws of nature have varied and by modern astronomy in which a multiverse is almost inevitable – see Ethan Siegel, Why do physicists say a multiverse has to exist, Forbes Science, Feb 2021.

12 See Chapter 2.

13 1 Corinthians 15:45 / Romans 5:12-19.

Creationist research focuses on the material events of the flood. This approach often rejects or is selective about discoveries[14] instead of seeking their ultimate cause. Creationists concerned by mainstream science can reconsider their century-old fears. Jesus urged his followers to come together as a family. The bond between us built up through a great love for our saviour, humanity, and a mission to the whole planet. To understand His promise of life to a fallen creation, Christians can accept both science and the entire Bible from Genesis to Revelation.

The key idea is to accept that God altered our universe. He folded the history discovered by science into the events in Genesis. That happened as a consequence of human sin. This explains all the evidence without abandoning scripture as accurate.

All the evidence discovered by science including Earth's long geological history and all of modern biology is exactly correct, but so is scripture. How science's discoveries unfolded, including the origin of our present universe within the Bible's events, is the focus of this book. Rejecting that as impossible underestimates God's power over space and time.

To prove the discoveries of science are real[15], supporting evidence is needed. Science has grown from describing, collecting, and classifying nature in the 19th century to understanding the forces that build universes. This unified theory of the physical world is remarkable, stretching from a distant creation to the present.

Researchers, however, can only take into account natural forces. They will never explain history's ultimate causes and meaning. These are the issues that motivate Christian seekers. Even if complete answers are not yet seen, this search for truth can illuminate science and affirm faith.

Ancient Flaws

"Jesus Christ is the end of all, and the centre to which all tends. Whoever knows Him knows the reason of everything.. The God of Christians is not a God who is simply the author of mathematical truths, or of the order of the elements; that is the view of heathens and Epicureans.. But the God of Abraham, the God of Isaac, the God of Jacob, the God of Christians, is a God of love and of comfort, a God who fills the soul and heart of those whom He possesses" – Blaise Pascal[16]

Pascal's God.

On the evening of 23 November 1654, mathematician and thinker Blaise Pascal had a turning point in his life. Pascal was a genius best known by Christians for inventing a wager about the existence of God. As a mathematician, he helped begin the modern theory of probability. He also made some of the first mechanical calculators, the ancestors of modern computers. Pascal's Law was his discovery, which

14 Although few creationists directly challenge mainstream science, many still use objections that were immediately disproven when first suggested or misrepresent what science is really claiming. See most of the claims here for example as used by Kent Hovind, David Menton, Jonathan Sarfati, and Australia's own Ken Ham the founder of Dinosaur Adventure Land.

15 This book is as dense with facts as a science textbook. It does not assume scientific ideas to be true without providing proof, or at least pointers to deeper study. This is vital when presenting an alternative to existing creation models based on discoveries from diverse scientific fields.

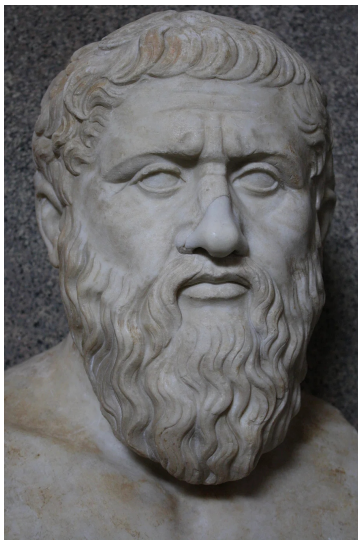
16 Pascals Thoughts, trans W. F Trotter, Collier Press, 1910, p. 186, Wikisource

established the theory of the hydraulic press. Today we measure units of internal gas pressure[17] or material stress in a certain number of Pascal's.

On this night, he opened his heart to the Jesus that he met in the gospels. This certainty was a holy fire inside him, a transformation. It was a call from "*The God of Abraham, God of Isaac, God of Jacob*[18]*, not of the philosophers and scholars*", as he wrote at the time. The most profound truth from the Bible is that we have a direct relationship with God. We may go beyond the symbols of religion because of this spiritual link to our creator. Unfortunately, traditions have developed around what a God must be. Where the Bible is silent or provides limited information, borrowing ideas from other cultures is risky. Inaccurate ideas about the nature of God, humanity and creation were brought into Christianity.

Identifying these issues helps improve our understanding of the real God of history and our origins[19]. Others have echoed Pascal's idea that assumptions of classical thinking propose wrong ideas about God. Rabbi Jonathan Sacks for example writes "*What Williams saw as a contradiction within faith, I recognised as a contradiction between the Jewish and Greek conceptions of God. The changeless, unmoved mover was the highest God of Plato and Aristotle. The God of history was the God of Abraham. They simply did not belong together.*[20]"

Plato's Eternal Forms



Plato[21] is one of the most dazzling thinkers among ancient writers. Born in 428 BC to a privileged family, he lived towards the end of the Golden Age of Athens. He grew up during the Peloponnesian War with the city state of Sparta. Plato must have seen the consequences of this unrestricted conflict, and the near civil war that followed and hoped for a better future. This can be seen in his religious and philosophical writings.

His impact on science and faith begins with his concept of a world of forms, illustrated by his story of the cave. Forms are flawless, unchanging, one of a kind patterns, which the natural world imperfectly reflects, like shadows seen on a cave wall. The material and visible world is just flickering shadows while the unseen ideal world is the true reality. Plato believed that creation is an accurate realisation or copy[22] of those eternal forms. Although the creator is the builder of nature, and is good he is unknowable and just one of the many gods. Unlike the philosophers that came before him, Plato required a creator god to arrange and harmonise nature. He believed that the original chaos had been shaped to fit a divine musical scale and that nature's material is based on the geometric ratio's of various shapes[23]. Nature was he thought, essen-

17 Pascal's are derived from Newtons of force per square meter. In 2023, Christians celebrated the 400 anniversary of his birth an event commemorated in a letter by Pope Francis.

18 See A Night of Fire: The Mystical Vision that Converted Scientist Blaise Pascal.

19 By pointing out that God has limited his own influence over the universe due to death and sin. Therefore it is acceptable to invoke the consequences of natural laws when discussing origins.

20 The Great Partnership: Science, Religion and the search for meaning, Jonathan Sacks, p. 83.

21 Photo of a bust of Plato, mid-1st century BC copied from a 4th century original statue by Silanion.

22 "*Now, regarding the entirety of heaven or if you wish the cosmos, we must first answer the fundamental question: whether it has always existed, with no beginning, or has an origin. It is observed so must have come into existence. … It is proven that all things tangible and seen have a beginning and are a result of some cause. Yet finding the first cause, the creator and father of all is a difficult endeavour, and once he has been discovered, declaring anything about him is impossible. So let's us go back and ask another question about the cosmos: Which model was used to construct it? A self-defined and eternal one or was it based on something already existing. As our cosmos is beautiful and its maker good, it is evident that the builder fixed his gaze on the eternal, it would be an insult to the gods otherwise. The cosmos is most beautiful, and he (the demiurge) is the greatest of all causes, it is obvious to everyone that he was looking to the eternal.*" - Plato, Timaeus, p28c. Paraphrased for easier comprehension.

23 "*From Plato onwards, there is an assumption of a god organising the cosmos. For each of the actions of that god there has to be a reason and some of those reasons are supposed to be mathematical or geometrical.*" - Mathematicians and their Gods, Lawrence & McCartney, Oxford University Press, 2015, P45. The Builder constructed the universe by fash-

tially good and orderly. The perfection of the planets and the heavens was widely accepted. After all they were already worshipped as gods and the sky was their home. The Earth was flawed, but still copied from a perfect design.

Plato's world of forms is spiritual, existing beyond any physical creation, even the heavens. He believed that humans could only learn things because of the movement of souls through reincarnation. Between their lives on Earth, human spirits could glimpse the Plane of Truth[24] they share with the gods. This is higher than the physical world. Souls need to escape, leaving the material world far below to reach[25] it. The qualities and knowledge they gain from this experience determines the kind of human they are then able to inhabit. Plato's ideal for society was stratified with everyone having a fixed role in life. Soul's are the same. They descend from the highest, a philosopher, lawful king, prophet or priest, artist, or skilled worker, down to the lowest souls that move into animals. "*The soul which has not yet seen the Truth can never pass into a human*". Having seen the horrors of civil war, Plato focused on how we can do better. Especially in his most famous book The Republic. That showed how humanity can build justice and rational thinking into society. Rulers should be philosopher-kings establishing a strict but fair government. Everyone should understand their place in this grand scheme and obey the principles of society. That would permit citizens to take unified action, during peace or war.

The idea of eternal forms became a foundation for the growth of early science. It allows natural laws and mathematics to exist out there in the sunlight of Truth. There is a reality beyond the cave, waiting for scientists to discover it. Science also looks for recurring patterns in nature. Placing everything into just one group each, helps with this, although it badly oversimplifies. These groups assisted early scientists to construct hierarchies of life. Aristotle was Plato's student. His attempt to classify the animals he observed was just the beginning of this process. Carolus Linnaeus the 18th-century Swedish botanist took it much further, inventing a system that categorised all known animals and plants in a tree according to their common features. Today's science creates elaborate trees[26] of descendants based on their genes. Plato's ideas align with the scientific notion of observation as the path to truth. Scientists need to examine many imperfect examples to find their common features. However the ideal of eternal forms was distorting. It promoted inaccurate ideas such as fixed species. Creatures always returning to the ideal static form that they belonged within. Earth's biology[27] isn't like that, and this common idea still causes problems.

Aristotle disagreed with his teacher Plato. He rejected any need for a perfect realm of forms outside nature. Instead, the forms were simply the essence of each creature. Helping it to achieve its purpose.

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ioning each of the four primal forces of nature to be as perfect and excellent as possible. He selected four of the five regular solids: fire is a tetrahedron, air an octahedron, water is an icosahedron, and earth a cube. The remaining regular solid, the dodecahedron, is used for the universe as a whole, since it approaches most nearly the shape of a perfect sphere - Plato's Timaeus, Stanford Encyclopedia of Philosophy, 2022, plato.stanford.edu/entries/plato-timaeus/

24 "*The region above the heaven was never worthily sung by any earthly poet, nor will it ever be.. The colourless, formless, and intangible truly existing essence, with which all true knowledge is concerned, occupies this region.. It is a law of destiny, that the soul which follows after the gods and obtains a view of any of its truths is free from harm until the next epoch.. For a human being must grasp a unified understanding of the manifold impressions of the senses via reason; and this arises from a memory of those things which our spirit once glimpsed, when it travelled with the gods and climbed up into real existence. Elevating its gaze above the things that exist*" – Plato, Phaedrus, p247.

25 This is partly a metaphor but also contains a real explanation of Forms and the differences in human and animal natures, because reincarnation (metempsychosis) was a common Greek belief. It is not entirely clear how Plato understood the Forms, because he doesn't fully definite them but they appear to have developed throughout his writings. Some were abstractions like Justice or Truth, others were oddly specific but hard to define. For Plato the world of Forms was more real than the everyday world which contains only imperfect copies. While living beings were merely copies of copies, far removed from the perfect originals.

26 Genetics provides a far cleaner definition of relationships, across vast families of organisms and is sometimes surprising compared to anatomical trees. A recent example identifies relationships across a sample of 50 percent of all flowering plants, a massive dataset for this successful plant group, that corrected several previous errors in their family tree with thousand of detailed genetic samples.

27 Biologists talk about a species, but it is a vague human classification of something much fuzzier and constantly changing. A cross section of a set of shared genes at a given time with the edges arbitrary cut off for simplicity of discussion.

He was concerned with the purposes seen in nature[28]. He felt that everything had a distinct cause and purpose. Should a creature develop[29] a body part, that was not suited to its way of life it would soon die. So over time every animal and human will find their place in a self balancing world. These ideas about nature's independence were part of his quest to develop formal logic, the foundation for science. He saw no need for a builder of the universe because he believed that nature was self sustaining and everlasting. Aristotle was one of the first to think of nature as being without a designer but not without complex relationships or structures. He did wish to avoid an infinite chain of causes without a beginning. Therefore, he proposed[30] a timeless mover of the planets, an originating first cause. This mysterious thing was eternal and incapable of change. Not even a god, the first mover was a faceless impersonal force. Merely the first link in the great chain of cause and effect. It started the crystal spheres of space spinning, helping to create the heavens and that was all. His followers did not see much evidence that the gods were active in the world anyway. They were inspired by his self-caused, self-sustaining cosmos in which everything had a plan and a purpose. Aristotle had invented naturalism, and it would go on to become one of science's key assumptions.

Plato's world of forms was appealing to later Christian philosophers. However, they also employed the idea of a first cause to describe God. The creator was without any history or ability to change but created the moving parts of the universe. He also gave a purpose to everything within it. Greek philosophy originated the idea that everything in nature is designed for a fixed role in a grand mechanical[31] design. Humans are just tiny cogs in the ordered machinery of nature.

Augustine and Plato

Platonic ideas were equally damaging to early Christianity. In the 3rd and 4th centuries AD, followers of Plato extended his ideas. In their view, every eternal form originated with the supreme form, who generated them all in descending steps. The idea of God held by Plato's later followers was also different. He was the only truly holy being and the highest of Forms. Greek educated Christians and broader society in the late Roman Empire accepted this remaking of God's nature because it fitted their idea of the world. This was already a foundation of society, due to the influence of the Hellenistic empire founded by Alexander the Great. That had once reached from Spain, down to Egypt and eastward to what is today Pakistan. By this time it was ancient history but was still an empire of the mind. That period had made Greek culture, its writings and philosophy vital knowledge for centuries.

Historian Will Durant writes about this topic in his book[32] the Story of Philosophy. As he explains, much of the intellectual structure of Catholicism, beyond the Bible's foundations, is derived from Plato. Medieval ideas of heaven, purgatory, and hell are traceable to the last section of his Republic. An understanding of the universe's structure comes from Timaeus. The Christian concepts of realism and a Divine Eternity reinterpreted Plato's forms. Plato's influence on philosophy, Greek and Roman culture and Christian theology cannot be overstated.

28 Greek teleos, the final cause and purpose of a thing or its reason for existing. Aristotle's notion that everything requires a teleos, supported the rise of epistemology.

29 Since the universe was eternal and everything developed due to a chain of causes, it needed some way to fix errors and adjust. Aristotle anticipated this aspect of modern biology. He may have been suggesting something like the concept of biological fitness, allowing a creature to carry out its purpose within nature.

30 Physics, Book 8, part 6. Also concluding that the universe must be eternal because it was the first thing changed by the unmoved primal force. The logic of this idea is a doubtful and incomplete in the original text.

31 The Greeks were not unfamiliar with mechanical devices. A few hundred years from Plato's era they could make items such as the famous Antikythera mechanism, a first-century BC multi geared analogue computer, somewhat like an astrolabe that could calculate astronomical positions and eclipses, discovered in a Greek shipwreck in 1901.

32 The Story of Philosophy: The Lives and Opinions of the Greater Philosophers is a 1926 book by Will Durant, in which he profiles several prominent Western philosophers and their ideas, beginning with Socrates and Plato.

Augustine of Hippo[33] who lived in this period, adopted many Platonist ideas. He accepted Plato's and Aristotle's ideas about God, before learning about Jesus from the gospels. Augustine reinterpreted Christianity through the lens of their religion. He agreed that the Highest Form must be the God of the Bible, building his defence of Christianity[34] on their ideas. It rebuilt the Bible's descriptions of God, placing Him at the top of a supernatural hierarchy, that mirrored the earthly church and state. That change stirred up controversy. For centuries, the church was wracked by the Arian heresy, which denied that Jesus was equal, or the same substance as God. How could that be true, when he was born from a woman and experienced time. After all, wasn't God eternal and timeless? Jesus must be the same as the demiurge, made along with time. The rebels decided that he must be just another instrument of God like the angels. It took years to resolve that difficulty. It led to church councils, many excommunications and brilliant writing, including the Nicene Creed[35].

Augustine described God's Eternity as static and unchangeable, modelled on Plato's universe of forms. Eternity in his book Confessions is a single unbroken moment that determines and contains everything. "*Who will seize the human heart and hold it still so I can see how Eternity, which has no future or past, stands still and dictates future and past times?*" Time had no real existence outside of the feeble imagination of humans[36], he believed. Eternity defined everything because it was the one true reality above nature. This view was an unholy mashup of the Bible and Plato's logic. It became the Christian intellectual framework for understanding both God and creation. Although its ideas were false in every way, it remained unquestioned for a thousand years. This collection of ideas are not supported by the Bible even though they have become[37] shared assumptions. Weslian theologian William Lane Craig[38] puts it this way, "*Doctrines of divine simplicity and immutability which are sufficiently strong to support divine timelessness are even more controverted than the doctrine of divine timelessness itself. These strong doctrines find no explicit support in Scripture, which at most speaks of God's immutability in terms of His faithfulness and unchanging character*". They add physical rules to God's nature that are simply not present in the Old Testament, the Gospels or in Paul's writing.

Thomas Aquinas

Thomas Aquinas writing seven hundred years after Augustine, defined many doctrines in the medieval church. He argues[39] that the existence of natural death and suffering is not contrary to God's goodness. God must create only imperfect worlds because He alone, is without flaw.

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33 Saint Augustine (born November 13, 354, Tagaste, Algeria, died August 28, 430 AD) was bishop of Hippo from 396 to 430, one of the Latin Fathers of the Church and perhaps the most significant Christian thinker after Paul. Augustine's adaptation of classical thought to Christian teaching created a theological system of great power and lasting influence. His numerous written works, the most well known of which are the Confessions (c. 400) and The City of God (c. 413–426), shaped the practice of biblical exegesis and helped lay the foundation for much of medieval and modern Christian thought – Encyclopedia Britannica.

34 Confessions, book 7, Ch 9 "*You (God) procured for me.. certain books of the Platonist's, translated from Greek into Latin.*" Ch 11 - "*I viewed the other things below You, and perceived that they neither altogether are, nor altogether are not. They are, indeed, because they are from You; but are not, because they are not what You are. For that truly is, which remains immutably*". Ch 15 - "*I perceived that it was to You they owed their being, and that they were all bounded in You; but in another way, not as being in space, but because You hold all things in Your hand in truth*".

35 Christians do not need to be bound to traditions of timelessness because it does not have strong biblical support. Which for example the idea of the trinity has, as seen in Genesis with "*Let us (Elohim) make man in our image*".

36 Although he was absolutely certain of the nature of God's Eternity, time remained mysterious. Writing that he could explain it until someone asked him exactly what it was. He did think that time began with the creation of the world in Genesis, this was the explanation for what God was doing before creation. This comes directly from Plato, "*The One's essence was Eternal, but it was impossible to bestow that attribute onto a created object. Therefore he (the demiurge) produced a moving picture of Eternity, made of patterns of numbered events, even that which we have dubbed time. For days, nights, months, and years did not exist before the creation of the cosmos, he formed those things with its construction.*" - Timaeus, 38b.

37 See for example the Apostolic Constitutions, book 7, section 34, written in Antioch, Syria about 380 AD possibly by the 4th-century Eunomian bishop Julian of Cilicia.

38 www.reasonablefaith.org/writings/scholarly-writings/divine-eternity/divine-eternity

39 God's Purpose for the Universe and Problem of Animal Suffering, B. Kyle Keltz, Sophia, 2019, Issue 58, p. 475–492.

God's purpose, is to create a universe containing a hierarchy of beings starting with spirits and descending from his perfection. Unfortunately, this requires corruptible beings at the bottom of creation. The nature of corruptible[40] beings necessarily[41] creates death and suffering. This is not awful according to Thomas. It is an essential part of The Plan. We were designed to be hopeful monsters[42]. God must sustain a hierarchy of life in order to fulfil His purpose as the first cause, which is to bring about creation and demonstrate His power, not necessarily to be gentle or warm-hearted. God has 'metaphysical goodness'[43], not necessarily moral goodness. God is good, in a way that transcends human concepts. Even when his actions cause immense suffering throughout his creation. One explanation for laws generating endless evil and misery is a designer with unknowable qualities. According to this view, God's divine nature requires Him to do things that, for a human, would be pure evil. For example creating and maintaining the tortures of hell. No wonder the church came to accept suffering as the primary path to holiness with that view of the creator, and were ready to kill anyone[44], including other Christians, who disagreed.

The existence of Jesus disproves any doctrine of divine simplicity, or timeless knowledge. In Jesus's own words, "*No one knows about that day or hour, not even the angels in heaven, nor the Son, but only the Father*[45]". God's knowledge and experience is shaped by time. In contrast to that medieval view, the royal line started by David preferred a metaphor of a suffering divine king. One who knows each person intimately. Sacrificing his life for humanity, not being an imperial dictator. It is no accident that Jesus quotes more from the Psalms than any other book.

Philosophers don't do science. They do not seek independent evidence or run experiments to test ideas but seek to deduce the truth[46] from assumptions and logical principles. This can injure faith if those assumptions are alien to the Bible. Philosophy and tradition cannot limit God. As the Bible shows, He is a living adaptive being who chooses to build, and adjust his relationships with his creations. Besides that, it is peak human arrogance to think we can learn anything about God's nature. Except when it is based on his own voice speaking to us through scripture. To remove distortions of God's character from our faith serves truth. As Newton[47] explains, "*It is rather a danger to religion than an advantage to make it now lean upon a bruised reed. There cannot be better service done to the truth than to purge it of spurious things*".

This ancient view of God and time, affected the philosophy of scientists, including Albert Einstein. Eternalism is the idea that time is just another dimension, that future events are 'already there', so time

40 Here Aquinas echos Aristotle's cosmology. Everything below the crystal sphere holding the moon is not just spiritually corrupt, changeable and contingent but physically made of poorer material than the heavens. It is obviously flawed so God must have intended it to be that way. Then below the Earth is the fiery realm of Hell. The worst of the worst.

41 Not only are they corruptible, but their nature being Earthly is intrinsically separated from God and therefore almost certainly will become evil.

42 This is part of a long history of Christian confusion over mans nature, i.e. Pascal "*What chimera then is man? What novelty, what monster, what chaos, what subject of contradictions, what prodigy! Judge of all things, clueless worm of the earth; depository of the true, cloaca of uncertainty and error; glory and refuse of the universe. Who will unravel this garble?*" (n. 438). A question greatly clarified by scientific knowledge of deep time and human genetics.

43 From a metaphysical perspective, Aquinas asserts that the world is better for having evil within it, because endless evil serves heaven's greater good. Natural evil contributes to the variety of creation, and God sometimes inflicts evil as punishment in order to maintain the just order of the universe. Balance justifies the evil God does. Thomas Aquinas, part 7: the question of evil - Tina Beattie, 12th Mar 2012, Guardian

44 Priscillian was executed in 385 CE. This was within five years of emperor Gratian recognising heresy as a crime. His call for a life of personal piety and asceticism, including celibacy and abstinence from meat and wine, was unpopular with the clergy. Notionally executed for practising magic, but based on a confession that was beaten out of him, he was the first Christian executed for heresy by other Christians. As the pagan emperor, Julian (331-363 AD) was reported to have said "*No wild beasts are so dangerous to men as Christians are to one another*".

45 Matthew 24:36, This verse shows that the Father's precise plans for the future were not known to Jesus at that time. Disproving simplicity, and models that exclude time from the divine nature of God. Presumably there is an exception in the idea of simplicity for the incarnation, but the idea itself is fundamentally broken.

46 Similarly to how early psychologists sought to understand the human mind by observing their own thought processes. As they discovered, that results in unstable theory that goes nowhere and predicts nothing.

47 Memoirs of the Life, Writings, and Discoveries of Sir Isaac Newton, Vol. 2, Edinburgh: 1855, p. 337, here writing about some doubtful additions to the end of NT manuscripts.

does not really flow from the past to the future[48]. There is a war of words over this question of time's nature among scientists and philosophers. Some prefer Eternalism with its static past/present and future[49], for its simplicity. There is also disagreement about God's relationship to time and what time truly is, and this debate has a long history. Isaac Newton believed[50] that both time and time's flow are the "*duration of the being of God*" and therefore, a useful side effect of God continuing to exist. That seems to me, to be the most elegant solution.

A truly timeless being does everything by necessity. Any universe it has contact with, becomes infected with that same quality. If God is timeless, then our universe must be completely predestined. This has been understood for centuries. It becomes hopelessly confusing when trying to explain free choices. Such as C S Lewis's explanation of God's foreknowledge: "*He does not know your action till you have done it: but then the moment at which you have done it is already 'Now' for Him*[51]" or Aquinas' views[52]. These theological stories[53], define God's relationship to nature without proof, and attack free will. Regardless of what gymnastics are employed to conceal that fact. They defend a traditional philosophy that was never inspired or scientifically accurate. For the universe to have a fixed future everything in it must be deterministic, predicted exactly by its previous state. However modern physics has proven that this is untrue. In biology, nature has the freedom to transform endlessly without any need for designs.

A God within time fits the Bible writers' views[54] and how He builds relationships through the ages[55]. If the Bible is accurate, then there are future events God has decided not to determine in advance. There are many places in the Bible when he changes his mind[56]. A biblical faith is about God with us. This does not limit God to a human scale. It confirms that He is present[57] and in command of current events.

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48 See Presentism, Eternalism, and the Growing Block Theory, Stanford Encyclopedia of Philosophy

49 According to the block universe theory, an analogy for time is that the universe is a giant block of all the things that ever happen at any time and at any place. In this view, the past, present and future all exist — and are equally real with no significance to the moment that is the present. Quantum variations on this include only the blocks from the beginning up to the present, so are closer to traditional views of time. Any model that includes quantum effects needs to eliminate a predetermined future due to its randomness.

50 Isaac Newton suggested in a number of his publications that physical space is God's '*emanative effect*', indicating something intriguing about the metaphysics behind his mathematical physics. Newton's ideas differ from Plato's and Aristotle's metaphysics of space, as well as from Classical and Cambridge Neo-Platonism. Newton was not just a mathematical physicist but also in some ways an independent-minded rationalist philosopher.

51 Mere Christianity, p.149. C. S. Lewis was trying to carefully unpick the impossibly tangled Gordian Knot of perfect foreknowledge. See in addition, discussion of the history of Molinism or the debate over what exactly free will is. As a matter of logic, complete foreknowledge should require perfect, aka double predestination condemning most people to damnation before their birth. In reality our universe is nearly always contingent so that the past and future exist only as memories or potentials in the present. Relativity may alter how we experience time, but not its sequence or direction.

52 Aquinas put it this way "*God is altogether outside the order of time, established in the Fortress of Eternity, beneath which the entire course of time is laid out, so in one look he sees all things that are done in the entire course of time*".

53 With Augustine's and Aquinas' model of time, God knew in advance which events and characteristics of Lucifer's nature, would combine to drive him to sin, and all the evil he would do afterwards, there was no ambiguity about his future. Yet God still made him that way, knowing his fate. If these models of time are correct, that would make God the intentional designer of evil. As Lucifer was wholly Gods creation and his environment and role was under His control.

54 Bible verses that seem to support a timeless state, such as 2 Peter 3:8 and Psalm 139:41, are being misused. They are discussing God's personality and plans. In Psalm 90:4, Moses, who once walked amid the fabled monuments of Egypt, writes, "*a thousand years in your sight are like a day that has just gone by*", but the verse only contrasts the stable nature of God with humanity's frailty. Acts 15:17-18 is talking about God's plan to redeem the gentiles, but might be applied to his plans in general. Such verses are misapplied to support a theory of a place or state of existence outside of time. Nowhere in the Bible does it promote any such idea.

55 When humankind emerged, we looked up and watched planets cross the sky. These wandering lights were voiceless and unmoved by our pain. So we sought comfort in idols made of clay, stone and wood, giving them faces with eyes to see us. They were a lie, blind and deaf to our pleas. Generations of rulers claimed divine power, thundering their laws from behind high altars. Their laws and temples could not fix humanities situation. In time empires dissolved, and nations spoke of the death of God. "He was only a dream of humanity's childhood. We are wiser now." Yet in all this seeking, we never found the creator of this universe. Yet God revealed Himself to humanity in every one of those ages.

56 God must have the ability, of even the lowest creatures, to alter plans. For example, in Amos 7:6, "*The Lord changed His mind about this. This too shall not be, said the Lord God*" and Jeremiah 26:13 "*change your habits and your deeds and obey the Lord your God. The Lord will change his mind about the disaster that he told you about*" (ISV).

57 The New Testament writers emphasise Jesus' deity and the fact that He is the only path to God, not simply a Greek demigod, the offspring of a god and a human.

Gods choices and our response to Him jointly defines the future, although he shares his current plans with the prophets. The best explanation of God's relationship to the future is found in Jonah[58]. The choices of key individuals altered future events and changed the judgement of doom that Jonah had been given. Shalmaneser the third, king of Nineveh and his court and then the whole city decided[59] to repent. In response, God changed His mind. That shows how nearly all prophecy may become conditional[60]. Because God is willing to turn back his judgements[61] and show even greater mercy than we expect.

Early Christianity, after the death of the apostles and the end of persecution, was a product of Jewish and Greek culture. It was the union of two mighty streams of thought about logic, human nature and God. The result has been immensely influential to all civilisations since. It was reasonable for the Greek speaking church beyond Judea to reuse ideas from their culture, but that doesn't make everything from this period inspired. It took the reformation centuries to unpick just a few mistakes of this era of the church. Their ideas about time and Eternity also need reexamining. Platonic religious ideas are also core features of creationism. They bring it into constant conflict with science.

A biblical viewpoint

In contrast to a personal saviour, the God of the medieval church is as unworthy of love as any Roman emperor. Christians can decide that God is timeless and that the future is fixed, but we must also acknowledge that these ideas do not originate within the Bible. As theologian Greg Boyd puts it, *"If our thinking about God remains steadfastly focused on the one who suffered a hellish death on the cross, would it ever occur to us to think that God's essence never suffers? If all our thinking is oriented around the crucified Christ, would we ever imagine that a God whose essence had no 'before' or 'after' and had no potential to change, or to be affected, or to suffer was more glorious than a God who in his very essence experienced sequence and had the potential to change, be affected and suffer?"*[62].

Free will is God's gift, but also something we naturally obtain from nature's laws. He gives us freedom because His love[63] does not insist on a single response, our God is not a dictator. Our universe does not run like clockwork where events depend mechanically on preceding ones[64]. At the boundary between randomness and order[65] freedom comes into being. There is a real God, one for slaves not senators. He rejoiced with King David, inspired his songs and pardoned his failures. He took the name of Yeshua, today's Joshua, meaning the One who Saves, but we call him[66] Jesus. He proclaimed freedom and

58 Jesus singles our Jonah as the model for his own ministry to the Romans and Greeks, everyone receives a free choice to receive Gods message or reject it, insiders like the Jews but also pagans.

59 The Assyrian legends of the sage Oannes, a fish-man hybrid who appeared from the sea and taught their people all manner of knowledge, including their story of creation, writing, lawmaking, construction, mathematics, and agriculture, must have influenced Jonah's reception just as God intended. The sage's priests would dress in fish costumes from head to toe. So, a messenger appearing alive, directly from a fish's mouth with a heavenly warning was exceedingly significant in their culture.

60 An exception are prophecies where timing is built in, see for example the days of Daniel. These represent Gods planning that overrules the choices of humanity.

61 Jeremiah 18:7 – *If I declare that I am going to uproot, stamp out and destroy a nation, or kingdom because of its wicked ways and then that same nation I warned turns away from its evil. Then I will change my plans. In my compassion I will not destroy it.* (Voice bible translation)

62 reknew.org/2017/04/challenging-assumptions-classical-theism. Boyd is a contributor to the BioLogos Foundation and has written extensively about reconciling Christianity with science. This point is why the crucified Christ was 'nonsense' to the Greeks, with their concept of Godhood how could it be anything else (1st Cor 1:23).

63 1st Cor13:4-7 - "*love does not envy or boast; is not arrogant or rude. It does not insist on its own way*"

64 The uncertainty in quantum system is proportional to Planck's constant and therefore is fixed at the time of a universes creation. That is the smallest unit of energy from which everything in the universe is built.

65 "*Quantum physics has a property of fuzzy randomness, which scientists feel could open the door to free will*" - blogs.scientificamerican.com/observations/photons-quasars-and-the-possibility-of-free-will

66 The first time the name Jesus was ever spoken was in June of 1632. Jesus is the name used by most English-speaking people today. It is an English transliteration deriving from the Late Latin name Iesus, which transliterates the Koine Greek name Ἰησοῦς Iēsoûs. In the Septuagint and other Greek-language Jewish texts, such as the writings of Josephus and Philo of Alexandria, Ἰησοῦς (Iēsoûs) is the standard Koine Greek form used to translate both of the Hebrew names: Yehoshua and Yeshua. In the post-exilic books, Joshua the son of Nun is called both Yeshua bin-Nun (Neh 8:17) and

justice within a better kingdom. God walked with us, washed our feet, danced at our weddings and wept at funerals. He shook his head at our stubborn pride, even as we buried ourselves in ignorance and darkness. This God of love was from Nazareth, the region known as the branch, and taught in Galilee,[67] where refugees, Jews, and outcasts lived on the edges of the Roman world. His people rejected and condemned him, but we are drawn to him as our older brother. He followed a divine plan[68] devised at the fall to bring humanity back to our creator.

The pagan gods were flawed, inventions of our misery and need for order. Compared to Jesus's unique kingdom, Plato's Utopian city envisioned in his Republic is an ant's nest. It has no genuine freedom below the noble classes. Instead, Jesus preached a justice that flipped the world upside down. God's purpose has developed within history, but the Christian message is part of a redemption larger than our universe. That plan is found in every book of the Bible, from Genesis to Revelation and it affects every living creature.

Yehoshua (1 Chron 7:27). Both the full form Yehoshua and the shortened form Yeshua were in common use during the Gospel period. Its meaning has also been translated as a cry (shua) for help to God (Yeho is likely related to YHWH). So the one name under heaven given among men by which we must be saved, is arguably or at least poetically Joshua, even if no one is going to give up referring to Jesus now.

67 "*In Galilee, the land of the outsiders, the people who had been living in darkness, by the road to the sea, will see a great light. The light of life will overtake those who dwelt in the shadowy darkness of death*" – Isa 9:1-2

68 Throughout Jesus' life, he sets out on deliberately to fulfil prophecies concerning the messiah and follows their plan for human redemption. However, he emphasises that his free will is not being infringed. When Jesus was being arrested, he said, "*Do you think I cannot call on my Father, and he will at once put at my disposal more than twelve legions of angels? But how then would the Scriptures be fulfilled that say it must happen in this way?*" - Matt 26:54 (niv). Prophesy does not compel it enables free choice.

Galileo

"In science, the authority of thousands is worth less than one spark of reason in a single man. Today's observations deprive all previous writers of authority because if they had seen what we see, they would have judged as we do"
- Galileo Galilei

Sceptics point to events in the Bible that appear to be scientifically impossible. There are few better examples of this than 2nd Kings 20:10, where God reverses the shadow of a sundial down the steps of Hezekiah's palace. Another incident is in Joshua 10:12, where God holds both the sun and moon in position during a critical battle.

For the people of the time who had a prehistoric view of a fixed Earth and a travelling sun, this would have sounded remarkable but still possible. Taken at face value, it sounds as if God is stopping or reversing the rotation of the Earth. That makes it harder to justify these verses as accurate.

Ironically, the Bible's accounts of these occurrences were the same ones used as evidence in the 1633 trial of Galileo Galilei. In an era when science required backing from the Bible to be accepted, he emphasised the superiority of observation and visible evidence. Though he was a faithful catholic, at the same time he trusted the evidence he could see with his telescope.

Telescopes had been recently invented in protestant Holland, and Galileo was the first to turn this invention towards the deep sky. He constructed his own telescopes and ground glass lenses. His first attempts could only magnify objects slightly. After some years improving his technique he constructed telescopes that magnified a thousand times and made things look thirty times closer than they were. That led to his discovery of the four great moons that orbit around Jupiter. He was also a keen researcher in other[69] fields. His physics experiments prepared the way for Newton's theories of mechanics and gravity. He died in 1642 just one year before Newton's birth.

The heavens were supposed to be built from Aristotle's fifth element, the aether, immaculate and faultless in substance, and to be one with God's divine senses[70]. Thomas Aquinas had effectively combined Greek cosmology with Christian teaching[71] a few centuries before, including the ethereal nature of the

69 A love of music seems to be a common theme in many scientists life stories. Galileo as a child was interested in the mathematical structure of musical compositions, and was encouraged in this by his father, a lute player and composer. This interest in mathematics launched his scientific studies.

70 Alan Lightman – Searching for Stars on an Island in Maine, Ch 5.

71 In his book Summa Theologica, Thomas Aquinas set a barrier between the celestial spheres and regions below that of the Moon. He drew on Cicero and Lucan for a knowledge of this immense frontier between Nature and Eternity. There was the Earthly, and then beyond the Moon were the eternal aetheric worlds. The result for Medieval and then Renaissance minds was a pervasive awareness of the existence, at the Moon, of what C. S. Lewis called a great divide. From aether to air, from heaven to the changeable elements of nature. It divided the realm of God from that of humans and

heavenly bodies and the idea that the earth stayed immobile at the centre of everything. However Galileo observed layers of craters on the moon and black pimples on the sun. As well as moons that orbited Jupiter not the Earth, through his handmade telescopes. Galileo's discoveries of flaws in the celestial bodies posed a threat to the Church, because they appeared to criticise the perfection and stability of the heavens and therefore its creator.

The church attacked Galileo because he proposed that the Earth rotated around its pole and circled the Sun[72] but this was just one part of the problem they had with his science. His enemies considered his independent ideas dangerously similar[73] to Protestantism. His evidence for a moving Earth included Venus having complete phases as it orbited around the Sun, and sunspots which spoiled the idea of a perfect Sun that did not rotate. He criticised those who refused to change their views, or even look for themselves at the evidence. "*My dear Kepler, what would you say of the learned here, who, full of the persistent determination of small serpents, have steadfastly refused to cast a glance through the telescope? What shall we make of this? Shall we laugh, or shall we cry?*" in a letter to Astronomer Johannes Kepler[74] in 1610. In this period the church's view was that all of nature follows God's architectural plans, and that perfect design is static and unchanging and especially the heavens. In his book, the Dialogue[75], Galileo rejected this, "*It is astonishing and an insult to intelligence that the greatest perfection and nobility of the great bodies of the universe is proposed to be that they are invariant, immutable, unalterable, etc. On the other hand, it is called a great flaw to be alterable, producing new things, or be adaptable. For my part, I see the Earth as lovely and admirable precisely because of all that can move, be generated, or altered within it and this occurs constantly... and I say the same of the moon, of Jupiter, and of all other worlds.*"

His scientific beliefs[76] and lack of political support led to his conviction for suspected heresy and the banning of his writings. This censorship eventually came to represent the overruling of science by religious power. Fortunately, he still had enough supporters for home arrest to be ordered[77] instead of execution. His own interpretation of the events in Joshua was that God had stopped the rotation of the Sun, which caused the rotation of all the planets, including the Earth, to stop. Alternatively, he suggested not taking the events in Joshua literally[78] but interpreting them as a metaphor of God's protection.

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demons, necessity from contingency, and incorruptible from the flawed and unpredictable.

72 His prosecution was part of an ongoing campaign to persecute anyone who had unorthodox beliefs about astronomy and the universe. The same Inquisition members who punished Galileo were also involved in the condemnation and execution of Giordano Bruno in 1600. Bruno maintained in his writings that knowledge by reason is better than knowing purely by faith. He felt that the stars were likely many other suns and that God may have created many self-sustaining, life-bearing worlds that followed natural principles the same as the Earth. He also proposed an infinite, varied universe, compared to the tiny medieval one. Documents show that precisely similar views were considered heretical and crimes against God. Falling under the general label of Pythagorean ideas. Alberto Martinez's book Burned Alive (2018) points out that such heresies were increasing crucial in Bruno's trial in the 1590s because he denied that he was opposed to the church or it's theology in any way. Later, the Inquisition's case against Galileo used startling similar attacks.

73 This was a long-standing problem. History documents the formal church's backwards stance towards scientific advancement. According to a papal bull published in 1515, all works in the Catholic countries of Europe had to pass censorship. The Roman Inquisition, reformed in 1542, regulated all printing in Italy and issued its first index of forbidden publications in 1559. While the Council of Trent (1545–1563) expanded definitions of heresy to include any questioning of current or historical church positions including philosophical ones. See also The Galileo Affair

74 Kepler was not breaking away from the Greek's geometric religion just reassessing it. He thought the five Platonic solids from Plato's Timaeus explained the spacing of the seven planets around the Sun, with the whole thing being on a musical scale. They existed between the planetary spheres as illustrated in Kepler's Mysterium Cosmographicum, 1596.

75 Dialogue Concerning the Two Chief World Systems, 1632

76 Galileo's scientific ideas about gravity were not modern, he thought tides were caused by the Earth's rotation for example and he was equally tripped up by Greek mathematical aesthetics. He rejected Kepler's elliptical orbits of the planets, based on the Greek philosophical principle that all heavenly things aught to be symmetrical. Orbits must therefore be perfect circles not ellipses.

77 One reason for the condemnation of Martin Luther was that he opposed the punishments of the inquisition believing that it was '*contrary to the spirit to burn heretics alive*'. This view was in itself heretical, according to the Pope Leo the Tenth who identified it specifically in his 'Bulla contra errores Martini Lutheri et sequacium' of 1520.

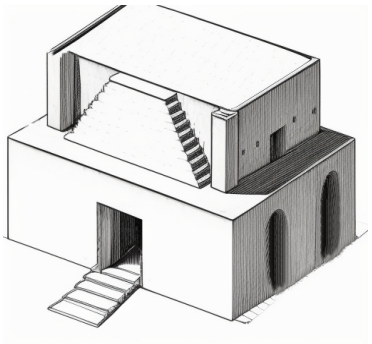
78 See Galileo's letter to the Grand Duchess Christina

Galileo's famous intellectual defiance, regardless of what you believe, these are the facts, is required now more than ever. Many people believe religion is itself an immovable object. While the growth and progress of science is an irresistible force. There is one way of relocating the immovable. Direct the force so it moves the remainder of the universe. The certainty of religion remains, but as Galileo might have said '*yet it moves*[79]'. Religion's certainty can become a weakness when it rejects evidence without bothering to assess it first. Science on the other hand is comfortable with competing explanations, that is how it improves.

In that spirit of open explanations, what if Hezekiah's and Joshua's miracles were actual events but not about physical motion? How could that work? Instead of being about the Moon's position or the Earth's rotation, they could be movements in time. That is a key requirement of Cosmic Creation. Showing that, apart from more than one universe and an explanation for Earth's deep history, God does manipulate the flow of time.

Joshua and Hezekiah

Sundials were the primary way of measuring time in Hezekiah's era. His particular sundial was likely a building-sized example, made to regulate palace timekeeping. Like the image below it would have been built with two sets of steps that were angled at 45 degrees. According to archaeological discoveries from this period. As the day went on, the shadow of the matching post moved down the steps on the left, then up the opposite side. That indicated the hour quite accurately.



God offers to show Hezekiah his mastery over all of nature by moving the whole palace and surroundings[80] forward or backwards in time. This act would show his ultimate control over time, as in Genesis. Now the king was suffering from potentially fatal boils, a symptom of a severe illness, maybe even bubonic plague[81] and his cry for help occurred when his kingdom was being invaded. Deeply afraid and seeking proof, Hezekiah picks the second option, as we read from verse 10, "*The shadow always moves forward*", Hezekiah replied, "*so that would be easy. Make it go ten steps backward instead*".

This event is so against our everyday experience[82] of time. Only a supreme God could do such a thing. The Bible records that the sundial's shadow then moved back ten steps. Given that most sundials of the time had only six steps, this one must have been built for more precision or time moved by nearly a whole day. In any case, it was a substantial period and at least several[83] hours. God was not interfering with the Earth's momentum or rotation to prove his faithfulness to one man. He could have done so, but there was no need since he controlled time. Everything was in his hands. His people could rely on Him to cure the king and rescue the nation. In the end, God used the elegance of natural processes. After an outbreak of the disease in the enemy camp, the siege was abandoned, and the king recovered from his illness.

79 Galileo certainly didn't say that at any point during his trial, but may have expressed something similar years later. Reference: blogs.scientificamerican.com/observations/did-galileo-truly-say-and-yet-it-moves-a-modern-detective-story

80 How large an area?, that is unknown but likely ancient astronomers in for example nearby Sumeria, China and elsewhere, would have recorded this unique event if it had affected the entire planet as it was within the historical era.

81 Hezekiah's Boil, Barker, M., Journal for the Study of the Old Testament, Vol 26 Iss 1, 2001. Bubonic plague is known from bone and teeth samples as old as 5000 BC so this is a plausible explanation.

82 Unlike some other ancient cultures they had a strong linear sense of time, from the time of creation to the future astronomical cataclysmic of the day of the lord. *Behold, the day of the Lord is coming.. the stars of heaven and constellations. Will not flash forth their light; The sun will be dark when it rises, the moon will not shed its light* – Isa 13:9-11.

83 There are several ways this could have worked and still avoided the risk of paradoxical travel to the past, for example suspending local events until early the next day would also have satisfied the kings request.

What of the events in Joshua? Why did Joshua add the Moon to his request, if the purpose of the miracle was only to extend daylight for the fighting? Because both were revered as gods of time[84] who controlled the days and the seasons. There was no better proof that God is in complete control of nature. It is possible that He stopped the Moon from falling and suspended the law of momentum. However it's more likely that both this event and Hezekiah's sundial were local changes in time. The fact that the maker of space is also the controller of time should not be a surprise since, as Einstein discovered, the two are intricately connected. On the other hand, timelessness is logical and scientific nonsense, as absurd as the idea of a rock so infinitely heavy[85] that even God cannot move it. There is no reason for the creator to be cut off in a separate and fixed layer of reality like a butterfly trapped in amber. Separated from His many creations and communicating through lesser beings.

Manipulating Time

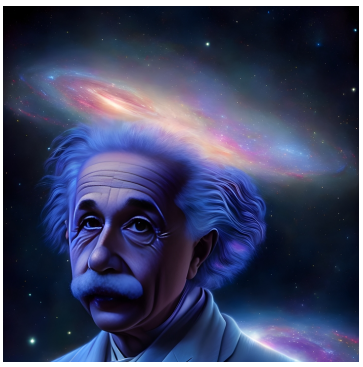
As Isaac Newton believed, time and space are just a natural consequence of God's presence wherever anything exists. Time though it may flow at one speed or another, has no beginning or end because it is a consequence of God's eternally creative power. In any case, whatever time is we can be sure that God is able to control its flow, just as he did for Joshua and Hezekiah.

Universe wide changes in time are common, for example events observed in early galaxies appear to take five times longer[86] than their timing does today. This is caused by the universe's ever-increasing expansion, that in turn is fuelled by hidden cosmic forces, altering both space and time. Manipulation of time, along with intricate quantum effects, must be divine powers.

84 See the ancient book of Job '*If I have regarded the sun in its radiance or the moon moving in splendour, so that my heart was secretly enticed and my hand offered them a kiss of homage, then these also would be sins to be judged, for I would have been unfaithful to God on high.*' - Job 31, v26-28.

85 In the physical world you can move practically anything, there are for example, gigantic black holes displaced from the core of their galaxies by ancient collisions.

86 Although any local observers back then wouldn't have noticed a difference. Astrophysicist Geraint Lewis of the University of Sydney, lead author of the study published in Nature Astronomy, commented "*In modern physics, time is a complicated thing. Dr. Who had it right, that time is best described as wibbly-wobbly, timey-wimey stuff.*" see Detection of the cosmological time dilation of high-redshift quasars, Lewis, G.F., Brewer, B.J., Nature Astronomy, 2023.



Einstein

"Most of what Einstein said and did has no direct impact on what anybody reads in the Bible. Special relativity, his work in quantum mechanics, nobody even knows or cares. Where Einstein really affects the Bible is the fact that general relativity is the organising principle for the Big Bang" - Neil deGrasse Tyson[87]

The General and Special Theories of Relativity are essential to astronomers and any creation model. Albert Einstein, the most famous scientist since Newton, developed both relativity theories, and they describe part of nature's laws. They predict the behaviour of space, time and matter on the largest scales of our universe. For example, how matter forms galaxies and these in time[88] grow into groups called galactic clusters and even larger structures. Relativity is essential for any theory of creation because it shows time to be variable, changing due to cosmic events.

Unlike the intensely religious Isaac Newton[89], Einstein's God was not a personal one[90]. Yet he recognised the need for both faith and science. He summed it up this way "*science without religion is lame; religion without science is blind*". He also reflected on creation in an interview with William Hermanns stating "*God is a mystery. But a comprehensible mystery. I have nothing but awe when I observe the laws of nature. There are not laws without a lawgiver, but how does this lawgiver look? Certainly not like a man magnified*". Models of the universe's origin and life assume natural causes rather than a creator for practical reasons. Even so, faith can guide believing scientists in their research. As they search for structure within the chaos of nature with tools of logic and intuition. As Andrew Torrance puts it in the series Knowing Creation[91] "*The Christian should recognize that her faith in the Creator gives her a deeper, fuller, and more accurate understanding of the history, structure, and behaviour of the natural world.. allowing her to view science as a Christian vocation*".

Music was a delight for Einstein and he played the violin[92] his whole life. Einstein's second wife, Elsa loved his dedication to music. She recalled that she'd long admired Einstein as he played the violin so beautifully[93]. Throughout his life, he saw classical music as a metaphor for an elegant and lucid natural world. On April 12, 1930, the Berlin Philharmonic Orchestra, conducted by Bruno Walter, gave a concert in Berlin. The music was Bach, Beethoven and Brahms, and the solo violinist was a 13 year old, Yehudi Menuhin. At the end of the performance, the audience burst into wild applause. Einstein was deeply moved, hurrying over to Menuhin, hugging him, then exclaiming[94], "*Now I know there is a God*

87 Also from an interview with Alan Boyle MS-NBC, 19/4/2005, "*History has shown that some theistically based belief systems have been able to adapt to the prevailing discoveries of science. Those that don't will be left behind.*"

88 The growth of Galaxies is far from a tranquil process. Our home galaxy is lumpy and twisted by its rotation and prior collisions. It is due to collide with the Large Magellanic Cloud, a satellite galaxy of the Milky Way, in the distant future. As with previous mergers, this impact will cause further disruption to its structure. As the Milky Way consumes it, the chaos will likely wake up the black hole lurking at the galactic centre, turning our galaxy into an active galactic nucleus or quasar. See The aftermath of the Great Collision between our Galaxy and the Large Magellanic Cloud, Cautun, M., Deason A.J. et al, Monthly Notices of the Royal Astronomical Society, Volume 483, Issue 2, February 2019.

89 Issac Newton wrote extensively on the books of prophecy, in his book Daniel and the Apocalypse, 1733 and elsewhere. He found in Revelation one of the greatest of all intellectual challenges. The thousands upon thousands of pages of careful writing Newton devoted to deciphering prophecy prove his devotion to that challenge. He contributed many ideas to millennial and historicist views that some later Protestant churches would adopt.

90 When asked whether he believed in God, Einstein replied: "*I believe in Spinoza's God, who reveals himself in the lawful harmony of all that exists, but not in a God who concerns himself with the fate and the doings of mankind.*"

91 Vol 1, Ch 4 introduction.

92 Albert Einstein had ten different violins throughout his life, each receiving in turn the nickname of 'Lina'.

93 www.cmuse.org/albert-einstein-music, he once remarked "*I know that the most joy in my life has come to me from my violin*", and he dedicated a lot of time and energy to becoming a better musician well into old age.

94 Einstein and Religion, M. Jammer, 1999.

in heaven!". The task of both science and art was to reflect on the natural order of creation. Einstein expressed[95] it this way "*The greatest scientists are artists as well.*"

He also expressed his spiritual beliefs in a talk with poet and German propagandist George Viereck. The conversation occurred in Einstein's Berlin flat, where Elsa, his cousin whom he married after his divorce from his first wife Mileva, provided strawberry juice and fruit salad. Viereck confronted Einstein. "Did he believe in God?" Einstein replied "*I'm not an atheist. The problem is too vast for our limited minds. We are like a little child entering a huge library filled with books in many languages. The child knows someone must have written those books. It does not know how. It does not understand the languages in which they are written. The child dimly suspects a mysterious order in the arrangements of the books but doesn't know what it is. It seems to me that is the attitude of even the most intelligent human being toward God. We see the universe marvellously arranged but only dimly understand it's laws.*"[96].

Albert Einstein was committed deeply to his Jewish heritage but much more to science. He was a determinist, doubting that free will significantly affects human destiny. When asked about his achievements he replied "*I claim credit for nothing. Everything is determined, the beginning as well as the end, by forces over which we have no control. It is determined for the insect as well as for the star. Human beings, vegetables or cosmic dust, we all dance to a mysterious tune, intoned in the distance by an invisible player.*"[97] This view is consistent with ancient views of time and predestination.

Discovering Space-Time

One discovery that Einstein made was that the passage of time is not the same everywhere. Depending on acceleration or the pull of gravity, the flow of time can be slower or occasionally faster than on Earth. He also found that the shape of space changes along with time. Space is dynamic and ever-evolving. It can warp, deform, and expand as well as shrink. Once Einstein united it, space-time became a powerful way to describe the behaviour of the universe. Understanding vacant space bending in a particular direction or rippling is challenging. Many people find Relativity confusing because they don't notice its effects in daily life. Yet it shapes the history and development of the universe.

Matter and even rays of light curve around planets, stars and galaxies[98] due to the distorting effects of gravity. Large galaxies and clusters[99] can shape the space around them so much that it creates a gravitational lens[100] as seen from Earth. Astronomers can then use this distorted region of space to enlarge distant objects behind it. The incoming light is focused by the shape of spacetime as if it was a lens in a cosmic telescope. These areas of bent spacetime[101] can be thousands of light years across. This distortion of the fabric of the universe is quite small on a human scale. However it is measurable, even around the Earth. Following is a photo[102] of a cluster of many galaxies. The light of a distant galaxy beyond can be seen smeared out into circular shapes by this bending of reality. The circled areas are all light from the same galaxy, as it takes different paths around the cluster, nearly completing an Einstein

95 Calaprice, 2000, p245

96 Glimpses of the Great, 1930. Not an exact quote as based on jotted down notes. When asked how Christianity influenced him, he replied that "*he believed Jesus to be an enthralling figure. The Nazarene, whose personality pulsated in all his words, showing him to be a historical individual rather than legendary*".

97 From George S. Viereck's 1929 Interview in the Saturday Evening Post, P117.

98 That we can't see gravitation field lines doesn't really matter. We can't see magnetic fields either yet a local collapse of huge magnetic fields helps trigger the formation of new stars and we can detect the direct effects of gravity waves and lensing for example.

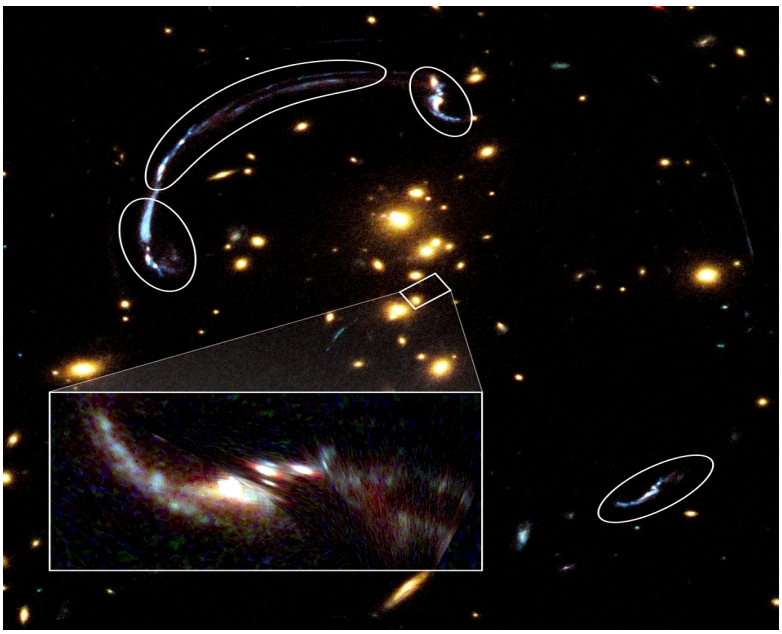
99 As well as smaller objects such as galactic core black holes, similar to the one in our own galaxy, which scientists recently imaged and even individual stars.

100 Gravitational lensing can also be used to measure the mass of smaller stellar objects such as white dwarf stars, neutron stars, and black holes and to measure the presence of dark matter. See also www.science.org.au/curious/space-time/gravitational-lensing

101 A light year being about 10,785 times the distance the Earth travels around the sun each year, or 10 million, million kilometres give or take.

102 Galaxy cluster RCS2 032727-132623 showing a single lensed background bluish galaxy. Credit NASA, ESA & Hubble Heritage Team, taken 9th March 2018.

ring around it. The box and inset image, shows a reconstruction of its true location and shape behind the cluster.



Einsteins theories continue to inspire modern science. Relativity is what makes black holes such fascinating objects for astronomers, especially those that form at the centre of galaxies. When heavy objects, such as black holes, rotate, their gravitation doesn't just bend passing light it twists[103] space and time around in a circle as they spin. Considering the gigantic black-holes at the core of galaxies, those ultimate heavyweights may even be altering the expansion of the universe through the energy they absorb[104] from spacetime. Einstein's discoveries show how the physics that explains our universe is more complex than our ancestors imagined.

In modern physics, an expansion or shrinking of the dimension of time, like that of space, is well known[105]. A change when compared to the usual tick of time we experience in daily life. Although tiny, these changes must be accounted for in precise atomic experiments and even the signals from satellites. This effect also turns out to be a vital ingredient in combining modern science with the Bible writer's point of view. Apart from creation there are several other miraculous events in the Bible that can be explained by a shift in time. Modern astrophysics can also explain how island universes remain apart[106], forever separated by incompatible laws. Einstein's contributions are critical to astronomy and especially towards understanding the origin of our universe.

One day human beings will travel much faster than the current speed record. This velocity was reached by NASA astronauts on their way back from the moon in 1969[107]. Much greater speeds will be needed if future explorers are to travel from Earth to visit other stars. In that case, we will see real life ex-

103 This twisting is referred to as frame dragging, i.e www.space.com/black-hole-wobbling-jets-warp-spacetime.html

104 If verified this would be an absolute triumph for Einstein's, already well verified theories refuting the assumption that Relativity breaks down within black holes. See Observational Evidence for Cosmological Coupling of Black Holes and its Implications for an Astrophysical Source of Dark Energy, Duncan Farrah et al, Astrophysical Journal Letters, Volume 944, Number 2, 2023. See also this summary of related research into cosmological coupling.

105 On earth, where speeds are small compared to the speed of light and the gravitational field is weak, it turns out that nearly all of our weight is due to the warping of time, rather than space. What this means in practice is that gravity can be treated as being the same as a constant acceleration. Due to this we can observe effects such as clocks on the Earth's surface running more slowly than in deep space. - see einstein.stanford.edu/SPACETIME/spacetime2.html

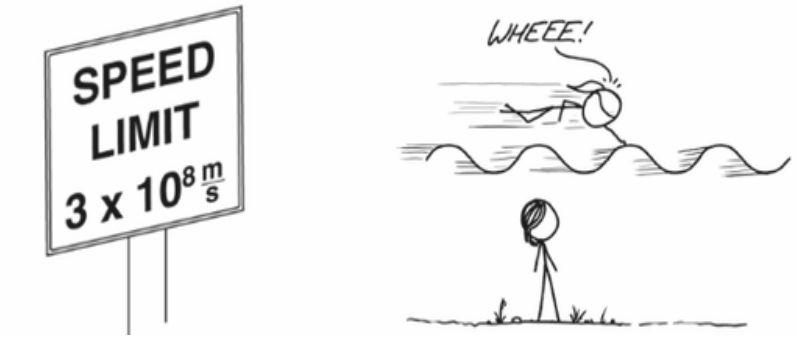
106 For details see information about Cosmic Inflation in the early universe. Essentially this is the solution to the problem of completely separated universes beginning with different laws.

107 39,897 km/hour relative to Earth. The fastest launch speed so far of any spacecraft was the New Horizons probe which reached 58,536 km/hour back in 2006 moving fast enough to escape not only the Earth's gravity but to leave the solar system.

amples of traveller's ageing being delayed. Relativity will alter the rate they experience time as they travel between the stars compared to their family who remains here on Earth.

Relativity and Time

Einstein's two theories show us the size of the universe and the limits on what we can observe. They also identify an upper-speed limit for all forms of matter and for the flow of information. This limit is the c in $E=mc^2$. It is part of the best-known equation in modern science. 'c' is the same as the speed at which light travels in space but is much more than that. It is also the fastest speed in our universe at 299,792 kilometres per second. The speed at which the universe communicates information with itself. To borrow a description from computer science it is the 'processing speed' of reality[108]. Without this limit, space and time, and cause and effect would start to fail[109]. The amount of energy, the E in $E=mc^2$ that is contained in normal matter is extremely large[110]. It explains the source of the Sun's light and the power of atomic weapons[111] as the energy bound up in matter is released.



Material things such as speeding matter particles experience a slowing of the flow of time as they approach 99 percent of the limit. At that speed, an hour stretches out to over seven hours compared to time here on Earth. Nature does this to obey the rules that maintain cause and effect from the viewpoint of any possible viewers. That is also part of the purpose of mass. It slows matter down by acting like an anchor tugging on space-time. While forces with no mass, such as gravity and light, always travel near the maximum speed.

As a result, an item moving faster in space has its passage through time changed. When the limit is nearly reached, this effect makes local events just about stop. While precisely at the speed of light, if that was possible, matter would not experience any flow of time at all. Even light only sometimes

108 Specifically you can derive some aspects of relativity by assuming that space-time is discreet. That is following quantum principles, it only supports a minimum distance equal to the Planck length, and a minimum duration equal to Planck time. The ratio of these values then determines the speed of light in empty space. See Three possible implications of Space Time discreteness, Gow, S, 2013, Unit for History and Philosophy of Science, and Centre for Time, University of Sydney.

109 This was really implied by physics even before Einstein discovered relativity, See this video from PBS Space-time – The Speed of Light is Not About Light for an explanation. The actual transformation from space to the time axis comes from the mathematics established by Pythagoras. The only difference is that the time term has the opposite sign to the spatial terms.

110 Einstein's equation may be used to calculate the energy (E) contained in matter. The matter (m is its mass) must be instantly transformed in order to determine the amount. The scale used to define the energy in this situation is acceleration. So matter may be converted into energy if it is broken up and each of its particles instantly accelerated to light speed (c). They can then be understood as moving energy packets, specifically as photons of light. The pure energy released can be visible light or X-rays. This is the radiation seen in atomic explosions. However, Einstein needed to transform the matter instantly, not over a longer period, to make this a total conversion or energy would be left out. This acceleration energy was also equal to 'c'. Giving the final equation: Energy is equal to the mass multiplied by c, squared. In a physical sense it is the strong force related gluon particles within the nucleus that give the atom much of its energy / mass.

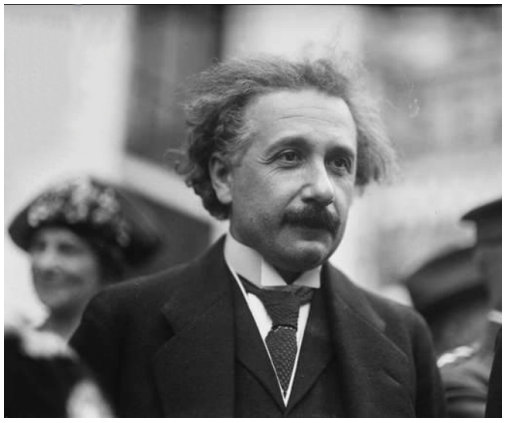
111 To Einstein's regret, although he initially championed their development, specifically in order to defeat Hitler before Germany could develop the bomb. He later argued forcefully, that atomic weapons should remain forever unused.

travels that fast on Earth, as light waves do slow down as they pass through materials such as water. While 'c' itself remains the same everywhere in the universe[112] and in all materials[113].

If humanity had a fast enough spaceship, this shift in time's flow could help us explore the galaxy. Accelerate to just below light speed, and you can reach the nearest stars almost instantly, at least from the traveller's point of view. Imagine you were invited to travel on such a spacecraft. For people contacting you from Earth, events on your spaceship and your responses would get slower. Then local time would nearly stop as you accelerated ever faster. Any doctor checking on your health from Earth would see[114] your heartbeat appear to slow to once a minute, then hourly as the flow of time stalled. Finally, it would take months of Earth time for your heart to beat once. As your ship's space/time distorted and everything on your craft, from clocks to computers, slowed and shifted along with it. Life on your ship would seem to go on at normal speed, while Earth's time and events outside the ship would accelerate, much faster than inside. A voyage around the galaxy would become a trip through time since millions of years would have passed when you returned to Earth.

If you could accelerate to this cosmic limit, your spacecraft could circle the Earth 75 times in 10 seconds. Unfortunately even this speed is still slow when travelling between stars. The light, even from nearby stars, takes many years to reach us. The laws of special relativity make it difficult to achieve speeds at all close to light speed. Sending even small robotic probes to other stars[115] will be a challenge.

Relativity was proven correct[116] in the 1920s, but it was to be overshadowed by an even more successful theory. Science has a long history of developing explanations that later prove to be just another stop on the journey. This theory explains the lives of particles even smaller than atoms. Particles with strange names like Lepton and Quark[117] These building blocks of nature exist at a scale so tiny we can hardly imagine it. At this deep level of reality[118], everything can be measured and is built from miniature fragments of energy. Modern Quantum physics can help us understand randomness, matter and energy throughout the universe.



112 To understand in more detail how the dimension of time can be related to the three conventional dimensions of space though Minkowski space-time, this article is a fine introduction – A Spacetime Surprise: Time Isn't Just Another Dimension by American astrophysicist Ethan Siegel.

113 Nothing can travel faster than the speed of space/time itself while existing within it. Light slows down in materials such as fluids, and this lesser speed limit can be exceeded. If a particle does, it will emit Cerenkov radiation. Which is a pretty cerulean coloured light sometimes seen in the water of nuclear reactor cooling pods.

114 Assuming the recording instruments were on Earth and observing remotely.

115 Unless you have a halo drive or some form of direct mass conversion. In which case, you can accelerate nearly to the limit. The problem with traditional rockets is the inertial mass of the ship which tends to infinity as it accelerates.

116 By the solar eclipse of 1919 for general relativity, other aspects such as gravity waves had to wait until experimental technology caught up.

117 Quarks are the building blocks of the better known protons and neutrons that make up the nucleus of atoms while leptons are every other common type of particle such as the photons that make up light and the electrons that surround the nucleus.

118 The Planck scale is an energy scale in particle physics and physical cosmology at around 1.22×10^{19} GeV (the Planck energy, corresponding to the energy equivalent of the Planck mass, is 2.17645×10^{-8} kg) at which the quantum effects of gravity become significant.

Chapter 2 – Uncertainty

Randomness

"In the presentation of a scientific problem, the other player is the good Lord. He has not only set the problem but also has devised the rules of the game – but they are not completely known, half of them are left for you to discover or deduce[119]*"*

- Erwin Schrödinger, physicist.

A Quantum reality

Scientists try to understand the principles that control our world. The visible everyday world of chairs, tables and kittens belongs to classical physics, which makes definite predictions. That everyday physics assumes that nature is deterministic. As the 20th century rolled on, it became clear that the many tiny atomic events that nature was built from, were outside the reach of traditional physics. In that deeper domain, another set of laws operated, but their main characteristic was uncertainly not determinism[120]. In response to this unpredictability, a new field of physics appeared. Its toolkit is known as quantum mechanics. These discoveries and their explanations transformed physics over the last few decades and will create extraordinary advances over the coming century.

Before quantum physics, scientists imagined atoms as tiny solar systems. They visualised electrons playing an orderly role as miniature planets[121], in orbit around the nucleus which was like the sun. Gradually, they understood that the universe is much stranger than such simple models. No theory in science is a protected species. That is one side of scientific discovery that can make believers uncomfortable, as it seems no model of the universe is ever permanent. Instead, discoveries are made by pushing a theory to its limits and seeing where it breaks. Unlike Relativity, Quantum Physics was a joint project with many great minds cooperating to understand the universe better. Early Quantum mechanics had been worked out in the years 1925 to 1927 by Niels Bohr and Werner Heisenberg, among others. Einstein never accepted[122] the completed theory. He rejected it because quantum physics limited what science could learn and it depended on random events not determined by existing causes. Even so, quantum physics was accurate in its predictions. He had helped improve it himself when he discovered the photoelectric effect, the same process that solar panels apply. However, Einstein believed it was a temporary solution and worked at reforming it into one part of a grander theory.

He also found the way that quantum physics needs an observer irritating and strange. Einstein once asked a colleague, "*Do you believe that the moon is not there unless we are looking at it?*[123]". Yet, as a

119 As quoted in Schrodinger by Walter Moore, Cambridge University Press, 2015, p348.

120 Determinism in a local sense is a foundation of science. If event A then consequences B. However in this context it refers to the universe as a whole. Determinism includes the 'many worlds' interpretation of quantum physics. That replaces a single fixed universe with an infinite number, but all still functioning like precision clockwork with no freedom at all. This theory of a quantum multiverse is an attempt to repair Universal Determinism after the damage inflicted on it by modern discoveries in physics. Its proponents completely ignore its dark moral implications. In a religious context, determinism implies double predestination. That is both the saved and the dammed are predestined to their fate.

121 This was Rutherford's model, the alternative was the plum pudding model proposed by J. J. Thomson in 1904 soon after the discovery of the electron, but before the discovery of the atomic nucleus. The 'pudding' being a spread out field of positive change which the electrons orbited within rather than a solid clump of protons.

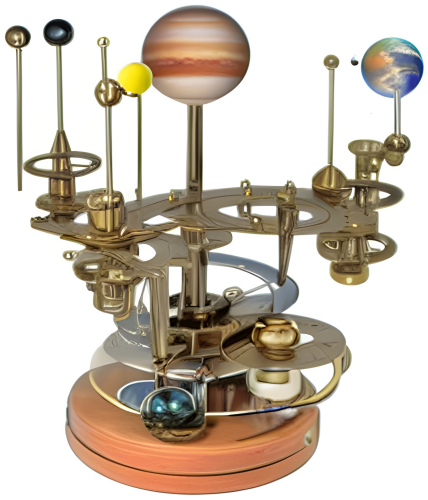
122 See Einstein vs quantum mechanics, and why he'd be a convert today – June 13, 2014 by Margaret Reid, The Conversation

123 Thus spoke Einstein on life and living: Wisdom of Albert Einstein, V. Alexander Stefan, 2011, p 301

popular song goes, the universe is made to be seen by our eyes[124]. The observer effect and other quantum rules are essential to nature. The properties of particles only come into existence or have any fixed reality when measured[125]. In other words, when they interact with the larger world. Before the measurement takes place, they exist only as a field of probabilities. A strange state that holds many alternative possibilities. At a tiny scale, the universe is built from probabilities of different kinds. Within atoms there are no stable parts. Unlike the plastic balls and connectors of high school chemistry that represent molecules. Richard Feynman put it this way[126] "*The behaviour of things on a very tiny scale is simply different. An atom does not behave like a weight hanging on a spring and oscillating. Nor is it like a miniature representation of the solar system with tiny planets going around in orbits. Nor does it appear to be somewhat like a cloud or fog of some sort surrounding the nucleus. It behaves like nothing you have seen before.*" In Quantum physics, a scientist's choice of what to observe changes what they can learn next. So some combinations of questions become impossible to answer because the underlying reality is fluid.

Aristotle and pocket watches

Science has long ago moved on from treating nature as a mechanism, a vast Newtonian clock[127] or Orrery with gears that turn the seasons and move the planets. That is disproven by more than a century of relativity theory, quantum physics, chaos theory, and genetics, among other discoveries. However, even among scientists, the metaphor of nature being built of unfailing cogs and wheels lingered. Natural randomness is difficult for Christians. It challenges one of the most popular justifications for thinking the universe is designed and purposeful. Things with a random origin cannot have a purpose. Pocket watches, those Victorian icons of respectability and wealth[128] built of intricate but well-ordered gears and wheels, have an obvious reason for existence that marks them as created. Clergyman William Paley was the first to use that analogy in 1802, comparing a timepiece to a piece of rock that does not seem to exist for any particular purpose. The stone might not be designed, but the watch certainly is. That is the teleological or purpose focused argument for God being the creator.



If each species and part of nature has a design and a function, as Aristotle believed. Then a supervising creator is required. This argument is part of his philosophy, that is based on Plato's foundations. For that proposal to be correct, nature must be static or at least predetermined. It can't have any real design if it's constantly evolving into new random forms and chaotically erasing old ones. This creates an instant clash between the evidence and how Christians believe nature should behave. Along these lines,

124 From the song Saturn, by Sleeping at Last, "*You taught me the courage of stars before you left. How light carries on endlessly, even after death.. I'd give anything to hear You say it one more time, That the universe was made. Just to be seen by my eyes*".

125 How do the equations of quantum physics work to make the world we know? The most widely accepted translation of the physical significance of the mathematics of quantum physics is the Copenhagen interpretation. The key to this is the role of the observer. Probability applies until an observation is made. Measurements made by observers collapse the probability field allowing things to have stable properties. Observations are forces connecting from the surrounding macroscopic environment and need not be of human origin, for example we observe quantum effects on distant stars but no human existed when that light was emitted.

126 From Part 6 of The Character of Physical Law, 1965.

127 Newton himself rejected this characterisation of his ideas about nature, as predetermined and mechanical. Pointing out that God did not just create the universe but continues to sustain and repair as it grows and changes. To regularly wind up the clockwork to put it another way. However the idea of a mechanical universe predated his discoveries and persisted long after his era. Copernicus used it in his work, On the Revolutions of Heavenly Spheres. Nicole Oresema (1325-1382) compared the idea of a world machine to the universe that God both constructed and maintains but its foundations are in Greek metaphysics.

128 Pocket watches were given as retirement or graduation gifts. Translated to the wages of the time, they would have cost a few thousand dollar in today's money. Just like a high end mobile phone. Most of the price was based on the quality of it's movement (internal gears), as a person that bought one expected to use it for decades in different cases.

some Scientists abandoned a cosmic designer. Instead they developed a flawed idea that everything human is predetermined by our genes or unfolding molecules[129]. In this view, free will or any kind of emergent higher complexity[130] is just a useful delusion. That has not been proven but comes from the same assumptions. Some Creationists blame sin for ruining God's lovely but static blueprint. They claim God must be incredibly orderly, pointing at his exact directions for building the temple and its services, clothing, and rules and harsh punishments for any deviation. His entire creation must also be meticulously planned. In their eyes, nature is a broken machine, instead of an adaptive and dynamic universe.

An alternative is to see God as the designer of nature's rules rather than hand-making every tiny thing. The evidence supports that view. Nature's laws are subtle yet powerful, implying a creator who does not design nature as a machine, like a human would, but speaks into existence the seeds of future ecosystems. Immature but with an immense capacity to diversify and flourish. The principles of nature contain beauty, logic, and design. They exist to allow God's creation to evolve. However, freedom also implies the potential for devastation and evil. Nature is not clever and cannot forecast consequences, therefore freedom breeds inherent evil. God is able to redirect nature, so misery and suffering is prevented. Since the Fall, He has not done this in our universe, at least not always. Why did God include the Tree of Knowledge in the Garden? Because he valued his creatures' ability to chose. When Adam and Eve sinned, God carried out their decision. They would no longer be shielded, but would face the full repercussions of their choice. They sacrificed the protection of God's children for the freedom to struggle and grieve. All of nature has suffered along with humanity. Natural laws are free of most controls and separate from God's splendour. The Earth and universe we live in are the consequence of intricate rules that create planets and life. At the same time, it is fraught with lethal anarchy and ruin.

A Theory of Everything

"*If God created the world, his primary concern was certainly not to make its understanding easy for us*" – Albert Einstein, 1954[131]

Nature is uncertain and chaotic, from rocks and trees up to stars. It is chaotic in both the mathematical and the ordinary sense of that word. The laws of nature include the decay of natural systems and primal violence. There are stable islands of calm and order, but they rise from a sea of fire. We need to learn about this side of physics to comprehend our universe.

Einstein and the new physics

Today's physicists seek a way to unite gravity and quantum physics. Combining them would create a theory that explains[132] everything. Einstein spent the last thirty years of his life working to bring together his relativity with quantum effects. Unfortunately, his attempts[133] failed. That was because he modelled the universe using classical laws. His mathematics should have included the randomness that exists everywhere. As a determinist, he doubted that the universe had any such freedom. He believed the probabilities were just an illusion. Underneath must be a mechanism generating[134] the apparently random events. The idea of a clockwork universe, just like steam engines, was disappearing[135]. He was

129 Which is true but only in the limited sense that chemistry is deterministic on the scale of molecules.

130 If you reject the existence of free will, that applies to the research society does. The content and quality of research and its reception is predetermined by the molecules and biology of scientist's brains and beyond their control or is it? If science as a whole, can transcend the limitations of individual researchers through emergent complexity then why can't the human brain since it contains multitudes of subtle influences, aspects of self and competing thoughts.

131 In a letter to the American physicist David Bohm, just 14 months before he died.

132 Such a theory would unify our understanding of primary forces in physics but not be complete in an absolute sense.

133 The math of quantum mechanics and the math of general relativity, when they confront one another, they are ferocious antagonists and the equations just don't work, according to physicist Brian Greene

134 Understanding the Properties and Behaviour of the Cosmos, D. Hainesworth, 2011, p561

135 Partly due to Einstein's proof that light is formed from quanta. That is fixed packets of energy. Science was abandoning failed models with a new generation of physicists born in the twentieth century, such as Heisenberg, Paul Dirac and

not ready to let go of it[136], but his rejection was based on a gut feeling. "*The (Quantum) theory produces a good deal but hardly brings us closer to the secret of the Old One*[137]" he wrote in December 1926. "*I am at all events convinced that He does not play dice*".

In 1927, in a speech at the fifth Solvay[138] Conference, Einstein repeated this point. Niels Bohr, one of the founders of quantum theory, replied, "*it cannot be for us to tell God, how He is to run the world*". Using hidden mechanisms rejected reality. In the same way, the ancients calculated complex epicycles for planetary motion. These were circles within circles, and even required backward movements, so the planets could orbit the Earth. The truth is that this universe's existence rests on chance and uncertainty. It is the exact opposite of a kingdom of mechanical precision. Our universe is not a Bach fugue but more like the chaotic anti-harmonies of Caténaires by Elliott Carter. However much we wish it to be otherwise. For Christians, our understanding of the universe affects how much we think God needs to direct natural events. Traditional Christianity saw the will of God in every event. Modern faiths recognise that creation is built on independent laws.

Unifying physics on a T-Shirt

Ironically, by challenging quantum physics, Einstein only succeeded in expanding it. In 1935, along with physicists Podolsky and Rosen, he proposed an idea. They would get around quantum laws using pairs of particles. Their method works like this. Generate two identical particles. Let them move away from each other. Measure their speed and position. Take only one type of reading on each one. Since they are identical, the properties of the other half of the pair will be the same. Then, combine the reading to give a complete picture of the system. By splitting the measurements, was it possible to discover everything about a particle? To transform quantum laws into classical explanations. Could Einstein restore predictability by showing that hidden design was there all along?

Instead of fixing uncertainty, they had discovered quantum entanglement. Entangled particles are a single probability field. Starting with identical particles creates this unified field. Testing one particle limits what we can measure about the other. No matter how far apart they are. We cannot trick nature into revealing every property. Suppose we trying to observe everything at once. That randomises the particles so they are no longer identical, breaking the entanglement. It was a rare example of Einstein underestimating nature's complexity. He could not undo the uncertainty built into the laws of nature because it is essential to natural law. No one since that time has been able to do so.

The quest began by Einstein to find a grand theory of everything continues. Following his lead, scientists may someday discover a single equation that unites all the forces in the universe[139]. Hopefully, one small enough to print on a T-shirt. This search is ongoing, with the nature of gravity and mysteries such as dark energy being explored[140]. However such an equation would explain only this universe, not others lying beyond its boundaries. Questions about space and time did not benefit from the advances of quantum physics. With the discovery of gravity waves, there has been recent progress. Astronomy that

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Wolfgang Pauli and geopolitics that funded advanced atomic research.

136 The method of re-normalising quantum equations does not function with space-time since it can be exceedingly complex topographically. The combined equations are full of infinities that cannot be substituted with experimental data. That explains why today's researchers have yet to make progress and to be fair why Einstein would have also struggled even if he had decided to embrace Quantum theory.

137 The Old One i.e the creator, from a 1926 letter to Max Born, one of the fathers of Quantum Mechanics

138 The Fifth Solvay Conference on Electrons and Photons was held from 24 to 29 October 1927, in Brussels. This was a follow up to the 1911 conference. The world's most notable physicists met there to discuss quantum theory. The leading figures were Albert Einstein and Niels Bohr. While 17 of the 29 attendees were or became Nobel Prize winners, including Marie Curie, who alone among them, had won Nobel Prizes in two separate scientific disciplines.

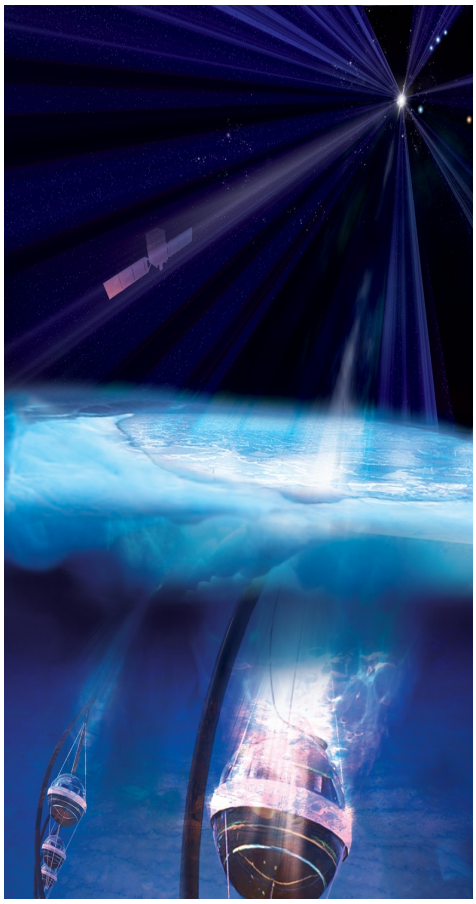
139 String theory has the potential to show that all of the wondrous happenings in the universe - "*from the frantic dance of subatomic quarks to the stately waltz of orbiting binary stars; from the primordial fireball of the big bang to the majestic swirl of heavenly galaxies – are reflections of one, grand physical principle, one master equation*" – Brian Greene, physicist, mathematician, and string theorist.

140 Dark energy is the force that's causing the universes expansion to accelerate, rather than slow down. Not to be confused with dark matter which helps galaxies form. This naming is generally recognised as being a complete mess.

watches the universe using gravity waves is just getting started. Researchers can detect the collisions of neutron stars and black holes many light years[141] away. That is due to the ripples[142] these impacts create in space-time, just as predicted by Einstein in 1916.

You might believe that subatomic physics is only theoretical. Yet the knowledge provided by quantum physics is vital in modern electronics and computing. So, what are its various uses, and what does it explain that previous theories cannot? Over the last decade, quantum computing has progressed from theory to systems capable of beating regular computers. Quantum processors are known to be vastly better at some tasks than current ones.

Quantum effects are also essential to physics because they allow certain kinds of radioactivity. Particles can display unexpected behaviour, such as passing through barriers like those in the nucleus. Conventional physics says they should not have enough energy to break out, yet somehow they do. This 'superpower' is referred to as quantum tunnelling, because it bypasses barriers without any effort rather than using energy to escape. This mechanism is what permits atoms within the sun to fuse together and release atomic energy[143]. Quantum tunnelling is critical to life on Earth because it delivers precisely the right amount of energy for a stable sun.



The details are too complicated to go into here, but it comes from the basic uncertainty in particle locations built into nature and the kinds of matter within the core of the sun. The tunnelling process itself has several peculiar features. Not only is no energy required, but the particles arrive instantly[144], exceeding nature's usual speed limit. This is allowed because nothing actually moves – the particles simply exist in a different position. Their location is not a real property but a probability. At the quantum level reality is undefined.

Entanglement, is applied in modern computing to transmit data[145] securely. Its role in chemistry[146] is being actively explored. In nature, Birds use it to see the Earth's magnetic field lines. That skill allows them to navigate across vast oceans. There are also hints that quantum processes in the brain[147] are essential. It also assists astronomers in measuring gravity waves[148] by improving detectors. A research station sits deep beneath the Antarctic surface at the south pole. The IceCube neutrino[149] observatory watches the unseen universe through the polar ice. It collects

141 A light year is around 9.5 trillion kilometres, a vast but useful measure for interstellar distances.

142 You can think of the ripples as a brief microscopic stretching in one spacial dimension of everything they pass though and be mostly correct. This brief change in the dimensions of space moves in a wave across the universe from the point of collision.

143 The surprising quantum reason why the sun shines, Starts with a Bang, Dec 28, 2022.

144 Specifically in some time less than 1.8 attoseconds, but there are strong reasons to believe its instantaneous since another quantum process, entanglement shares information at no less than 10,000 times the speed of light.

145 Any spying on Qubits (quantum bits) would break the entanglement destroying information and leaving a clear signal that transmissions have been tampered with.

146 Particularly scattering of chemical reactions fuelled by the development of quantum teleportation, quantum communication, quantum cryptography, and quantum computation—see Entanglement classifier in chemical reactions, Li, J, Kais. S. Science Advances, Vol. 5, no. 8, Aug 2019.

147 "*We have seen some hints that quantum mechanisms are at work in our brains. Some of these mechanisms might help the brain process the world around it through sensory input. There are also certain isotopes in our brain whose spins change how our body and brain react.*" - Article: Brain experiment suggests that consciousness relies on quantum entanglement, Fernandez, E., BigThink, Nov 2022.

148 It's cool that this method was first pioneered at the Australian National University rather than a better known centre of physics research. See physics.anu.edu.au/quantum/cgp/research/gravwave

neutrino particles from events in distant galaxies. Its eighty-six light detector strings turn their lens towards the ground. They use the whole planet as a shield. That filters out unwanted particles, such as cosmic rays. See the artistic image of the detector strings and sensors[150] to the left.

IceCube detects explosions caused by black holes at the centre of distant galaxies. Searching for evidence to test unifying theories of physics. Researchers have released some early data combined with satellite observations. They reveal quantum forces altering space-time. Neutrinos record these changes as they travel. That matches[151] the predictions of some models. If confirmed, it is a significant discovery showing that gravity and quantum theory can be combined.

Christians believe that God acts in our universe. How can that occur when every force is based on randomness? Alvin Plantinga in his book Where the Conflict Really Lies: Science, Religion, and Naturalism provides a possible answer (p119). Both human beings and God can cause quantum systems to resolve into a final state. Humans because we have free will in selecting the systems we interact with. While beyond that, God may be the ultimate universal observer. Alternatively it may be that quantum systems are built to resolve[152] on their own. Only one thing about our universe is certain, and that is: randomness affects everything.

Perfect without a blueprint

The quantum world of the tiniest particles stretches the human imagination. Probabilities replace knowable reality. Scientists join the dance of particles, their results influenced by how and what they choose to test. Particles pop in and out of existence in empty space due to chance alone. That is why quantum physics is awe inspiring. Its effects extend from tiny particles out into the universe, even shaping the largest structures[153] observed by astronomers.

Forget medieval ideas of perfection, our creator is nothing like a human architect. God does not construct worlds according to static plans. He creates universes with powers that cannot be fully predicted, with wildness in their laws, but protects each creation. As parents know, there is beauty even in children's messes because of their potential. Randomness in nature is a promise of original living things, all children of the creator. This is why God gives nature the spark of natural chaos. However, in our universe, this power is out of control and feeding on decay rather than growth.

"The consequences of an uncertainty principle when applied to the whole universe are alarming. They imply that nothing in a quantum universe can be determined with certainty. Ever!"
- Laura Mersini-Haughton,
Before the Big Bang: our origins in the multiverse[154].

149 Neutrinos are the most frequent mass-carrying particles in the universe, and the most accurately named in the Standard Model of Particle Physics: since they are small, neutral, and weigh so little that their mass has yet to be determined. Created in vast numbers flooding out from within stars they hardly affect normal matter at all.

150 Image credit NASA/Fermi and Aurore Simonnet, Sonoma State University.

151 Could quantum gravity slow down neutrinos?, Amelino-Camelia, G., Di Luca, M. G, Gubitosi, G., Nature Astronomy June 2023.

152 As in the Ghirardi–Rimini–Weber theory (GRW) also known as spontaneous collapse theory.

153 In 2013 the Planck satellite mapped the effects of quantum processes that occurred in the early history of our universe across the whole visible sky.

154 "A quantum universe may sound weird even to seasoned physicists – but that is irrelevant. Whether or not we accept it, nature has chosen it for us; numerous experiments have confirmed the validity of quantum theory to a very high degree of precision"

Naturalism and the Bible

"The modernist accepts more science and critical thinking in their approach to scripture, but they lack a factual grounding for having their religious beliefs; the literalist denies so many sciences, yet they seek to have a religious faith grounded in facts – be that the facts of the Bible or the facts of nature" - Aaron Adair[155]

Shifting beliefs about creation

Is science vs creation a vital question for believers? Does Christian faith require belief in the age of the earth as implied in the Bible? However you answer that question, acceptance of traditional ideas about humanity being a special creation[156] is declining especially in the west.

There is a trend against organised religion and a general increase in atheism in the western world but something else is happening. Public opinion takes decades, if not generations, to catch up with scientific discovery. Within the last few decades, there has been an explosion in the geographical breadth and precision of the fossil record as it describes prehistory. Counting individual molecules in a sample rock is not uncommon, providing accurate measurements.

Considering this progress, there is little space for doubt about what the fossils tell us about living systems as they were at the time of burial. Educated opinion among the general public is reflecting that trend. At one time, the shape of fossil animal bones was all palaeontologists had to go on in placing a creature within the Tree of Life, but now that is only part of the evidence. Since the 1980's fossil proteins, trace fossils like microscopic life and the DNA of living descendants have helped to reconstruct[157] the past.

However this information may not be equally shared. According to a 2005 Pew Research Centre study, 70% of Evangelical Christians in the US think that living beings have not altered since their creation, whereas just 31% of Catholics and 32% of mainstream Protestants agree. So many are still clinging to false Platonic views of nature.

The discoveries of science are in conflict with existing creationism based on pagan speculations about Forms, the transmigration of souls and how nature works. That species or 'kinds' are unable to evolve into other forms while a perfect world must also be static are missing from the Bible but are common Christian assumptions.

The ability to point to significant gaps in the scientific record of history is disappearing. Discussing instead how this knowledge integrates with the Bible is the challenge Christians need to focus on rather than trying[158] to discredit it. Its helpful to think about where such evidence fits in the timeline of creation. As Issac Newton wrote "*Amicus Plato amicus Aristoteles magis amica verita*" or Plato is my friend, Aristotle is my friend, but my greatest friend is truth.

There are fundamental principles in science that cause religious people to be distrustful. Science focuses on material forces. It is often sceptical about ancient wisdom and trusts reports of unusual events only when the evidence is convincing. It accepts material collected from the natural world as needing to speak for itself, without assumptions.

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155 Evolution and Compatibilism: What it Takes to Reconcile, Aaron Adair, Adjunct Professor of Natural Science, Babson College, February 2019.

156 See https://theconversation.com/fewer-australian-university-students-than-ever-before-believe-in-creationism-101674

157 See for example Molecular analysis confirms T-Rex's link to birds

158 Dating of fossils should never be accepted uncritically, but there is not enough flexibility to shift the dates into a range accepted by flood based creationism, when verified by independent lines of evidence.

Naturalism is the belief that there are no forces in the universe with a personality. Gravity does not go easy on the tired, and electrons do not fall in love with protons. Natural laws do not adjust for our convenience. It rejects the existence of any ghostly, demonic, or divine hand guiding lifeforms or planets. Naturalism is helpful as a scientific assumption because it removes the otherwise messy question of motivation. It divides into an empirical side focused on measuring the elements and events subject to natural law and the principles, such as everything that exists is part of nature.

Practically it means science rejects explanations that require supernatural intervention to function. God is ruled out as an explanation because no one can test his connection with the universe by building an experimental setup. At the same time, we don't have the mathematics for even weakly godlike intelligences[159]. On the other side of the supernatural, imagine if scientists had to factor in shadowy or demonic forces altering their samples. That would greatly complicate[160] coming to reliable conclusions. Assuming supernatural influences permits anything to happen for unknowable reasons.

Naturalism is present in other areas, such as biblical criticism[161] where it is at the same time useful but damaging. It is also challenging for belief in creation to thrive using materialist principles. For example, creationist research emphasises the mechanics of the flood. However they are not able to progress scientifically because they are trying to understand a supernatural event using purely physical explanations. The two worldviews conflict so severely that the result is either a jumble of pseudo-science unsupported by facts or investigations that nibble at the fringes of established science but cannot explain any of its major discoveries.

Naturalism provides a framework for human knowledge. Why are we able to comprehend anything about nature as humans? Science believes that long-term evolution equipped primates with brains[162] capable of swiftly analysing and reacting to complex events. Making sensible choices is vital, and there is always room for improvement. A species that can predict changes to its surroundings will flourish. While some physical abilities may suffer, improving one's brainpower is an excellent strategy that has been a trend in mammals for a long time, one we benefit from. All mammals share this advantage, which is why scientists can train a rat[163] with ease compared to insects or reptiles. Problem solving intelligence[164] is not the best feature of human brains, it is that we have more freedom than other creatures. Other creatures with large brains also have some freedom to choose. However, they cannot manipulate the abstract symbols of language or override their instincts when that is useful as humans can. The cornerstone of human wisdom is our capacity to see the future and take action before things

159 "*Charles Stross introduced the phrase 'weakly godlike intelligence.' Weakly presumably refers to the fact that such beings would still be bound by the laws of physics—they couldn't perform actual miracles, for example. As a writer, I'm filled with admiration for the phrase, since weakly and godlike have such contrasting meanings that it forces you to think when you read it for the first time, and the term weakly is often used in a similar way, with various technical meanings, in scientific discourse, giving a vague sense of rigour to the phrase.*" - Kinds of Minds, J. Storrs Hall, May 30, 2007 https://www.kurzweilai.net/kinds-of-minds. As an example, the hypothetical aliens of intelligent design are weakly godlike because they do not manipulate the laws of universes but only mess with Earthly biology.

160 If you start with a belief in a conspiracy of that kind, then you can justify rejecting any evidence as tainted.

161 A human centred understanding of the Bible is possible if you remove God's purposes from it. The Bible's books are reduced to historic artefacts from ancient civilisations allowing you to dissect and compare them. That does lessen its usefulness in saving humanity, but many exciting stories remain. Similar to the modern idea of a Christian government, it keeps the symbols of faith but none of the reality.

162 The forces that shaped human mental powers did not have a planned stopping point. So just like bridges that are built extra strong, they are over-engineered. Our brains are more advanced than we usually require. The same skills we can use to predict the weather in a few days or a shift in our tribe's politics allows us to do science as well.

163 It's no surprise that rats have been employed as laboratory animals for many years. Despite being undersized, their thoughts operate in a similar way to humans, and their brain anatomy is also comparable. They can navigate mazes, memorise routes, and carry out intricate multi-step activities. Rats are also sociable creatures, showing signs of despair and loneliness if isolated. They also love to be tickled, especially on their backs and bellies, and tickled rats let out tiny giggles, sadly at a frequency too high for us to hear.

164 Even bumblebees can solve complex tasks from observation, share solutions socially and therefore innovate over time. Conscious experience and making choices is not something humans alone possess but a feature of all life found at different strengths in each species.

go wrong. To foresee our future just as God does. It starts as an intrinsic potential[165] given at birth that can develop or be lost.

Science rejects blind faith; there is no theory so sacred that it can't be explored and its reality tested against the evidence. Science helps us better comprehend where we came from, where we fit into the natural world, and what makes nature tick. This self-awareness guides us as a species, but there is no salvation in this view of the world. Science's goals are purely descriptive and do not offer an alternative to faith. Unlike the followers of Jesus, those that accept only science have no ultimate hope, either personally or for others, for no species[166] can avoid extinction. Any meaning we may generate in our lives will die along with our temporary human cultures. That is how most atheists understand our world.

The persistent evil in human nature remains a mystery that science cannot resolve. Our mental abilities are often misused, acting against our best interests. Selfishness affects our whole species, as the continuing extinction and climate crisis shows. Most scientists believe that humankind is ultimately alone and free to choose our destiny. This is not true. All of us are part of cosmic events that extend far beyond this universe. Our life has been affected by Gods actions and those of the Devil, and other beings from universes beyond our own.

Most scientists are not interested in examining Genesis for evidence of actual events. They consider it on the same level as the creation myths of early Egypt, inspired by the flooding of the Nile. The temple leaders who selected it to begin the old testament did not add it for the use of historians or scientists. As the earliest history in the Bible, it probably builds[167] on oral accounts that predate writing. A key question is its inspiration. When Christians say the Bible is inspired, that does not mean it is written in a cultural or literary vacuum. The text need not be without errors or mistranslations, but essential meanings must be as God intended. The Bible also contains direct revelations. That includes knowledge given in the form of visions. The events seen in a vision must be accurate. However, the seer may be taught through forms and symbols[168] that only make sense in their own culture. Genesis includes elements[169] from the writer's culture to provide context. This is the nature of inspiration to write the divine message in a form the reader can appreciate and understand. Inspired writing is God's desire to save us given written form; all other useful purposes are secondary.

In contrast to other explanations of creation of the time, Genesis's main events are unique. These include the days of creation, direct communication between God and Adam and Eve, and the events surrounding the fall. The goal is to make clear God's role as the sole and all-powerful creator and show how Abraham's line runs back to the loyal side of humanity[170]. A history is not Genesis's primary pur-

165 See for example Stephen Cave, The Free Will Scale, https://aeon.co/essays/free-will-is-back-and-maybe-this-time-we-can-measure-it. - Like IQ or EQ, there should be FQ: a freedom quotient to show how much free will we have – and how to get more. As we start to understand, and learn to measure, the capacities that underlie behavioural freedom, we can begin to put this natural free will on a scale. Paralleling the measurement of intelligence. Such a scale could give us insights into factors that hinder or enhance our efforts to shape our lives.

166 Atheistic scientists hope for the survival of sentient life, and positive memories of humanity in the species that will emerge as our descendants if such beings appear, but that's about the best that can be expected.

167 We shouldn't underestimate the reliability and detail of such accounts. Oral histories are known to have preserved records of geographical changes. For example sea level changes across 7 to 18 thousand years. - Aboriginal Memories of Inundation of the Australian Coast Dating from More than 7000 Years Ago, Nunn P.D, Reid N.J., Australian Geographer, Sep 2015.

168 That is especially true when the writer witnesses something far beyond human experience, such as the angelic beings and wheels of Ezekiel.

169 Apart from the genealogies, other examples would include the separation of the waters above the sky and below and the lands and rivers near Eden which echo the Enuma Elish, the Babylonian creation epic. The same as religious texts throughout history, Genesis quotes from well known descriptions of creation to convince the reader.

170 As Steinberg puts it "*Genesis is a book whose plot is genealogy*", Genealogical Framework, p41.

pose[171]. The book covers extended periods with no more than a line or two, with many events treated as assumed knowledge.

Care is required to understand Genesis within its cultural and literary background. Genetic proof of humanity's development is the most useful evidence of its timing. For this reason, the precise year when Adam and Eve first appeared in history must remain unknown. Yet it must exist between the markers of the old stone age with its simple stone tools and lack of writing, and the first permanent settlements which grew along with farming[172].

Adventists and creation

How does the Seventh Day Adventist church to which I belong fit into the creation vs science debate. In some ways we have been a major reason why it is still a conflict. We are not against science in most fields, especially in the area of health. Adventism's use of both the Bible and science to dispute tradition has been one of our strengths. Academically and practically, we have worked to keep our hospitals at the frontiers of medical research. Seeking recognition for our schools and universities also started early with our medical graduates. That has helped integrate Adventist education into a mainstream position in society. We are accepted by other churches as conventionally protestant, although with quirks. According to Randall Barlmer, a professor of religion at Dartmouth College, "*I think there's kind of a cultural difference and a residual suspicion because they worship on Saturday rather than Sunday. My observation is that Seventh-day Adventists are looked askance at to some degree. It's not because of anything heretical in what they believe, but it's just kind of a cultural difference.*"[173]

Adventists emphasise the significance of a Sabbath rest as the Bible teaches, which is an echo of Eden. That rest was something Jesus practised in his years of teaching and healing. It points to a final restoration of nature, to what creation was always meant to become. Faith in the literal truth of the Bible and the many strands of its history has encouraged us to support biblical archaeology. We highlight the essential role God's law plays in people's lives, although the law is just a signpost directing us towards safety rather than protecting anyone directly. Our focus on the second coming is equally essential, promising a time when God's highest and most profound law will sweep death and decay away forever. We have led out in defending against the violations of faith by governments. We believe the state should never align itself with any religion as it did in the past. Our message has been heard, with 18.7 million members worldwide in 2015 and 21 million in 2021. Adventists are among the most widespread Christian denominations, with churches in 216 of the 237 countries and regions recognised by the UN. That means we need to try to bring together many diverse cultures, with their own explanations of God and creation. This challenge could result in a fossilisation of ideas and a retreat to a fixed, western and fundamentalist viewpoint when faced with so much diversity. I hope that is not the way things play out.

The Adventist church sticks to a literal creation in a few real days, an initial perfect universe that is a key part of this explanation, and an event beyond empirical study. As Seventh-day Adventist church founder Ellen White puts it "*Just how God accomplished the work of creation in six literal days he has never revealed to mortals. His creative works are just as incomprehensible as his existence*"[174]. Its beauty was the ideal that God desires for all his creations. This event does not require a scientific explanation. Apart from the fall the laws of that planet had no effect on our own. Her objection to scientific views, arose from her belief that they contradicted the intent of Genesis. Galileo's observation applies. If she had been born in the modern era instead of 1827, she would have 'seen what we see and judged as we do' and arrived at a biblical explanation for nature's complex history. After all, science was just getting started in her era.

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171 It is impossible to reconstruct a timeline back to Eden from things such as Genesis' lists of ancestors. They were preexisting lists adopted by the writer(s) of Genesis. Therefore they are not shaped by inspiration, and also inconsistent in different Bible manuscripts, suggesting that they are added for context or literary purposes and not reliable.

172 Example of early permanent settlements would be for example the remains of huts made around 17,000 BC at the Ohalo site near the Sea of Galilee. These were constructed from mud and branches but were occupied year around.

173 See NPR all your questions about Seventh day Adventism and Ben Carson answered.

174 3SG p. 93

Because we love God's Word faithfully, some think that means rejecting science. Adventists sometimes find themselves standing alongside Flat Earthers, hired propagandists promoting falsehoods for oil businesses, and governments hostile to freedom of thought in public discussions, especially online. That is a result of our occasional denial of whole branches of science. Like any area of internal disagreement, some topics are avoided more often than freely discussed for fear of creating doubt rather than growing faith. That means not even discussing any evidence that seems to contradict a simple biblical account. Even so, questions of creation's meaning and natures need for salvation go to the heart of being a Christian. Science gives us an insight into natures condition but also the creators extensive mercy.

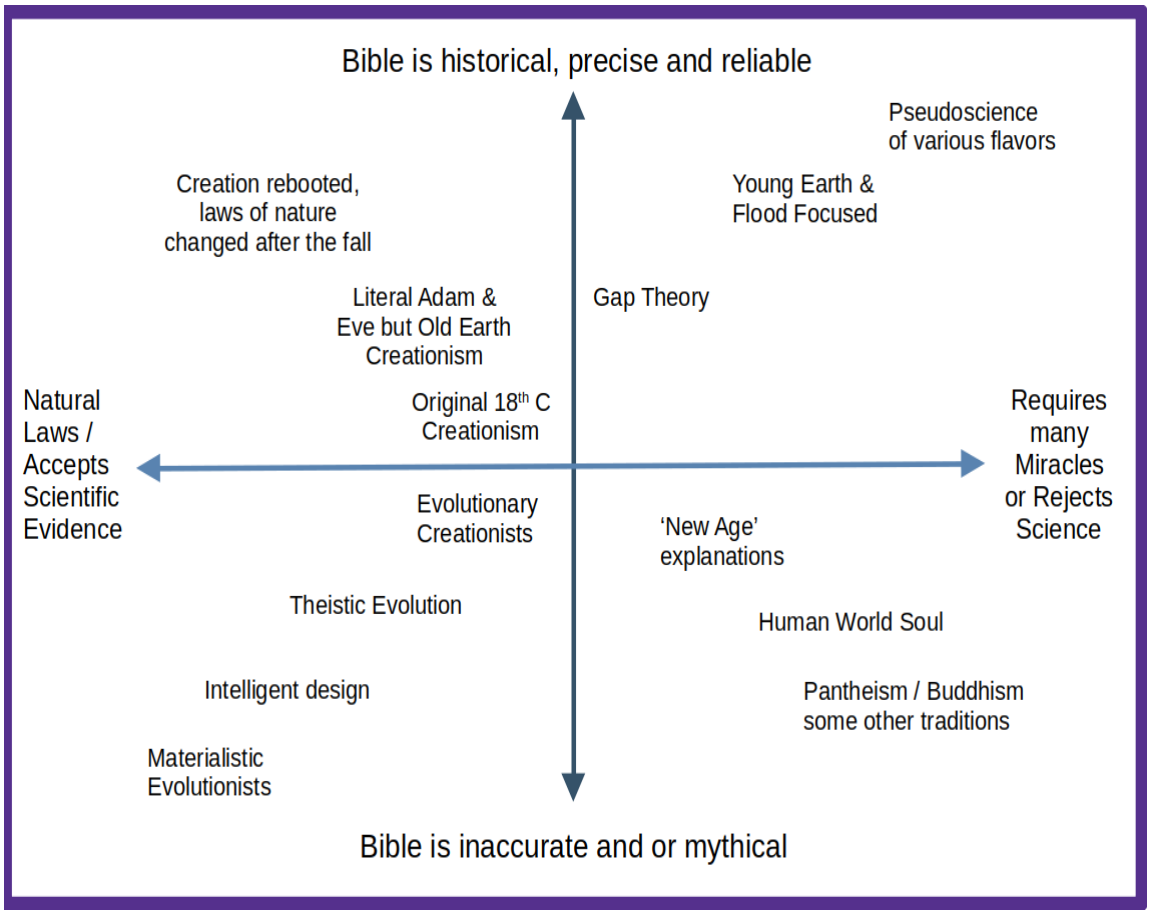
Deciding that scientists are the enemy adds much heat and no light. Some believe that, like Paul, they should "*destroy arguments and every lofty opinion*[175] *raised against the knowledge of God.*" Instead, why not follow Peters advice making a defence of our faith with gentleness and respect[176], a more Christlike approach. Then we will be able to better answer the challenges of this topic, including those coming from other church members. Many scientists recognise the value of a faith that sees meaning in our existence, provided it accepts the facts of history.

Mapping the explanations

What follows is a graph of how I see the competing explanations for creation. In particular, how the Bible is viewed and the value placed on natural law vs. many exceptional miracles as the 'engine of creation'. Protestant culture is based on the one of a kind authority of the Bible beyond other books and human knowledge or traditions. We find truth in what the Bible says about creation and natural law. However, history needs to be seen through both scriptural and scientific lenses. Together, they enable us to focus on essential details that the Bible's account leaves out or only implies.
I am not alone in saying that modern biology and deep time are compatible with Genesis. The BioLogos organisation also claims the same thing. They support a weak agreement between the Bible and science. Theistic Evolution sees the themes and moral principles in Genesis as not contradicting evolution or deep time while permitting it in some ways. In summary, views on the bottom focus on individual salvation as the only reason the Bible exists. In contrast, views at the top of the graph accept an accurate Bible. According to these groups God implements the plan of salvation in the context of history. The plan to save humanity started with the creation and the fall. As God unfolds his goals throughout the Bible, it teaches where the separation from God occurred and how He will make it right. That knowledge is as much revealed truth as the New Testament accounts of Jesus' words.

The creationism displayed in the graph, labelled as Original 18th Century Creationism, accepted God as the universe's creator but was firmly attached to an orderly mechanical and designed universe. This view was beginning to shift as some early scientists admitted that there had been multiple eras and an ancient Earth. Nature had been affected by many catastrophic events apart from the flood and other upheavals, as the geology of the time was proving, but most retained the idea of species existing in fixed kinds. My proposal, Cosmic Creation, is a unified model supporting faith and science equally. The events in Genesis were real. They explain the development of our universe, galaxy, the Earth and living things over billions of years. Nothing in the Bible, including a creation week of seven real days[177] in Genesis chapter one contradicts any discovery of science.

175 2 Corinthians 10:5 – this approach did not work that well for Paul considering the lukewarm response to his Areopagus address.
176 1 Peter 3:15 ESV
177 Seven periods of 24 hours, not some kind of mystical long age per day.



Competing ideas are most useful where everyone agrees on the facts. Having a high standard of evidence for what is factual, is the key to progressing[178] towards truth.

Adjusting to new evidence

Ideal answers to the difficulties raised by science do not exist. We ought to believe that "*Faith is not certainty. It is the courage to live with uncertainty*" as Jonathan Sacks puts it[179]. Christians were not called into being to fight science but to seek our creator. We can declare to everyone that God is their parent. Our ability to understand creation extends beyond a narrow emphasis on biology, physics, or the importance of the most recent fossil. However, there is a growing contradiction between a literal understanding of Genesis and the evidence. Something has to give, and faith is frequently the victim. More innovative models of our origins are required to support Genesis' historical accuracy. We must do better, for new knowledge will damage faith if it is based on wrong assumptions.

178 An unbiased standard for evidence is critical to science, as Charles Darwin wrote, "*False facts are highly injurious to the progress of science for they often long endure: but false views, if supported by some evidence, do little harm, for everyone takes a salutary pleasure in proving their falseness: and when this is done, one path towards error is closed and the road to truth is often at the same time opened*".

179 Jonathan Sacks, The Great Partnership, p97.

Decay and Universal Law

“The world has signed a pact with the devil; it had to. It is a covenant to which everything, even every hydrogen atom, is bound. The terms are clear: if you want to live, you have to die. The world came into being with the signing of this contract. A scientist calls it the second law of thermodynamics.” — Annie Dillard

Nature as it works today is based on corruption, on the breaking down of the dying so life can exist. Even stars are part of this cycle of decay and rebirth. While before the fall, each creature, every plant and cell, was protected by the presence[180] of God and urged toward growth and harmony.
Exactly how this worked is difficult for us to understand since our own universe’s laws are so different. His guidance countered the risk of randomness turning to evil ends. Under the present laws, He chooses not to limit chaos, resulting in natural evil. He witnesses baby sparrows fall to their death, and stars consume their planets but does not catch them[181]. God prevents only the worst large-scale effects of chaos so that life on Earth might go on.

Energies dark twin

Not so long ago, we used steam engines for most heavy work. Coal-powered steam was cheap and made factories and modern life possible. While useful, it was also inefficient. Engineers put much effort into increasing the pressure of early steam-filled boilers and optimising the conversion of pressure into movement. Unfortunately, early engine designs could convert only two percent of the pressure into useful work. So, there was a strong incentive to improve designs.

Nicolas Carnot, a French military engineer, developed a design in 1824 for a heat engine. Based on the known physics of the time, it seemed possible to capture all of the energy generated by the movement of gas between a heat source and a nearby cooling zone. Energy would be produced as the gas repeatedly cycled between hot and cold regions. On paper, his invention efficiently converted the entire potential energy of the heat difference into engine movement. That was obviously wrong, and he was able to extend the existing laws of physics to demonstrate that even in a machine with no moving parts,

180 I’m not implying any form of pantheism which is unscientific and poor theology. Rather this is the supervision expected of any loving parent. Allowing random growth and exploration but protecting from disaster.

181 Also central black holes consume and irradiate huge areas within galaxies making whole regions unlivable. As seen above in an artistic impression of a black hole about to destroy an incoming planet. There is growing evidence that some of these massive and dangerous objects predate the galaxies they exist in and may have seeded their growth.

energy would still be lost. Any engine will experience many unavoidable losses in the real world, from loose pipes to wasteful fuels. For instance, modern steam engines, such as those used in power plants, can convert just half of their pressure into useful work.
Between 1850 and 1860, Rudolf Clausius, a German scientist and mathematician, built on Carnot's work to predict losses for steam engines. He coined the word entropy which he intended to sound something like energy[182] to represent the amount of wasted power. As the idea grew, Statistical Mechanics such as Boltzmann and Gibbs realised that they could measure it by examining the disorder in any energy system. They applied the idea to the molecules within gases with great success and went on to use this form of entropy in inventing the science of thermodynamics[183]. Clausius and physicists in the same field realised that entropy's existence was a universal truth. Summing this up in 1865 with the statement, "*The entropy of the universe tends to a maximum*".

Biology and decay

All systems decay unless propped up from the outside. For example, our Sun's energy drives most life on Earth and provides the external energy it requires. Life represents a tiny whirlpool in nature's vast stream of decaying energy. "Entropy makes things fall, but life ingeniously rigs the game so that when they do, they often fall into place[184]". Later in its development, entropy was used in information theory to represent losses within that field of study and in quantum physics to represent the purity of quantum states. However, its primary role is to be energy's dark mirror, ruling the domain of loss and waste. In this form, its steady increase is known as the second law of thermodynamics. This law states that the energy wasted can only grow[185] within a closed or sealed-up system.
As astronomer Sir Arthur Eddington[186] once said, "*Don't worry if your theory doesn't agree with the observations because they are probably wrong. But if your theory disagrees with the Second Law of Thermodynamics, it is in bad trouble*"[187]. It does not forbid species from adapting, as some creationists believe. Entropy is not the same thing as complexity. A biological system can be twisty, with many complex steps or parts, and that can cause it to waste a great deal of energy. On the other hand, streamlined systems are usually efficient. Species can add information in the form of extra abilities or lose them. Nature may fight entropy off for a while by opening up to outside sources or delay it, but the flow of energy in their bodies and the ecosystem they belong to will always be downhill.

Entropy and evil

Cancer is the expression of uncontrolled entropy inside cells. For example, cancer cells often fail at protein folding and suppressing unwanted genetic code. They are structurally less organised and prone to extra damage from inflammation. Cancers begin with uncontrolled cell growth, spread randomly through other organs, and develop treatment resistance by mutating. The existence of cancer, in particular, is a clear sign of the flaws in our universe and its deep history. Those points will be discussed in more detail in a later section. The forces of entropy lead everything to perish[188] in our universe. That makes no sense if only our planet suffers the consequences of sin. The major result of the fall is increased entropy. It is a key element of the enigma that is natural evil.

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182 www.scholarpedia.org/article/Entropy

183 Thermodynamics is a field of physical science that studies the interaction between heat and other types of energy such as chemical, mechanical and electrical energy. In a broader sense, it defines the interactions between all types of energy.

184 According to Professor of Anthropology John Tooby: "*For example oxygen diffusion from the lungs to the blood stream to the cells is the entropy of chemical mixing—falling toward more probable high entropy states, but increasing order from the perspective of replication-promotion*" - Falling Into Place: Entropy, Galileo's Frames of Reference, and the Desperate Ingenuity Of Life, 2012.

185 In special cases such as inside Time Crystals it can remain the same, but never decrease in this universe.

186 Eddington is also famous for leading the solar eclipse observations of 1919 that confirmed general relativity and for working out why time in our universe only flows in one direction. In his 1927 book, Nature of the Physical World he declares that 'Time's Arrow' is a direct consequence of natures ever increasing entropy. His religious views were Christian. As a dedicated Quaker the search for truth in all its aspects was his key. "You will understand the true spirit neither of science nor of religion unless seeking is placed in the forefront". In his view answers to the great questions must embrace but not be limited to scientific explanations.

187 As cited by Steven Hawking in his lecture the Beginning of Time.

188 Death is not entirely awful. It is also contains some mercy, a reprieve from agony for most creatures.

Marie and the Atom

"*A scientist in his laboratory is not only a technician: he is also a child placed before natural phenomena which impress him like a legendary tale.. Neither do I believe that the spirit of adventure runs any risk of disappearing in our world. If I see anything vital around me, it is precisely that spirit of adventure, which seems indestructible and is akin to curiosity*"[189] - Marie Curie.

Seeking without faith.

Christians differ on a wide range of issues. One thing they all agree on is that God is good. Yet natures flaws can turn anyone away from faith in God's goodness. That is true of some scientists, such as the extraordinary Marie Curie, born Marya Sklodovska in 1867. She gave us the term radioactivity and was the first to prove its energy came from the inner structures of atoms. She was the first woman in Europe to receive a doctorate in research science, the first woman professor at the Sorbonne University, the first woman to receive a Nobel Prize, and the first person to receive two Nobel Prizes in distinct scientific areas. Many historians rank her as equal to Einstein in her impact on the public perception of science.

She was born in Eastern Poland, then a tightly controlled province of the Russian Tsarist Empire. Her father was a high school physics teacher and freethinker, while her beloved mother was a committed Catholic. Her mother was sick much of the time with tuberculosis. Marie was the youngest of five children but closest to her oldest sister Zosia, who was like a mother to the younger children.

Marie would have been taught in school to respect the leader of Poland's oppressors, the Tsar. Polish children were instructed that as Emperor and head of the Russian Orthodox Church, he was appointed by God[190] to rule over them. Since the authorities were suppressing Polish education after uprisings against their regime, her family experienced many difficulties. Finances were stressed as her father had been demoted by his school for speaking out. He had protested because Russian authorities had eliminated all laboratory instruction from Polish high schools, a subject he loved to teach. Maria later recalled, "*I easily learned mathematics and physics, as far as these sciences were taken into consideration in the school. I found in this ready help from my father, who loved science.. Unhappily, he had no laboratory and could not perform experiments.*" A few years before her birth, her uncle had escaped to Paris to avoid deportation to Russia. That choice probably saved his life. The threat from the authorities extended through her childhood into her teens. Just belonging to a Polish student organisation or speaking up put her at risk of deportation or death.

To make ends meet, her father took in boarding students to earn money through tutoring. Tragic events followed this decision as the overcrowding of their apartment led to an outbreak of typhus spread by body lice. In this bacterial illness, infections start with a severe cough, bleeding under the skin, and if

189 Stable diffusion image based on her photograph taken at 19 years of age before leaving for Paris

190 "*Unlike the majority of European monarchs, the Tsar crowned himself, an act which underlined his status both as a priest within the Church and as autocrat by Divine Right, the rightful interpreter of God's will on earth and the source of both civil and spiritual law. In the ideology of the Russian monarchy, there would be no obvious division between the civil and the spiritual, the church and the state*" – God in All Things – Janet Ashton

untreated ends in delirium and death[191]. Tragically for young Marya, her 15 year old sister Zosia was killed by the infection, while her other family members recovered. Then the following year, her mother died from her long-term illness. According to Barbara Goldsmith's biography[192], her sister's and mother's deaths had a shattering effect, driving a life-long battle with depression and moulding her religious views. "*Curie would never again believe in the benevolence of God*" and would avoid formal religion her entire life. However, this suffering motivated her to seek out knowledge that could benefit her homeland and the world. Encouraged by her older sister, who had just completed her medical degree, to come to Paris, she migrated there, embracing the chance to do higher studies in mathematics, physics and chemistry at the famous Sorbonne University[193]. After graduating, she married a fellow scientist Pierre Curie, and there is no doubt they fell deeply in love.

Advancing science by discovering radioactive[194] elements with her husband, she devoted her life to understanding radioactivity and was later assisted by her daughter. She was also interested in practical applications of her discoveries. With her sister's help, she developed the first nonsurgical treatment for cancer, opening a clinic in Poland. During the first world war, she turned to battlefield medicine, making battery-powered X-ray machines. They could be driven up to the front lines where surgeons were operating. Today her example is emulated by many doctors and scientists who work selflessly for the progress of humanity but without religious motivation. She summed up her scientific work as exploration and adventure but a lot of arduous work went into each unique moment of discovery.
The elements she discovered, Polonium named after her beloved Poland[195], Thorium and Radium, are vastly more radioactive than Uranium. Their origin is found in the most violent and powerful astronomical events. These include supernovas and collisions between stars, which I will discuss later. On Earth, such elements are part of the crust but also drift down in the material that hits Earth, riding in with the dust from deep space.

Mysterious atomic whispers

One of the earliest discoveries the Curies made when investigating the invisible energy of radioactivity was how specific it was. There were identifying whispers of energy coming from each element, yet unaffected by any chemical process. They soon suspected that unlike all other substances known to science, these materials were not breaking chemical bonds but dividing their basic atomic structure. All radioactive substances are unstable, dividing irreversibly into other radioactive materials and eventually[196] into lead. Radioactive atoms obey the law that closed systems always decay. All matter was created from energy, and to energy, it may return. By revealing that atoms could break down, the Curies gave scientists an insight into creation. The decay at the heart of matter shocked physicists, since they had assumed that atoms were eternal. Their discoveries set the stage for relativity by showing that matter and energy could exchange forms.

Radioactive decay is independent of the materials surrounding an element. The chance of decay depends only on its atomic structure and events occurring within the atom's nucleus. It is also unaffected by temperature. In 1913 Pierre Curie tested a sample by dipping it in liquid hydrogen, which is espe-

191 In epidemic typhus outbreaks where there is no access to antibiotic treatment, from 10 to 40 per cent of cases are fatal.
192 Obsessive Genius: The Inner World of Marie Curie (W. W. Norton, 2005).
193 Maria found the intellectual freedom of Paris a revelation compared to Poland - "It was like a new world opened to me, the world of science, which I was at last permitted to know in all liberty"
194 She coined the word Radioactivity to describe the spontaneous emission of ionising, penetrating rays by certain atoms. She measured these rays using a combination of ionisation chambers, quadrant electrometers, and piezoelectric quartz detectors.
195 Named at a time when the dominant and empire building 'aggressor nations' of that era, Russia, Germany and Austria denied that Poland even existed.
196 Considering periods of time that are vastly longer than the lifetime of our present universe, then lead may not be the bottom element, rather an isotope of zirconium (92/40 Zr) could be the final atomic destination. It just takes an insanely long time for the decays to happen, so for all practical purposes the more stable heavy elements like lead and bismuth are where things stop.

cially cold. Its emissions remained the same. More recent tests[197] have confirmed Pierre's results with extreme precision.
Radioactive atoms can lose protons from their core, transforming them into an entirely different element. This alteration is driven by quantum[198] processes. Radioactivity is unpredictable at such a small scale, but there are vast numbers of atoms in even a small chunk of matter. So the decay time and the level of radioactivity can be predicted. The period scientists use to measure decay time is called a half-life. In a general sense it is the time required for half of something to undergo a process. For example when elements decay and transform it is the time it takes for half of the source material[199] to be altered.

Although weak compared to the fusion that powers the sun, radioactivity is essential to geology and life on Earth. It is needed for life because it generates heat[200], keeping our planet's interior liquid and moving, which brings up fresh minerals. In addition, radioactivity is part of the formation process[201] of new worlds.

Isotopes, decay and half lives

Discussions about radioactive materials often mention isotopes. Isotopes are atoms with the same number of protons[202] but with different numbers of neutrons. That makes them heavier or lighter than the usual form of an element and can also make them radioactive. Many elements have isotopes, for example hydrogen can be altered by adding an extra neutron[203] to make the heavier material called deuterium. Lighter isotopes are formed by removing neutrons. Chemically, isotopes do react differently to their parent element so they can be quite useful.
The half-life of an element can be a long period of time or extremely short. For example, the element Bismuth-209 has what may be the most extended half-life of any isotope at about 20,000,000 trillion years[204]; it is nearly stable atomically but not quite. Technetium-99m, one of the most common medical isotopes used for imaging studies, has a half-life of six hours. In contrast isotopes of Hydrogen have the briefest existence[205], lasting for less than a billionth of a nanosecond. When elements with different decay rates occur together in a single rock, comparing their proportions gives a reliable method for measuring its age. A rock with one radioactive element, has a single geological clock. You can cross-check your results and measure a sample's age precisely when there are several. Today the Curie's are laid side by side in France's national mausoleum, the Panthéon[206] in lead-lined coffins, the reward and the price for a life spent seeking knowledge.

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197 Half life of the electron decay of ^{97}Ru:, Precision measurement shows no temperature dependence, Goodwin J. R. et al, arXiv:0910.4338, 2009 also Measurement of the half life of ^{198}Au in a non metal, high precision measurement shows no host-material dependence, Goodwin J. R. et al, 2010, Phys Rev C (2010) etc.

198 Or they can gain them with similar effects. Decay occurs when one of the following particles is released which depends on the decay type: an alpha particle, which is similar to a changed helium atom (with its electrons removed), or a beta particle which is a high energy electron or positron, or a gamma ray, which is just high energy light stronger than X-Rays. Typically alpha decay is the most damaging since it is relatively slow and rips up other molecules in passing.

199 When measuring just the emissions from materials it is the time it takes for the level of radioactivity to halve.

200 How much of the heat delivered by Earth into space is attributable to radioactive decay of its elements? Radiogenic heat accounts for approximately half of the total. Due to the heat from decaying Uranium, Thorium, and Potassium etc in its minerals.

201 The radioactive decay of Aluminum-26 partly formed in new solar system's planetary discs, plays a key role in the formation of planets with layered interiors. Aluminum-26 has a short half-life of just 720,000 years, which means that it decays rapidly. As it decays, it releases a great deal of heat, which helps melt the rock at the centre of a planet. This melting allows heavier, metallic elements to sink to the core, while lighter elements as found in the iron poor continents float to the surface. This process can help to create the complex layered interiors that we see in rocky planets like Earth.

202 The difference between protons and neutrons comes down to their constituent quarks and helps build the university vs high school physics explanation of atomic forces.

203 Deuterium also called heavy hydrogen, is an isotope of hydrogen with a nucleus consisting of one proton and one neutron, which is double the mass of the nucleus of ordinary hydrogen, which has just the one proton.

204 If for example 100 grams of bismuth-209 had been made within a supernova at the beginning of the universe more than 14 billion years ago, about 99.9999999 grams of it would still be around today.

205 Hydrogen-5 holds the record for shortest half-life at 86 yoctoseconds. Yes a yocto-second is a real thing its 0.000,000,000,000,000,000,000,001 of a second.

206 Having been removed from their previous family graves in 1994. Ironically this was built as a church building commissioned by Louis the 15th to glorify his rule. This honour would likely have horrified the practical Marie who when asked, requested a plain dress for her own wedding as she intended to reuse it for daily wear in the laboratory.

Chapter 3 – Evidence

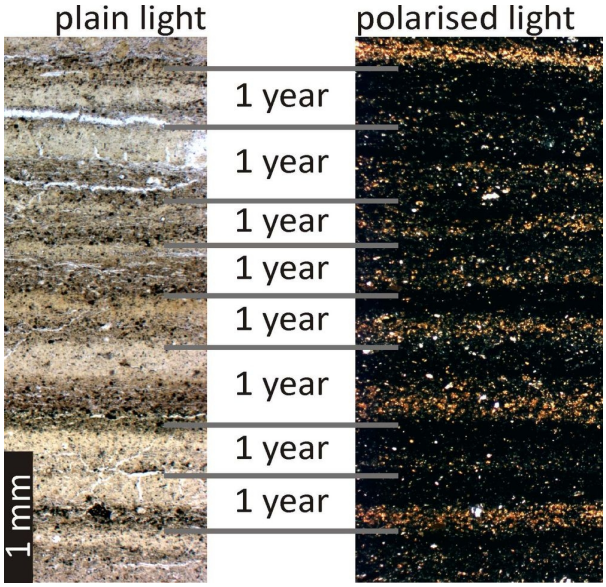
Deep Time

"Deep time is measured in units that humble the human instant: epochs and aeons, instead of minutes and years. Deep time is kept by stone, ice, stalactites, seabed sediments and the drift of tectonic plates.. Seen in deep time, things come alive that seemed inert. New responsibilities declare themselves. Ice breathes. Rock has tides. Mountains ebb and flow. Stone pulses. We live on a restless Earth." - Robert Macfarlane[207]

Lake Suigetsu

Many geological locations preserve the history of the Earth in natural elements. Dust in the ice and items swept into cave systems, compressed in rocky soils, and preserved beneath crystal layers. All help reveal the depth of time, teaching us details of ecosystems and climate.

One notable place for understanding history is Lake Suigetsu in Japan. Suigetsu is one of five shallow lakes formed between volcanic peaks. Its name means moonlight reflecting[208] on water. Legend tells of a wild dragon that made its home among the mountain ridges and in the lakes, bringing protection and harmony[209] to the region. The rugged central island that divides three of the lakes looks like a majestic home for such a creature. All the lakes were kept clean and flourished under his care. In time, however, the dragon fell in love and departed to be with a female dragon from the far north. So his home was abandoned, the lakes fell into disrepair, and their waters clouded with silt.
Aside from Suigetsu's significance in myth, its importance for geology is that the buried sediments at the bottom of the lake are composed of thin layers, added[210] every year. Below is a snapshot of this long record covering just a few years.



The sediments of lake Suigetsu come in yearly layers

Many annually laminated deposits are found worldwide. Another example is the Lago Grande di Monticchio in Italy. Summer and the winter season, add two distinctive layers of material every year, one lighter and the other dark. The quiet lake surface in summer is a perfect environment for the green-

207 Robert Macfarlane, Underland: A Deep Time Journey, 2019
208 Also 'pit of the stomach', but I'm going with the prettier alternative.
209 Japanese Dragons unlike their western counterparts are water deities or Kami (spirits) associated with rainfall and bodies of water, and sometimes depicted as large, wingless, serpentine creatures.
210 Lake Suigetsu is a varve, a geologic deposit of materials built by natural cycles with many laminated layers.

blue algae known as diatoms. As they die, their bodies drop through the water. Their silicon shells create a bright layer. Meanwhile rock dust, sand and darker debris accumulate throughout the year. The layers are yearly because the diatom's only thrive in the warmer months of the year. Like the rings on a tree, this created a record of summer and winter layers. Most of these are thin, less than half a millimetre thick. Suigetsu has a shallow inflow from an adjoining lake, meaning the incoming water is clear and sediment-free. That is needed because the yearly layers would be cut up and disrupted by a rapid river. It also lacks oxygen, with no organisms living in the deeper waters to break up the delicate materials after they are laid down.

Some of its layers include material from known historical events. These materials include clay's deposited by floods and tephra rock fragments[211] created by volcanic eruptions in other parts of Japan and as far away as Korea. There are around thirty layers with visible volcanic fragments, and many microscopic layers of ash also exist in cores taken from the lake. The layers also contain pollen from flowering plants. That allows scientists to reconstruct changes in local species of plants and temperatures. Recorded in the layers are recent events like the digging of a channel to the sea by farmers around 1664. These discoveries cross check the accuracy of the information dug up. Young earth creationists have attacked[212] these studies of lake cores. However, researchers made great efforts to accurately record the evidence from the lakebed. High quality work was vital to their research. Their goal was an accurate timeline for the climate of the whole region.

The East Asian monsoon influenced the climate at the lake, and it was also affected by major tropical storms. These events are visible in layers of clay distributed through the lakebed samples from floods clouding the waters. The samples show, that flooding occurred in repeating rhythms as the climate went through long-term cycles. Cycles appear in patterns in the cores as short as 220 or as long as two thousand years. The material's radiometric and optically stimulated luminescence[213] dating also confirms that the layers were deposited yearly. So we can be certain that they were deposited consistently in the past and not all at once. For example, the 9000th pair of layers contains ash dated close to 9000 years old.

The sediment cores collected from the bottom of lake Suigetsu contain over 100,000 distinct layers representing more than 50,000 years of real time[214] from the present, season by season. Below the sampled layers are even deeper records, they are yet to be analyzed but are reliably expected to record seasons in the lakes back to 150,000 years. This however is merely an eye blink compared to the life of the planet. Suigetsu is but one example of the evidence that existing creation theories cannot explain[215], found all over the world.

Ice, ash and zircons

It is useful to combine these measurements with other independent sources. These include radiometric dating, the climatic events recorded in tree rings, ice cores which show seasonal changes. Also, ash from volcanic eruptions, and the magnetic changes seen across the sea floor due to the tectonic dance of the continents.
The ice cores of Dome C a vast area in the Antarctic have yearly layers going back 800,000 years. While cores dating to 2.7 million years have been recovered from the Allan Hills in Antarctica showing the long term development of Earth's climate through trapped gases and rock dust found[216] in their layers.

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211 Tephra is composed of fragments of molten rock that are blasted into the air by volcanic eruptions. Tephro-chronology is the dating of rock layers by examining volcanic layers i.e doi.org/10.1016/j.quascirev.2017.12.013

212 Testing and verifying old age evidence: Lake Suigetsu,Varves, Tree rings and Carbon 14, Davidson & Wolgemuth.

213 en.wikipedia.org/wiki/Luminescence_dating – a reliable method for providing a minimum age for buried materials, from a few hundred up to half a million years. As it requires only on a minute or two of sun exposure some time before burial occurs to set the clock.

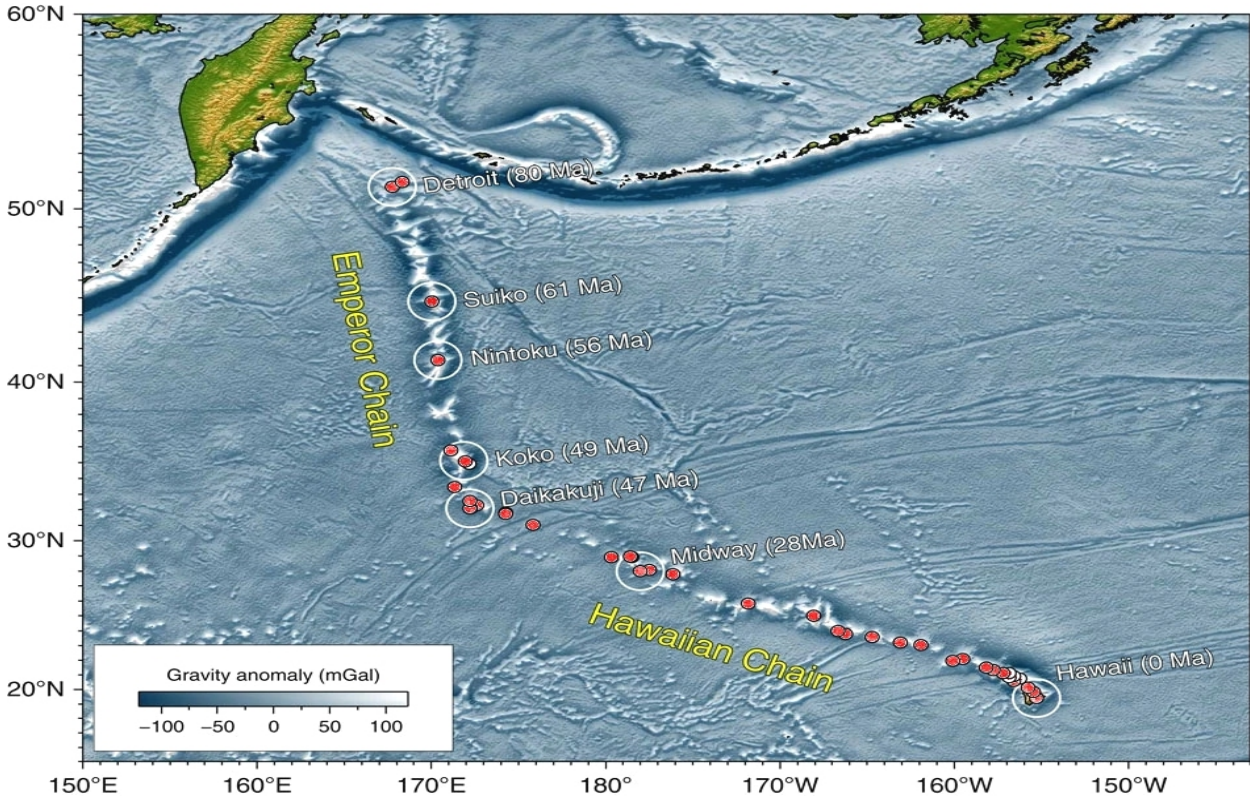
214 This is virtually yesterday in geological time, but along with other older evidence which it confirms, rules out simple Biblical chronologies.

215 Defenders of traditional creation theories point to example of more rapid deposition of materials in layers under specific conditions. However none of these exceptions apply to lake Suigetsu or the other lakes selected as historic records.

Some rocks are excellent recorders of the moving layers, and age of Earth's restless geology. They carry tiny histories of nature's cycles. Zircon crystals absorb and contain multiple radioactive elements, allowing scientists to date them using emission tracks and by measuring the proportions of elements they collect. This is because zirconium has the same electrical charge and about the same size as an atom of uranium. This causes zircons to build up a predictable amount of radioactive material in their outer layers. They can have inclusions of other nearby rocks, preserving more delicate materials as they form. They are also tough, jewellers use them as diamond substitutes. They can survive eroding out of softer rocks, being swept up by lava[217] and included in new rock formations repeatedly. Each time this occurs, they collect a new coating of material that is added to their outer surface.
These layers form a record of events that anyone can measure. Since each layer is newer than the ones below, this provides a way of dating the events the zircon has experienced. Especially when you compare many of them. A similar effect happens with diamonds[218] that form on the undersides of continental plates. They record the slow recycling processes of the whole planet. That gives geologists a window into deep time, based on tiny markers. They record forces that build landmasses and join and divide continents. Records of this kind are the reason geologists are certain not only about the age of the Earth but also, complex ongoing events in its structure.

Pacific Island evidence

The increasing erosion of islands[219] in a chain, as they are carried away from the volcanic hot spot in the crust where they first erupted is proof of great age.



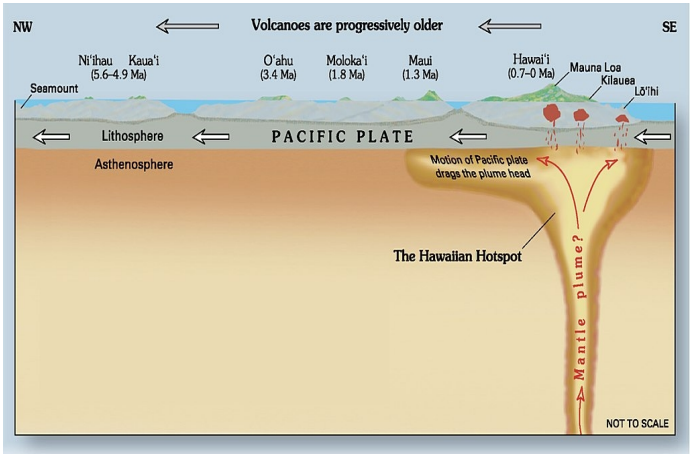
216 2.7-million-year-old ice from Allan, Hills Blue Ice Areas, East Antarctica reveals climate snapshots since the early Pleistocene, Yan Y, Ng J, Higgins J, Kurbatov A, et al, Goldschmidt Conference, 2017.

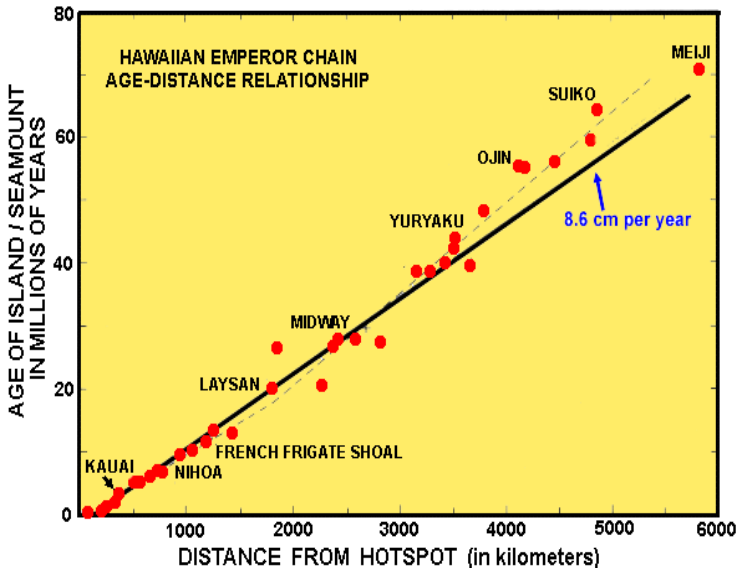
217 Because zircon has a high melting point of over 2500°C, it is used to line furnaces in the steel industry as cladding for nuclear reactors, heat exchangers, and especially strong alloys. Its atomic arrangement causes it to take up uranium during formation (half-life 4.5 billion years) and thorium (half-life 14 billion years), which geologists can cross-check. That makes it an essential mineral to establish the age of rock formations.

218 Diamond show the formation and breakup of super continents like Pangaea, Rodinia, Gondwana etc - Sublithospheric diamond ages and the supercontinent cycle, Timmerman, S., Stachel, T., Koornneef, J. et al, Nature, 2023.

219 Used under a Creative Commons 4 licence, https://doi.org/10.1038/ncomms15660, credit Torsvik, T., Doubrovine, P., Steinberger, B. et al. Pacific plate motion change caused the Hawaiian-Emperor Bend. Nat Commun 8, 15660 (2017)

The image shows the Pacific seafloor, with Alaska's pointy island chain over the Aleutian Trench at the boundary of the tectonic plate. To the bottom right are the islands of Hawaii.





What is immediately visible is a line of underwater mountains connecting to the Hawaiian islands. It extends from the Aleutian Trench, off Alaska, to Hawaii 6,000 km away. A volcanic hotspot generated this range of underwater volcanoes and the Hawaiian islands at the still erupting end of the chain. This hotspot is a vigorous upwelling of liquid rock pushing through the moving Pacific plate above. An intense flow of magma from beneath the Earth's crust creates the hotspot, although the origin and structure of these geological oddities are still being investigated.

Most volcanoes occur at plate boundaries where the crust is thin. This gives rise to geology like the well-known Pacific Ring of Fire. Hotspots, on the other hand, generate volcanoes in the middle, burning right through the rock of the plate. Many other seamounts and their island chains are caused by hotspots, such as the Galapagos Islands, the Azores, and the Samoan islands, but it is the longest and best known. In the diagram, you can see many of the points in the chain with their approximate radiometric[220] age. The oldest islands are in the northwest on the map. Moving in that direction from the hotspot, we see newly formed or mature islands with steep volcanic cones. Then flatter, sandy islands with eroded cones. Coral atolls form rings around the rims of the seamounts as the now-extinct volcanoes erode beneath the waters. Lagoons form over the submerged crater rims. Finally, the entire chain dives underwater, and only the nubs of islands remain dotting the ocean floor.

Geologists can use the progression in the island's ages to time the movement[221] of the Pacific Oceanic plate towards the northwest. You can see that there is a close relationship between age with the distance[222] to the present location of the hotspot. The bend in the middle of the chain is unusual and still being investigated. Did the hotspot itself shift due to changes in magma flows around Earth's core or did the overlying plate deform, or both? In any event, the dating[223] proves that the hotspot is the source of the islands.

220 How can we learn the ages of the undersea volcanoes that comprise the Hawaiian and Emperor Island seamount chains? Radiogenic dating is the answer, the seamounts' basalt contains minerals containing a high concentration of the element potassium. This has a well known decay rate. Any traditional creationist interpretation would need to carefully adjust these rates and erosion too for the composition of sampled rocks with distance to mimic the same effect.

221 Source University of Hawaii at Hilo, Geology department and USGS images.

222 The best straight line across all the data, considering the bend in the seamount chain, yields a tectonic plate velocity over the hotspot of roughly 8.6 centimetres per year. That is significantly slower than fingernails grow.

223 The dates vary from a straight line because scientists can only sample rocks from the most recent lava generated without deep sea drilling and the length of time between a volcano appearing and its last eruption varies. However the correlation is still excellent and could not have been generated by a random distribution.

Loihi, the Hawaiian chain's youngest seamount, is erupting from its top, currently it is at a depth of 1000 meters below sea level. It is gradually building what will someday be the successor to the Big Island[224] of Hawaii. Australia has similar chains of extinct volcanoes along our east coast, where a hot-spot burned a trail of ancient eruptions.

It is a different situation in the Philippines as those islands were generated where many ancient sea plates collide and are gradually being recycled into the deep Earth in ocean trenches. The geological region stretching from Malaysia to Taiwan, including the Philippines is one of the most interesting and complex on Earth. It has traces of lost undersea geological structures[225] that were once huge but are now swallowed up by time. It's oldest region of sea floor rock was once attached to the northern edges of the Australian plate. This has since moved a long way northwest.

Natural reactors

There is too much other evidence to review it all, but here is one additional example that I've found convincing. Nuclear reactors were among the most complex machines made by humanity until the development of computers. Apart from enriched fuel, they require other substances to slow the fast neutrons produced when uranium atoms split, or the chain reaction between the atoms of the fuel will fail. Just the right quality of fuel, the right amount of moderator, the control rods that dampen the reaction and circulating coolant are all critical to avoid an explosion in a traditional reactor.

One fact that has been known since the beginning of the nuclear age is that naturally radioactive uranium can't create a chain reaction. It is usually found in a form that is only weakly radioactive[226] and is simply not rich enough in the most active isotopes. It takes a lengthy process to extract, refine and enrich it. Yet natural reactors did once exist in the Oklo region of Gabon on the west coast of Central Africa[227] many geological ages in the past. Geologists agree that "*The Oklo phenomenon, is one of the most amazing and surprising discoveries of the 20th century made in the domains of geoscience and nuclear physics*"[228]. The following photo is the remains of the one located closest to the surface, now lifted at an angle[229]. Most of them were found below ground, during uranium mining.

224 Eighty Million years from now, the Big Island will be eroded away to sea level, but a chain of new Hawaiian Islands will have replaced it, extending further westwards. This is based on 2019 data acquired by researchers at the Berkeley Geochronology Center, aboard research vessels roaming the far Pacific, at the U.S. Geological Survey's paleomagnetism lab in Menlo Park, and at Stanford and other research centres.

225 The Pontus Plate, a long lost tectonic plate once covered more than a quarter of the modern Pacific Ocean, was discovered by geologists from rocks discovered in Palawan and Borneo. Tectonic plates sink only slowly into Earth's deeper layers. The Farallon Plate, for example was part of the seafloor of the Pacific Ocean but disappeared over 30 million years ago beneath the North American continent. It is still visible in the echos of earthquakes as they allow the deep crust to be seen. - Plate tectonic cross-roads: Reconstructing the Panthalassa-Neotethys Junction Region from Philippine Sea Plate and Australasian oceans and orogens,, van de Lagemaat, S., van Hinsbergen, D, Gondwana Research, Vol 126, 2024.

226 Specifically even refined from a mix of other substances like decay products, 99.28% of the ore is in the form of U-238 an isotope that has relatively low activity. Fortunately there are other isotopes although they make up less than 1 percent of the ore that are extremely radioactive.

227 Back in 1972, routine analysis of ore from the Oklo mine showed an unusually low concentration of uranium-235. This was unlike samples from any other location on Earth. However, there was another mystery along with the depleted uranium were unexpected elements like caesium, curium, americium and even plutonium. Such elements are usually formed only in nuclear reactors as the byproducts of fission. Natural plutonium is presently unknown on Earth since it long ago decayed away due to its short half life.

228 Inception and evolution of Oklo natural nuclear reactors, C. R Geoscience, Bentridi, S, Benoît G et al, Vol 343, Iss11–12, 2011, Pages 738-748.

229 Image credit Mark J Rigali, Sandia National Laboratories / US Department of energy, Sand 2011-9307C

These reactors started off within seventeen deposits of uranium in various places, in what are today the Oklo and Bangombe regions[230]. What we visualise when we think of a reactor is something large, but most were lens shaped concentrations only a few metres wide and centimetres thick. Just one richer location within much larger uranium ore bodies, surrounded by other rocks. As water invaded the surrounding rocks, building up as it dripped through cracks, it slowed the radiated neutrons sufficiently to support slow and steady nuclear fission. As the uranium atoms divided, they produced additional radioactive elements which further fuelled the reactions.

The Oklo reactors produced quantities of hazardous plutonium and caesium isotopes throughout time, but most of this long ago decayed to harmless substances like barium. So, how did these reactors work when natural uranium is so weak? To fully understand, we must return to the already mentioned concept of nuclear half life. True, natural uranium currently does not emit enough energy to split surrounding atoms in a chain reaction. However, as you retrace events back in time, it becomes more likely since the active concentration doubles with each half life.

The amounts of each uranium isotope is uniform in Earth's crust, so at present all uranium ore mined contains less than one percent Uranium-235. This is the form that powers atomic reactors. Go back two billion years, or about three half-life's of 700 million years. The natural concentration reaches 4 to 5%, which is higher than the three percent used in reactor fuel today, That would have allowed atomic fission to occur spontaneously as long as incoming flow of water[231] was maintained. To work the geology must not contain rocks, of a kind, that poison the chain reaction[232] by absorbing neutrons. The amount of uranium must not be too large or rich or it would have vaporised instead of sustaining a reaction. As a result, just a few examples of such reactors survive today. Although more may be found on other worlds where conditions were once right such as on Mars.

A missing explanation

Great age is not an explanation that traditional creationists can use to explain the reactors. Instead, they claim that God altered a few laws of the universe after creation. Then changed them back to current settings, just to explain this particular evidence. It is possible; any miracle is within God's power. Never-

230 See Nature's Nuclear Reactors: The 2-Billion-Year-Old Natural Fission Reactors in Gabon, Western Africa by Evelyn Mervine, Scientific American, guest blog, 13/7/2011

231 To slow the generated neutrons down sufficiently so they can strike other atoms and begin a chain reaction.

232 Other sites with a similar uranium level and water have significant quantities of the element vanadium, killing reactions before they can cascade. Both the concentrations of uranium and vanadium were indirectly influenced by early bacterial life around the time oxygen levels first started to grow in the atmosphere.

theless, you would have to ask, why alter the fundamental laws of nature to multiply the rate of atomic decay? It is unreasonable to require miracles. Just to save traditional creationist timelines, especially if other facts refute that interpretation. It needs a reason, aside from patching a hole in religious theories!

It would not help with other dating measurements in any event. It is just suggested to explain this evidence. Tinkering with radioactive constants would have caused undesirable effects[233] on our sun so that alternative is not sensible. Why would the sun be affected by radioactive processes? That is because every star's life is a constant battle between gravity and the surging forces of nuclear fusion, change this delicate balance, and you risk a collapse, explosion, or in this case, our otherwise unremarkable sun scorching[234] the inner planets. If you increase radioactive decay by four times, the amount needed for the reactors to function. Then our sun would have been a lot brighter. Like B-class stars, it would have been 40 times brighter and much larger with a surface temperature of more than 15,000 kelvin. A disaster[235] for the whole inner solar system.

The Oklo reactors cycled for hundreds of thousands of years, producing the expected amount of decay elements for the type of uranium that would have existed two billion years ago. There is a second kind of explanation that traditional creationism uses when cornered by facts. That is to claim that God created geology pre-made to look old. In this case making the exact balance of decay elements in the rocks and their structures. In order to make it look, in exquisite detail, as if the rain had been trickling down through the cracked rock, invading the uranium and triggering the reactors. God would need to add the appearance of damage as they exploded repeatedly over years and years, cycled between wet and dry climatic periods, and the resulting layers of daughter elements[236] made over vast periods. That would be quite a messy deception. In contrast, my proposal adds a cosmic focus to interpreting the Bible and accepts what the evidence is telling us. The Earth and the solar system are ancient, just like our galaxy[237]. Oklo's natural reactors make complete sense in that context.

The Bible interprets itself, as does God's other book, nature. Given these examples alone, any questioning of deep time doesn't make sense. There is far more evidence I could add beyond these discoveries. If reading this makes you uncomfortable or you find it controversial, that likely reflects conservative religions' recent view of science. You may have been told, even in a sermon, that scientists and modern biologists are against the Bible and your faith.

The truth is that deep time is real. It is required to understand creation, especially in astronomy and biology. At the same time, complex genetic changes have occurred[238] that only long-term evil and chaos can explain. Plato's and Aristotle's pagan religious beliefs are unreliable guides to understanding nature. It is no accident that nature records the past. The history unearthed by scholars is a record that God intended to exist, exactly as we discover it. It shows how everything flows from nature's laws, from the layers on microscopic zircons to continental fissures. Christians ought to respect both revelations of truth. Accepting discoveries about nature, even when they differ from our previous assumptions.

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233 Tweaking the fine structure constant by just the right amount works for this

234 Looking at the stars now, we should see a bloating and brightening effect in stars at a ~6000 to ~10,000 light year radius around Earth's location at the time, which is not observed. Careful analysis of reactor data shows that the fine structure constant was the same as today.

235 Sunlight is the first thing to be concerned about. The Earth would receive around 40,000 watts per square metre per second instead of 1000. This energy is three times the flux received on the surface of ultra-hot Mercury. At the same time, the Earth's crust would have become highly radioactive. Almost all combustible objects in sunlight would have caught fire within a few seconds. So Adam and Eve would have died by burning long before radioactivity became a concern.

236 If there was such a perfect simulation of the past, then how does that differ from a real history? For events taking place in the mind of God or in a real physical universe the result is still a true history of nature.

237 If the Galaxy had developed independently or been created in place, it would have had this lovely spherical halo of mass shaping it's star formation and an elegant flat disc. The fact that its halo is slanted and has a football-like shape with random bumps shows that our Galaxy was involved in at least one merger event and probably several.

238 Creatures need more plasticity in their genes under traditional models than scientific ones, deep biological changes that transformed species after the fall would need to be hundreds of times faster or all special miracles.

Predators, Parasites and Design

"There have been enormous extinction events, and enormous slow-rolling revolutions that have pushed certain kinds of life into peripheral, boutique niches.. Life is also a system constantly in competition with itself, from predator and prey to host and parasite, and pathogen to victim[239]"
- Caleb A. Scharf

Why does conventional creationism, with its assumption of rigid design, clash with current biology? Because conflict and chaos are built into life at every level. Not as a failure of living systems but as part of their essential functions. Human beings in our present fallen state are fragile. We require a system of living things to support us by dying so we can live. We must cook our food and take shelter from the elements. Our genetics is fragile and full of weird workarounds. It contains fossils in its code, showing evidence of our ancestor's battles against nature and especially with viruses[240].
Animals and plants also have the same difficulties as we do, or more in many cases. Approximately forty percent of living creatures have a parasitic existence and use ingenious and sometimes rare abilities to infest or live off other creatures[241]. There are vast numbers of parasites in nature. There are almost a million Helminth species including parasitic worms, flukes, tapeworms, and nematodes. The diversity of a group of species matches its age because it takes time to radiate out into different forms. Groups like the Helminth are exceptionally old and diverse.
The abilities needed to be an effective parasite are too complex to evolve quickly and are vital for survival[242]. Many life cycles and methods of attack in parasites are so complicated they rule out small-scale evolution as a possible explanation[243]. Many species cannot reproduce at all without infecting[244] or consuming another creature from the inside[245]. To exist, parasites need to have been in contact with their hosts as they evolved together, becoming specialised in just one or a chain of host creatures. Parasites feed on host species that fight back. Their genes have evolved to evade the host's existing defences. This occurs in a series of feedback loops that are dependent on both the host and the invaders through millions of generations. The process is called co-evolution and is essential for these creatures.

Viruses are a ubiquitous kind of parasite. More than 200,000 distinct viral populations[246] feed on the ocean's inhabitants alone. They are a topic I will expand on. They were not created by any loving creator, especially not by the God of the Bible. It also seems improbable that anyone engineered viruses or other parasites. The Bible does not mention genetics or humans influencing animal species, except when breeding for valuable traits[247] in domestic animals.

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239 The Noninevitability of Life, Scientific American, 28/2/2020

240 These are human endogenous retroviruses, www.nationalgeographic.com/science/phenomena/2015/02/01/ our-inner-viruses-forty-million-years-in-the-making They are problematic for flood based creationism because we share the exact same ones with other mammalian species. See the section on viruses for details.

241 Homage to Linnaeus, How Many Parasites? How Many Hosts? - www.ncbi.nlm.nih.gov/books/NBK214895

242 You could even call their feeding abilities 'irreducibly complex' given they had only a couple of hundred years in which to develop under flood based creationism. See also *Sphaerularia Vespae* which manipulates giant hornets sterilizing the females and using them as a delivery system for their offspring. All from inside the victims body while having nearly perfect yellow and black camouflage that matches the victims own coloration.

243 Consider also Sacculina carcini which parasites crabs, this species seeks out its prey, burrowing into the cracks in its armour. Once inside it spreads through the host's nerve centre, stomach and genital area. It then protrudes out from the crabs abdomen where a female crab would normally store her eggs. The crab will protect the growing slug like parasite as if it was her own fertile eggs. If the parasite attaches to a male crab it can even make it infertile and cause changes that causes it to act like a protective female.

244 The green-banded broodsac which mind controls snails and rides them around until consumed by a bird is both especially colourful and icky with a complex two host life-cycle.

245 Roundworms such as rhabditid nematodes like Strongyloides stercoralis, for example which develop into free living adult male and female worms that mate to produce immature and thin larvae. These cannot reproduce like their parents but need to locate a host and penetrate it's skin. They then migrate from the entry site to the hosts gut, where they deposit their eggs. Some of these eggs may be excreted to hatch into the free roaming sexual form of the worm while others hatch internally and penetrating through the intestines migrate to other organs of their host.

246 Marine DNA Viral Macro- and Microdiversity from Pole to Pole, Gregory, et al., Cell, Vol 177, Iss 5, 1109.

Defences and suffering

The picture to the left is not an ant giving a termite a ride. The whole creature is a beetle[248] found in Australia's Northern Territory. It mimics a termite by enlarging its abdomen. When fully grown it can live within a termite mound for the rest of its life being fed and protected by the colony for free. Its an example of a parasite which has no reasonable explanation without a long co-evolutionary history. Other species are still gradually improving their mimicry[249] like the beetle in the picture to the right that lives in the nests of army ants and feeds off their eggs.

There is no plausible reason for either demons or prehistoric scientists to create these damaging and odd species in some lost era, as some creationists have suggested. Such an idea is very strange. Consider sap-sucking insects, blood-sucking ticks or intestinal worms that live only inside particular deep sea fish or crabs. Why would anyone bother to invent so many strange species that do not hurt anything apart from another obscure creature? These are creatures that science has only recently discovered in many cases. There are only two realistic options, given how complex their skills are and their dependency on their prey. Either, God intentionally made all of those horrible creatures[250] and their life skills to add to the suffering creation experiences, along with defences against them. That is possible but unlikely. Alternatively, they evolved naturally along with their host species during the reconstruction of nature after the fall. Their slimy nastiness[251] coming from the potential evil built into nature's basic laws.

What about changes that help animals defend against being eaten? Were these abilities like deft camouflage, internal poisons, sharp spines or stinging needle-like hairs specifically designed? No one in the conventional theories of creation has a reason to modify the instructions for animals, plants, fish, or insects to assist their defence. If the goal is to regulate species numbers, these powers are unneeded. Nature will balance life and death regardless of the skills on either side. Just like the abilities of parasites, they don't make sense without the slow development of many species together under the pressures of a fallen universe.

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247 Jacob did select for coat patterns that would benefit him in Genesis 30:32-43 and there was undoubtedly plenty of practical attention paid to the fertility of plants and animals.

248 Though termites are blind, they feel one another by touch. Therefore, the termite 'puppet' may aid the beetle in evading discovery. The beetle likely absorbs substances from the skin of termites or manufactures comparable molecules to strengthen the pretence that it is a termite. Because the mouth parts of Austrospirachtha carrijoi are small, scientists believe it begs food from its hosts rather than consuming eggs or larvae. This modification certainly benefits the beetle, once inside the nest, it may relax and live off termite room service for the rest of its life.

249 Although this does not look similar to an ant to us, who knows what it looks like to the compound eyes of an ant. Especially as they rely on chemical cues and probing with their antennae not just eyesight.

250 Not all are nasty. *"An inordinate fondness for beetles."* That was the reply of J.B.S. Haldane, a British scientific polymath of the early 20th century, when he was asked if there were anything that could be concluded about God from the study of natural history. Science has described over a million beetle species with many more added every year. This makes sense as the older a family of life is the more diversity can be expected.

251 Australian leaches suck! But they are adorable babies compared to the giant Amazon leech which can grow to half a meter in length or Tyrannobdella rex which specialises in attacking mammal's orifices, including eyes, urethras, rectums, and vaginas. It does not drop off its host after feeding but can remain attached at the site of its bite for days and weeks. After a time it can reach a length of up to 7 cm. Leaches also feed from each other, ironically often killing their victim, see australianmuseum.net.au/learn/animals/worms/leeches/

Some plant eaters have developed their bodies and whole way of life around the need to avoid predators or to increase the cost if attacked. However, the balance of species in an ecosystem constantly changes, and no defensive strategy will survive a fight with an opponent that can swiftly adapt. Adaptive power is essential, even when the failures create a steep price for individuals. Most plant eaters invest in several kinds of defence because their predators and even their food is fighting back. Nature evolves without any design or plan except selfish needs. This ability is powerful, enabling every creature to survive if given enough time to adjust. Some creatures on the other hand were just born to kill.

Despite those elongated fangs, the iconic North American Smilodon (Latin for knife tooth) was more of an ambush hunter with a bear-like build. It is thought they would spring from hiding, grapple prey with their forelimbs, hold them down, and then stab with their sabre-like teeth using their well-developed neck muscles to generate the killing force[252].

That nature is messed up has been a point of discussion in the church for centuries. The early Christian, Arnobius of Sicca[253] writing in the 4th Century decided that the creator was only responsible for the pretty and useful parts of nature, "*We deny that flies, beetles, and bugs, dormice[254], weevils, and moths, are the work of the Almighty King. Without incurring criticism we can be ignorant as to who gave them their beginning and at the same time maintain that not by the Higher God were they brought forth such useless, pointless, purposeless creatures.*"

Teleology, or the idea that all species were designed with a purpose, is a failed explanation for nature and was never part of the Bible. It also generates flawed theology since everything in a creatures genes needs to be explained, even things that have always worked poorly, or caused damage. A Platonic view of God's creation, where species have a fixed form and purpose leaves no room for dangerous or parasitic species. Like Arnobius, some creationists agree that nasty species were not designed by any creator. They evolved from shared ancestors sometime after creation. That option assumes that many original species with complex life-cycles and skills are possible in a ridiculously short period. While it is true that most insects and fish have short lives, quite a few[255] are as long as animals, so extremely rapid evolution of so many new families of species would not have worked. That also violates their own, constantly repeated, claim that evolution is not capable of adding any new abilities and ignores genetic evidence of co-evolution and the relationships between species.

252 www.nationalgeographic.com/news/2013/7/130702-sabertooth-cat-bite-prehistoric-science-animals/

253 From Wikipedia - *Arnobius (died c. 330) was an early Christian apologist, priest and writer of Berber origin during the reign of Diocletian (284–305). According to Jerome's Chronicle, Arnobius, before his conversion, was a distinguished Numidian rhetorician at Sicca Veneria (now El Kef, Tunisia), a major Christian centre in Proconsular Africa.* His writing shows familiarity with logic and science, but less Biblical influence.

254 Dormice at are adorable, and rare too, but he was probably thinking more of regular domestic mice.

255 Queen Termites can live up to 50 years. The gigantic Tarantula hawk wasps with their extremely painful string live for up to 20 years, Splendour beetles can live up to 30 years hiding quietly inside a tree and growing, only emerging to mate. Periodical cicadas are also some of the longest-living insects in the world. These creatures spend 13 or 17 years underground as nymphs before emerging as adults to mate, sing and lay eggs. So insect life cycles can sometimes be as long as mammals and the same applies to sea life. Deep sea Rockfish for example are slow-growing, late-maturing and long-lived.

Yet the issues don't end with predators, parasites and death. Birth, too is a problem, for nature is wasteful and cruel to the young. Take, for example, the Quoll, mainland Australia's largest surviving meat eater. Captain Cook collected them during his voyage along the east coast in 1770 and recorded Quoll as their local Aboriginal name. At that time, four species of Quoll lived on the mainland. Today, there is only one.
Although settlers originally called it the native cat, it is really a marsupial of the Dasyurid[256] family. It has some relationship to the Tasmanian Tiger and distantly to kangaroos. They are pretty animals with fur ranging between reddish brown to dark chocolate and white spots on the body and tail. Underneath, they have a creamy white belly. Sadly, the Quoll lives fast and dies young, usually after only two to four years. Females have babies after their first year. Males tend to die immediately after their first breeding season. They put every possible effort into having offspring. The males are what's known as suicidal reproducers[257], just like their cousins the Antechinus[258]. As they stop eating and sleeping and fight other males their health is affected, making them easy prey. That fate is built into their genes.

Because they are marsupials, their young are born tiny and undeveloped and only 6 mm long. There are between 15 and 30 babies born at a time. They must crawl across their mother's belly to one of only six nipples. There, they will attach, dangling under her belly and gradually develop. The six who connect to a nipple first will live and later transfer to riding on her back until they are large enough to hunt for themselves. However, many of these will not make it to adulthood. Life is unforgiving to the young and inexperienced. Any Quoll babies that arrive late, after all six nipples are taken dies without access to food. Efforts to save the Quoll are ongoing, but their status remains endangered.


A baby Quoll not long out of the pouch

The Quoll is typical of the wasteful nature of reproduction. Organisms spread their seed without thought or plan. The plant kingdom can be even worse, as anyone afflicted by spring pollen knows. Mothers suffer as well. Scientists believe an Australian lizard endures what could be the world's worst pregnancy. Pregnant Stumpy-Tailed lizards must gestate a giant baby weighing more than a third of their weight[259] without being able to swell up or use extra body space due to limits imposed by their

256 Photo is a baby Eastern Quoll, Dasyurus viverrinus (Shaw, 1800), still common in the forests of Tasmania.
257 Suicidal reproduction is uncommon in mammals. However, it is found in other branches of nature, Pacific Salmon spawn once and die soon after, as do octopuses, who decline and die while nursing their eggs.
258 Their cousins are called Antechinus. Like the Quolls they are carnivorous but cute, with light brown fluffy fur. During the mating season the males cannot stop making cortisol (the stress hormone) due to extreme testosterone levels. All of those stress chemicals become toxic. Internal bleeding is likely the cause of death for the vast majority of males, however their bodies do provide food for the females. In the case of Quolls, their death is not hormonal, but males hardly sleep or eat while travelling and fight a lot more, resulting in many male deaths. Females Quolls on the other hand live for a few more years, although feeding six babies per season can't be easy.
259 The stumpy follows a 'put all your eggs in one basket' approach. A few youngsters, lots of maternal involvement, with high individual survival rates. The mother is stressed, but each infant has a good chance of surviving because of their independence at birth. They are very particular about when they give birth. During drought years, they just focus on survival. They can live for more than 50 years, so missing one year of reproduction is not a problem.

bones and scales. Growing this massive baby is akin to a woman giving birth to a seven-year-old child. Breathing, eating, and moving becomes nearly impossible for this poor lizard.

While not as terrible as that pregnancy, flaws in reproduction also apply to us. Tragically, most human conception ends[260] in an early miscarriage. The affected women are not even aware that a potential baby existed at all. They experience it's death as merely a heavy period[261]. That is because we have a larger than usual number of weakened and defective embryos compared to other species. The reason for this is not fully understood. The inner surface of the womb, where embryos usually attach, actively prevents any connection, blocking the growth[262] of such damaged ones. The chemical bargaining between the embryo and its potential mother fails. Depressing as this is, the embryo's defects would likely cause it to die anyway, just later in its development. This gate keeping is natural since humans devote much time to raising our offspring, and layers of filtering before a baby can be born helps keep the species healthy.

A traditional creation story

Can the problems in making a quick transformation to a death-based ecology be ignored? We should accept, that only God could make such a massive change to our world. In the following story, I assume that this is done instantly and ignore all scientific explanations. As no natural process could have transformed nature in only a few hundred years between creation and flood.
I do not believe the following story is accurate history. Instead, it illustrates the problems in traditional creationism's theories. If science is ignored, the following scenario is what believers are left with.

The curtain rises on our story just after the fall of humanity. Dark changes are happening, across the plains and deep sea depths. In some unknown way[263], creatures across the globe are compelled to give up the harmless lives they have lived until now. Every member of the spider family all at once stops feeding on plant sap. Instead, they start spinning complex traps. Luckily, the silk they used for swinging from plants or making sticky nests also works to catch creatures. So they can wrap them up for some leisurely blood-sucking. The spider's DNA and tiny brains must have been all rewired. They somehow identify the kind of creatures that they need to prey on and which ones to avoid because of size or stings. The spiders hunt, but they are also the hunted.

Creatures that will prey on the spiders, such as mud wasps, also have fresh instructions. They have a complex new lifestyle to deal with. These wasp species must be taught how to catch spiders or other prey and sting them in their sub-esophageal ganglion. That's a small organ at the rear of their front body section. The substances injected will keep the spider alive but unmoving as they spread through their blood. Like all wasps, its venom is painful, but the spider cannot react. The combination induces paralysis that is unrecoverable. Next, they will imprison the spiders in mud tubes. One spider in the tube will have a single wasp egg injected into its abdomen. Luckily, the wasps already have exactly the

260 www.sciencealert.com/meta-analysis-finds-majority-of-human-pregnancies-end-in-miscarriage-biorxiv miscarriage is the predominant outcome of fertilisation and an inevitable part of human reproduction at all ages.

261 The fact that our bodies spend so much effort on screening for only the best embryos is why objections to contraception and abortion, and genetic engineering are ridiculous. However many pregnancies human prevent, that is only a tiny proportion of what nature itself kills to preserve our species. Given humanities load on the environment it is better that every child is planned for, and loved by their parents.

262 Early pregnancy loss: the default outcome for fertilized human oocytes, The Annual Capri Workshop Group, Journal of Assisted Reproduction Genetics. 2020 May; 37(5): p1057.

263 Only God had the power to make such a dramatic change. Traditional creationism acknowledges this but ignores the implications and inconsistency of including this in the original design "*Our knowledge of how God actually changed the creation, and what He changed in creation, may never be certain .. God created razor-sharp claws and teeth that can cut flesh. Yet the animals did not use them for carnivory (meat eating) until after the Fall of Adam.*" see Answers in Genesis - Creation's Original Diet and the Changes at the Fall. It's ridiculous that this author also quotes biologist B. F. Skinner to explain wasps and leaches and similar creatures. "*Simpler forms must have evolved first and have been selected by appropriate contributions to survival, the final pattern being shaped by a long series of contingencies of selection*" – so its fine to accept long term evolution for creatures that we don't want to try to explain. When conventional creationists say, please accept evolution on a massive scale, to explain this whole topic. That shows they are having severe difficulties with the evidence and really have no explanation.

right equipment in the form of a stinger that can also inject their eggs and strong jaws that can chew up dirt to make mud. Anyway, there the spider will remain, its spine broken, waiting for baby wasp to hatch and eat it from the inside out. At the same time, up to twenty-five other paralysed spiders are packed around the one egg carrier. All still alive and waiting to be snacked on by the wasp baby. Some species of wasps will even cooperate to fill the tube. Both Mum and Dad will collect spiders for their offspring to feed on[264] but no creature is safe in this threatening changed world. For even Mud Wasps are attacked by even more specialist killers, such as the Crypt-Keeper wasp[265]. Many of these species inject specialist viruses to disable their victim's defences and protect their own eggs. The viruses in turn steal the prey's genes to better victimise them. So it's biological horror all the way down. Also, try not to worry about what this change has done to Earth's many bacteria.

In the oceans, even more complex webs of feeding on death are being imposed species by species. Eurypterids, also known as sea scorpions[266], are learning to use their claws and serrated-spine-tipped stings to hold and kill their fishy prey. Meanwhile, creatures like the Sabre tooth tiger that coincidentally have long and pointy front teeth[267] have given up using them for chewing plants. I suspect they now think that fresh blood has an attractive smell. So it might be better for humans to go somewhere safer now, as death's reign has truly begun. A word to the wise – check any convenient-looking cave for oversized prehistoric bears before moving in.

264 Making them both horrible and adorable at the same time. It is impossible to conceive of this behaviour developing naturally in a brief period between the fall and the flood. Both the design of their bodies and their skills are critical to the wasps survival and specific in their victimisation of the spiders, who are themselves effective predators.

265 This species is known for chomping though their victims forehead as they mature. The Crypt Keeper is "*one of the few parasites capable of altering the behaviour of similarly insidious parasites—a practice fittingly dubbed hyper-manipulation. A new study published in the journal Biology Letters suggests the crypt-keeper, or Euderus Set, is even more powerful than previously believed: In total, the wasp can possess at least seven other insect species.*" - 'Crypt keeper' wasp brainwashes far more victims than thought - Science, Eva Frederick, Sep. 24, 2019. Early biologists found in the existence of parasites of this kind a persuasive argument for the randomness of nature. It is hard to imagine these wasps being specially created by any kind of holy or kindly God.

266 Sea scorpions were a family of ancient aquatic insects that died off 253 million years ago, long before the dinosaurs appeared. At up to 2.5 meters long they were gigantic for insect predators, and their family was successful for a vast period of time, 214 million years in fact. They specialised in killing armoured fish, their front claws held the fish in place while their sting injected paralysing venom and their strong mouth-parts took care of any armour on the prey. They were not all top predators, however all of them would have really loved human swimmers had we been around, so soft and slow! They were common and found in lots of different forms as are most fossil families discovered. They would have been quite cool to observe feeding, but from a safe distance. See Pterygotid eurypterid palaeoecology: praedichnia and palaeocommunities, Braddy S. J., Bulletin of GeoSciences, Dec 2023.

267 The sabre-toothed cat existed in Europe alongside Homo heidelbergensis."*We can say that the early humans - and the sabre-toothed cat – were living 300,000 years ago in the same area, in the same landscape .. The discovery illustrates the challenges that the Schöningen hominins would have faced and suggests that the wooden spears were not necessarily only used for hunting, but possibly also as a weapon for self-defence.*" - https://www.bbc.com/news/science-environment-34944560. The Schöningen findings are noteworthy because they show the precise design and finishing of wooden tools. These included throwing sticks for killing medium-sized or fast-moving wildlife made by hominids that were not genetically modern.

Scene of Cave Lions hunting from the prehistoric art of Chauvet Cave[268]

God must have applied individual adjustments to each creature on Earth, from the microscopic up to giant dinosaurs and killer whales. He had to change each individual cell in each animal since every cell is differentiated and focused on a specific role, from skin cells and hearts to the brain. Changing the code of a whole species at one time would have left each individual the same. They would have all been clones without natural genetic variation, creating a disaster. So God included the effects of millions of years of natural development and random events as they would have affected each specific cell within each creature. He remake them, as if their ancestors had evolved under natural laws. Adding memories of having suffered, fought and competed to survive to their brain cells and bodies' reflexes. Along with their scars, both physical and genetic. Creatures including humans, kept the same general look on the outside but they were really different and mutated on the inside. In addition he created, or enabled the development of parasites. To attack and infect, and make all living things suffer horribly.

As Alexander Pope puts it in his Essay on Man:

All forms that perish other forms supply.
(By turns we catch the vital breath and die)
Like bubbles on the sea of matter borne,
They rise, they break, and to that sea return[269].

Every living creature needs instincts and skills to stay alive, killing and avoiding death from each other. Knowing how to survive with different behaviours and abilities like herding, spraying toxic chemicals at attackers, or just tasting bad. That lifeforms that had, up till then, only lived on plants were now equipped with fang and claw and defensive spikes and chemicals[270] was in this traditional timeline not just a lucky coincidence. The process had to have been instant. God needed to remake each species to fit it into the new balance. Creating predators without providing their prey some defence would have been unfair, and a lot of ecological collapse and extinction would have occurred. He must have altered every species' digestive processes and internal chemistry. As if that individual creature had lived in a death-connected way for their entire existence and their ancestors had too. Suppose things did happen like the story above. All these miracles must have been completed well before the flood, and likely at the time of the fall.

Forcing this shocking and terrible job on God is our only choice. That is, if we must reject science to support a history with traditional handmade species, and brief timing. The assumption that all of these events were natural changes occurring in a short time is incorrect. Evolution[271] cannot be that powerful. It is ironic that traditional creationists choose to believe in amazingly effective and rapid evolution. That is something that has never been observed in nature. It would have required intense guidance by God to avoid everything going extinct[272] in any case. Such changes are the only valid explanation if the traditionalists are correct. Fortunately, we know that God is good, so they must be entirely wrong.

268 Across one 12-foot slab of limestone, lions captured in individualised profile stalk their prey –a menagerie of bisons, rhinos, antelopes, mammoths, all drawn with skill and confidence.

269 An Essay on Man, Epistle III—Of the Nature and State of Man with Respect to Society, Alexander Pope 1688–1744.

270 Even if God knew mankind would sin and predestined nature for death, its still an odd way to create a new world, and implies that the creatures of creation week were not 'very good' at all they were just waiting a while before sinking in their fangs.

271 In fact it has been known since Kimura in 1968 pointed out that evolution can be totally undirected, being powered by the neutral drift of genes. Most of the time changes do nothing significant due to the many redundant systems of the cell that take over to keep things going once something breaks.

272 Hyper rapid evolution would have been horrifying for every living creature because mutations are so often damaging.

Chalmers and a gap in Genesis

Historians credit Thomas Chalmers (1780-1847), a renowned Scottish theologian and the first moderator of the Free Church of Scotland, with first promoting the idea of a gap in Genesis. Chalmers became fascinated by science and gathered the books of numerous geologists, including James Hutton. His studies led him to believe that the world was at the least, millions of years old. He tried to reconcile the geological facts with his faith. In particular, he wrestled with explaining geology within the brief events of the Bible. He solved the problem by proposing a massive gap between Genesis' first and second verses. He did not promote this much in his writing, but his solution inspired many Bible students who followed him.

More recently Scofield promoted the gap hypothesis in his Study Bible. Scofield writes in his comments on Genesis that God's first recorded creation can explain Earth's ancient geology. Thomas Chalmers first lectured to his theology students about his gap solution in 1814[273]. That decade was an early one for science. It included the founding of the first Geology Society in London[274] for example. However discoveries over the following two centuries would reshape everyone's ideas about nature. Science has made the idea of a gap or some better solution relevant to every Christian's views.

There is overwhelming evidence of the universe's immense age, just ask any astrophysicist. Due to this history and problems with a traditional view of Genesis, some Christians prefer alternative explanations for deep time. The common ones are the day-age and the gap theory. Both ideas have been officially rejected by my own church[275] which is committed to a literal seven-day creation as part of a sabbath focused theology. I think their value as explanations is doubtful but many Christians consider them useful alternatives. These theories connect faith and science but downplay the accuracy of scripture. By adopting them believers can explain millions of years of history, during or before, the six days of creation. It is worth looking at how both theories arose and why some Christians accept or reject them.

Thomas' answer came from a detailed study of the Hebrew of the first and second verses of Genesis and other events that might have occurred before creation. The text seems to hint at a pause after verse one, then something transforming[276]. In Thomas' explanation, Earth was created, and then by the second verse, it had become dark, chaotic, and entirely wet. That implied a creation followed by complete destruction. Finally, there was a replacement creation constructed over six days. Some think the damage was due to the fall of Lucifer[277] as the devil had been, at some unknown time before creation, cast to the Earth. The gap assumes that God reused existing matter throughout Genesis because we can see fossils from the previous creation everywhere.

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273 This was promoted to the general public by G. H. Pember, in his book Earth's Earliest Ages, first published in 1884. He points out "*since there is evidence of fossil remains of creatures who lived before Adam and these animals experienced disease, death and mutual destruction, they must have been in a different (sinful) world.*"

274 Phrenology, the study of personality through measuring minute bumps on the skull, and Homeopathy, the belief that water carries a shadowy memory of substances mixed into it, even after they have been totally removed, were two other theories appearing at this time. Phrenology is long dead but Homeopathy is still around and pharmacies sell sugar pills dipped in this magic water. I recommend collecting crystals myself, at least they give you something pretty to look at.

275 For example, talking about the Gap theory "*The theory that God did not create matter when He brought the world into existence is without foundation. In the formation of our world, God was not indebted to preexisting matter.*" - Ellen White, The Faith I Live By, p. 24. Similar statements by early Adventists discuss and reject the day for an age theory.

276 Most commentators see verse one as a summary of the whole book, then a pause before the details are described. Others point out the poetic design of the book in contrasting water and land, darkness then light, emptiness transformed into everything. Genesis is a work of art as well as religion and history.

277 Luke 10:18, discussing the apostles power over demons, "*I saw Satan fall like lightning from heaven*".

That is the story of the Genesis gap: there is a first creation, the devil is cast down. Then there are aeons of suffering, and a judgement and destruction of a corrupted world. All in just two verses. It is like the solution in this book but limited to a single planet. The best interpretation of the gap includes recent forms of life like dinosaurs, which helps explain more of the fossil record. It assumes that someone or something corrupted that early world because it contained conflict and death from its beginning, and then a catastrophe left it barren and nearly lifeless. Is Scofield correct that a gap can explain geology? For a gap to be a functional explanation, there must have been many millions of years of evolution, destruction and natural recovery, repeated many times before the events of Genesis. Since it wasn't God corrupting nature the devil must have been interfering with life over these periods. Finally the flood generated a few additional layers on top of all that.

This argument is reasonable as far as it goes. A useful explanation must fit the creation sequence envisioned by the writer of Genesis. It should agree with God's other explanations in the Bible. However, 1814 was before modern geology and physics. Any factual theory of creation must explain twenty-first century science[278]. That should include, for example, human genetics, the solar system, and chaotic natural physics. The gap solution does not appear to handle both sides of that challenge. It is trapped between satisfying the scientific evidence and following the Bible's events. For example, the sun and moon are created on day four of Genesis. Since the preexisting world certainly had a working sun and moon, the gap theory has a problem with these verses. Living worlds do not develop[279] or function without a sun.

The gap theory is also morally dark. It includes careless destruction of thriving ecosystems and intense animal suffering for long ages of time. Much of Earth's life, is more the Devil's work than God's. It suggests that God remade the Earth's surface by smashing it with a gigantic rocky asteroid. Those dinosaurs must have been especially wicked, but their doom took many millions of years to arrive. You would expect the creator to do something to defend nature even without humans in it. The devil is not a sufficient explanation for this moral darkness. As it does today, biology before Genesis required death and suffering to function. The fossil evidence is clear on this point. In addition, this theory requires that God reuses existing abused and damaged life in his replacement creation. After all life today belongs to the same genetic families found in fossils.

Any gap is rejected by Christians who believe in a direct creation. They cite verses such as "*By faith we understand that the universe was formed at God's command, so that what is seen was not made out of what was visible*" and "*He spake, and it was; He commanded, and it stood fast.*"[280] and the message of Exodus chapter twenty, "*God spoke all these words.. In six days, God made the heavens and the Earth, the sea, and all that is in them*". So there was no existing Earth or creatures before the six days of Genesis unless long ages are somehow part of day one. Adjusting the Bible's meaning in different verses to fit a recreation of the Earth is not really acceptable. God does not need to remix existing matter[281] or biology to create a world so the gap theory needs to provide some reason why he chose that option.

There isn't a geological divide between the world before Genesis and the present. Nothing in the fossil record shows a complete gap or break. Genetically there is no change between the creatures mentioned in Genesis and long extinct ones. While if a gap did occur the Bible's creation account ought to have included at least some details of such a major interruption to God's plans. More than just a pause between two verses. There should be a verse or two noting that great geological ages had passed.

Cutting back on the theories scientific claims does not help either. Even a pre-existing barren world with no life needs to work around the Bible verses I've listed. On the other hand removing life from the

278 Requiring a gap to explain everything is perhaps unfair, however at the least science shouldn't rule it out.

279 Planets can exist without a sun. Rogue, or ejected planets from collisions are a thing. However many independent lines of astrophysical evidence show our planet is not older than the solar system and developed along with it.

280 Hebrews 11:3, Psalms 33:9.

281 Adventists have always followed the principle of a creation from nothing, only under the relentless pressure to explain scientific discoveries have we retreated to a gap explanation.

gap theory[282] makes it scientifically weak and causes it to reject key evidence. Life on Earth has an impact that extends beyond the surface. Living creatures have changed Earth's geology and atmosphere over long periods. They grow in and modify deep geology in ways no flood can explain, influencing whole geological cycles. They change Earth's crust as it cycles carbon[283] to and from the surface, adding oxygen to its atmosphere, eroding the rocks, and removing iron from its seas in thick layers of rust. Any creation theory needs to include life's deep history to explain geology.

The story of the Genesis gap ends with terrible destruction leaving the planet nearly dead. However the extinction of the dinosaurs was not Earth's first or last catastrophe or even its worst. The worst would be the Permian-Triassic extinction event, also known as the Great Dying. The Permian era saw the origin of innovative early mammal[284] like reptiles and reached levels of oxygen higher than today but ended with extreme changes to the climate and an extraordinary 96% of all species on the planet dead[285].

Even if you accept a gap at the end of the age of dinosaurs, that doesn't provide a solution. Existing life didn't appear fully formed after the dinosaurs were killed. It developed from tiny mammalian and bird survivors of the asteroid that struck the Earth at that time. The survivors left a trail of fossil descendants leading to today's species. For example the long history of the whales as they transformed[286] from land animals to sea-going giants. These key events will be the focus of a later chapter.

Scientists say more than five worldwide extinctions are clear in the fossil record, all with different causes and duration. Even between these significant disasters, life experienced regular boom and bust cycles. That led to extinctions seen through the history of early oxygen generation[287] and use. Also, there were large extinctions of mammals after the age of the dinosaurs. So believers in a gap, must suspect that God created and then destroyed life again and again to generate the world we know. Life is more unstable and suffers more than some Christians think. As Geologist Charles Lyell wrote in 1837, "Amidst the vicissitudes of the Earth's surface, species cannot be immortal, but must perish, one after another, like the individuals which compose them. There is no possibility of escaping from this conclusion."

Is the second option, the day-age idea, preferable? In that theory, each day of creation should be around 2.28 billion[288] years long. If each day is of equal length. So Genesis should include the history of contemporary life only in the final segment of the last day. That obviously doesn't work. When you start with the Big Bang, this explanation fits better. If you imagine the ocean in Genesis as plasma and darkness, and chaos as highly compressed and interwoven primordial forces, light does arise next. There was a lot of light, followed by stars and, ultimately, planets.
That last component took some time. The stars had to form, fuse together all the atoms needed besides hydrogen, explode and be reborn several times to make them. Unfortunately, despite that promising

282 Since the earliest fossil evidence of life is in deep Archaean rocks, and traces of life exist everywhere any explanation needs to include living things.

283 After the Cambrian Explosion, organic carbon deposition in marine sediments increased significantly. Observations demonstrate that biogeochemical processes at Earth's surface have a profound influence on deep mantle composition - Perturbation of the deep-Earth carbon cycle in response to the Cambrian Explosion, Giuliani, A., Drysdale, R. N, et al, Science Advances, Vol 8, Issue 9, 2022. That effect may also accelerate the movement of continents.

284 By the mid-Permian, a group of reptiles known as Therapsids, that resembled gigantic rodents, had emerged. They may have even developed fur by the late Permian. Theriodontia or 'beast tooth' was one of this group that demonstrated innovations: A change in the bones that support the jaw allowing their mouths to expand wider, improving hearing. Their skull and teeth became larger, their teeth got more specialised, with a stronger jaw. They appeared ready to thrive and expand into many new species. However, that was not to be, Earth's entire biology was about to crash and burn.

285 "*The eruptions ignited vast deposits of coal, releasing mercury vapour high into the atmosphere. Eventually, it rained down into the marine sediment around the planet, creating an elemental signature of a catastrophe that would herald the age of dinosaurs*" - Evidence for a prolonged Permian–Triassic extinction interval.

286 This sequence of fossils from Pakicetus, a goat-sized, four-legged creature to modern cetaceans is likely the strongest science has discovered. Because it was so recent, virtually every step in that chain is well established.

287 Possible links between extreme oxygen perturbations and the Cambrian radiation of animals, Tianchen, H, Maoyan, Z, Nature Geoscience, 12, p. 468, 2019.

288 2.28 billion year long days, assume a count from the formation of the universe 13.8 billion years ago divided by six.

start, the explanation veers off course. Even if you believe that the days mark major events rather than being periods of time, this approach excludes nearly everything vital from the Bible's events. It explains nothing about the Earth other than its great age. If the day-age theory is correct, then the Bible is wrong about the timing of the creation of the sun and moon for example. Biologically, there are only descriptions of modern species that the writer was familiar with in Genesis. So it fails to explain any biological history. Overall this modern myth-making does not uphold the Bible or add anything predictive to science. It doesn't really fit them together at all.

Does either of the Gap Theories explain the planets? Each planet has specific features that conventional science explains well. For example the leftovers from the formation of the solar system, that surround[289] it with waste material, like the asteroids. There are also planets affected by impacts. This includes odd planets like Uranus with its rings and more than twenty seven moons, many of them captured over time, from gigantic passing debris. Some of its features are seen in the photos on the next page.

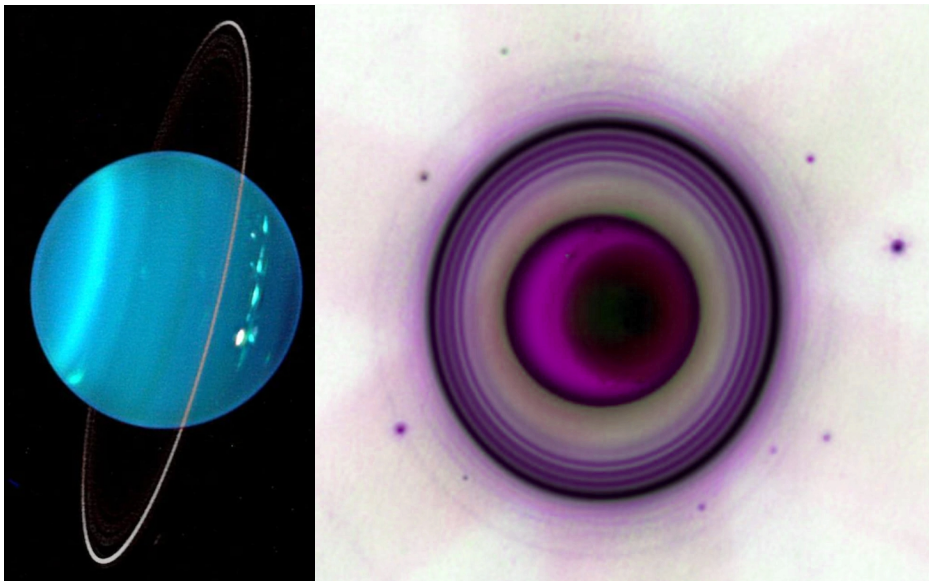


Photo of Uranus, visible light with contrast filtering (left) and infrared (right), showing its rings made of ice and broken rocks, seasonal polar cap and some of it's many moons. The whole planet is tilted at 97 degrees compared to the rest of the solar system. Image credit: NASA / ESA / CSA / STScI.

The God described in these alternatives is at best negligent. At worst, he intentionally causes suffering, pushing the development of species. Day-Age theories treat the days of Genesis as vast periods of time in a sequence unrelated to their order or as poetry disconnected from real history. The problem with both options is that evil affects every species throughout deep time. This results in "Billions of years of violence, predation, survival of the fittest, victory of the weak over the strong, extinction, disease, famine, and death, death and more death."[290] Life made to kill and live off the suffering of others, exactly as it does today. To get around this problem, some believe that the pain of animals and natural evil itself is unimportant[291]. Being egotistical about their own species, they prefer to think that God only notices human evil. Refusing to believe that animals or nature itself can experience corruption or injury.

Genetic sequences demonstrate that current species are connected to extinct ones, all the way back to the first appearance of life. This is not explained by any current alternative like a gap. If either gap alternative is true then we have to accept that God created the world's creatures with virus infected and

289 The waste left over from the formation of the solar system does include asteroids, more on them later, but also includes the much larger Oort cloud, which is a vast remnant beyond the orbit of Pluto.

290 Clifford Goldstein, Adventist Review, 12 Sep 2019 – discussing a Spectrum magazine summary of the book Adam and the Genome. He is correct. The laws of the universe as a whole and the genetic history of life on Earth must have been established after the fall of humanity. Before Adam and Eve, sin did exist, but their Earth was not created to suffer.

291 Such as theologian, Desmond Ford (1929-2019), who argues along these lines in his book Genesis vs Darwinism.

faulty instructions. That would build death into the universe as an essential part of its design. Instead of being a result of sin and that unfairly blames the creator.

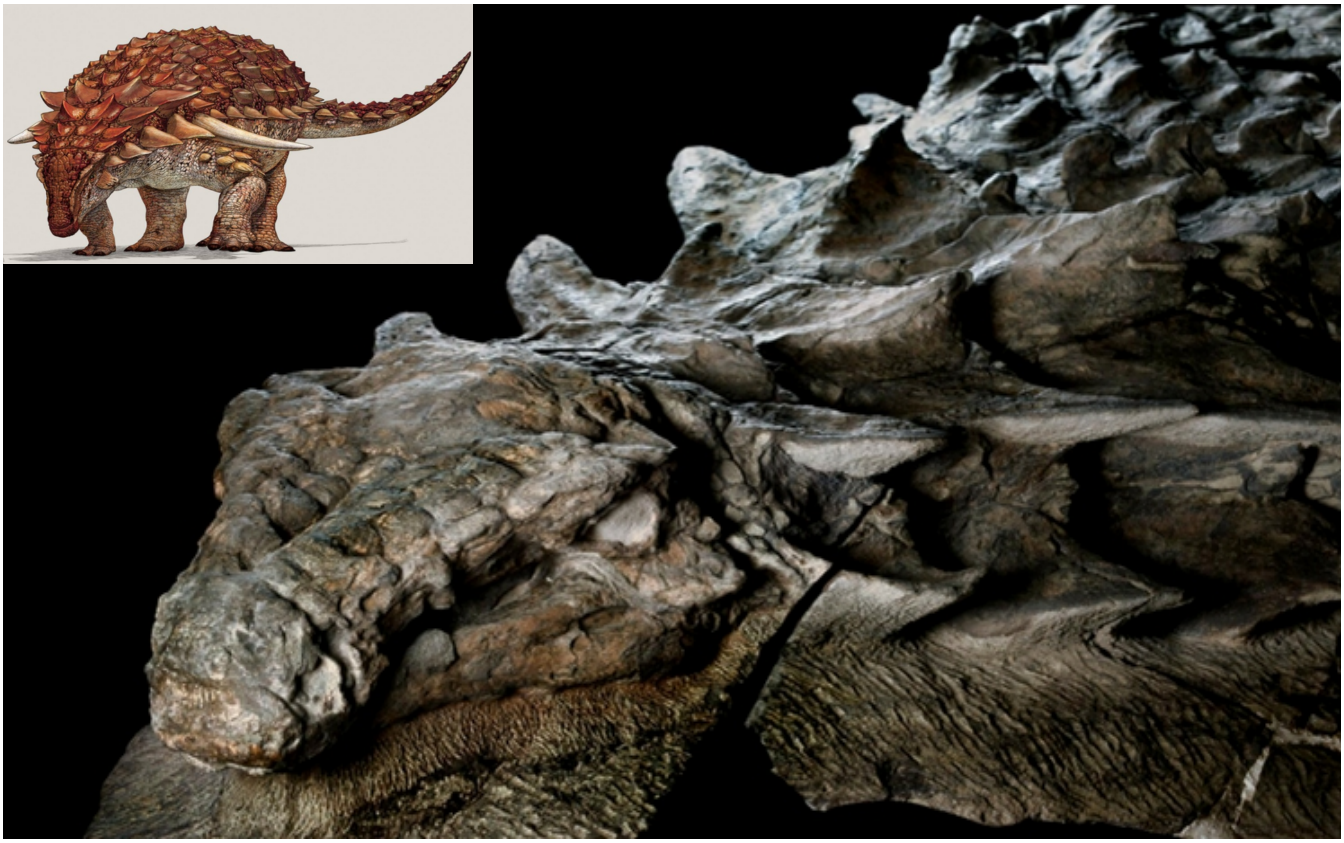
The alternatives presented all have significant flaws. In response, some Christians abandon the Bible as a source of knowledge. They prefer a purely scientific explanation. That is also a risky alternative. Science's assumptions erase God from history. They are left with only a sliver of faith and belief in a God without any role in his universe. They may think God is hidden. So much that only traditions and pleasant feelings show He exists. Many feel that only love matters, that belief is unimportant. There is no need to explain the damage seen in creation that causes humans and everything else to be so broken. Gods creation is pure and good, just because they feel it must be, in spite of all the evidence.

All Christians have a problem they need to recognise. It exists within either the scientific or biblical evidence about nature. This potential conflict affects everyone. From orthodox creationists to those who think Genesis is a fable. Cosmic creation shows the larger context of the Bible. It is a powerful approach to resolving either difficulty.

Shaped by Chaos

"Dinosaurs were curiosities to see in museums, or movie monsters that haunted our nightmares, or objects of childhood fascination, pretty much irrelevant to us today and unworthy of any serious study. But these stereotypes are absurdly wrong. They've been dismantled over the past few decades, as a new generation has collected dinosaur fossils at an unprecedented rate. Somewhere around the world, from the deserts of Argentina to the frozen wastelands of Alaska—a new species of dinosaur is currently being found, on average, once a week. Let that sink in: a new dinosaur every—single—week'

- Steve Brusatte[292].



A nearly complete fossil of a whole Nodosaur, showing its armoured skin & spikes[293]

Hunting Tyrannosaurs

We live in a golden age of fossil discovery of all kinds, and this includes many new dinosaur species. Conventional creationists, aught to be worried by the existence of dinosaurs. In spite of very shallow attempts to rewrite Genesis to include them. The problem is, their existence is absurd under any model that includes only the flood and a mere thousand years of in-universe time. Some were vastly overbuilt killers, but they grew that way to prey on even larger herbivores. They could not have been made that way as part of a holy creation, but they make sense in a world where death and conflict rules. All those

292 The rise and fall of the dinosaurs, a new history of a lost world, 2018, ISBN 9780062490421, p7.

293 Found by Canadian miners in a marine environment where it's unusual to discover dinosaurs. What's even more fascinating is that the fossil itself is a complete petrified body – not just a skeleton. This is rare in the palaeontology world as it's possible to see the dinosaur's scales, the half meter long defensive spikes on its shoulders and even its skin in great detail. Its colouring was lighter on the underside of the body and a darker reddish-brown on top. This is known as counter-shading, a common form of camouflage seen in many animals today, i.e. penguin and deer. It shows that despite the dinosaur's plate-like armour and array of spikes, it was under pressure from larger carnivorous predators and needed every possible advantage to survive.

teeth, spikes, and armour met a real need because of the laws[294] of sin and death. However, none of these creatures is mentioned by the Bible. Except perhaps for Job's Behemoth, but this is likely to be a modern creature, that Job would have known such as a hippo[295]. There are also some references to mighty sea beasts which are certainly whales.

Like the Leviathan, Job's Behemoth represents a spiritual power or symbol rather than any real beast. It is more authentic and truthful[296] to accept the intended meaning and archaeological context[297] of the Bible than try to invent biblical dinosaurs. There are far too many of them to share any one era. There are over 1100 identified species and 300 genera[298]. Instead of cluttering up the planet all at once, these species were part of many different changing ecosystems. Coming one after another, each with a top predator or two, a particular balance of prey species, plants, and surrounding geography and climate.

Palaeontologists document the details of many of these ecosystems, demonstrating that they were separate eras. Microfossils assist scientists to do this. They are fossils so small they have to be reassembled under a microscope. With hip and jaw bones sometimes as small as an eyelash. Microfossils come from lizards, frogs and other tiny creatures, leaving bones, teeth and even fossilised poo, which shows the shape of creatures guts and the content of their food[299]. They come from widespread and numerous creatures so there are many examples.

Along with plant remains from seeds and pollen, and tiny shells in the oceans, researchers can trace long-term changes in ecosystems – understanding their plants, landscapes and the food chains supporting larger creatures. Every part of the puzzle brings back to life one significant time or another in nature's life-story. It is the goal of palaeontologists to try to piece this whole complex history together. Their study, has revealed historic shifts in every aspect of life on Earth. In some of Earth's ages, it was totally different from today, with a single continent stretching from the north to the south pole and an unbroken ocean with no frozen ice caps. In the most remote eras, its atmosphere has been nonexistent or toxic and without the oxygen needed for humans or any large animal[300] to live.

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294 Romans 8:1–2: "*Therefore, there is now no condemnation for those who are in Christ Jesus, because through Christ Jesus the law of the Spirit who gives life has set you free from the law of sin and death.*" Paul is saying Christians are free from the sacrificial laws of Moses. The sacrifice of animals replaced the killing of first born humans, for every first born creature belonged to God (Ex 13:13, Num 18:15) so it was deadly serious. But Paul taught there is a lot more to God's gift. Sin, death and decay in nature is humanities legacy. Jesus' sacrifice frees us from the suffering and condemnation built into the universe's laws.

295 Ungainly as it is, the hippopotamus is the world's deadliest large land mammal, killing an estimated 500 people per year. Hippos are aggressive creatures, with a powerful bite. And you would not want to end up under one; at up to 2,750kg they can crush a human to death just by rolling over.

296 Generating propaganda for God is unworthy of a Christian, we don't have the right to add to the Bible for our own comfort and convenience.

297 Because stone was a main material for tools for aeons and early humans were just as interested in collecting and trading strange objects we are, fossils would have been recognised in almost every society. Early civilisations were probably aware of stories of dinosaur fossils unearthed in rocks. With only a limited understanding of fossilisation, they most likely imagined such species surviving in remote locations. Widespread legends of people magically turned to stone likely also began with human fossils. Fossil bones and footprints were well known. In Algeria, for example, certain dinosaur tracks were attributed to mythological Roc birds. Between 1000 and 1200 BC, the Anasazi people in North America created cave paintings representing dinosaur footprints. While Indigenous Australians recognised dinosaur tracks as belonging to the legendary Emu-man. On the other hand they would have only seen fragmented pieces of dinosaur bone. Extracting and reconstructing complete big fossils from surrounding rock is difficult even with modern techniques so the ancient understanding of dinosaurs would have been very incomplete, they would have been largely imaginary monsters. That explains the widespread mythology of giant monsters and dragons.

298 A taxonomic rank used in the biological classification of living and fossil organisms in biology. In the hierarchy of biological classification, genus comes above species but below family

299 These deposits are sometime quite large being collected by larger creatures ie: dinosaur poo, and even vomit.

300 Periods of low atmospheric oxygen are associated with the origin of air breathing in tetrapod fish, during the mid-Devonian. This adaption to an oxygen crisis in the water later allowed them to thrive on land.

Riding a wave of new life

Each ecosystem discovered has surprises. Even islands like Japan had their own land-based dinosaurs, such as Kamuysaurus Japonicus[301]. What is clear from all the recent fossil discoveries is that the rise of the dinosaurs was a matter of chance. They were towards the bottom of the pile for quite some time[302], especially in drier areas. They were the prey of giant crocodiles and their many relatives, reptiles, that were larger and fiercer than they were. However, the Earth changed, the single vast landscape of Pangaea splintered into individual continents during it's geologic cycles. That created a disaster for life as a whole, with many species killed, but with death came opportunity. Dinosaur adaptability won them a secure place in many new ecosystems. In those early years of the Jurassic, their numbers exploded as they moved out into a newly emptied world. They then split into many different species, the ancestors of the famous families of dinosaurs that we all know.

Palaeontologists can trace the development of whole families of dinosaurs. For example, we now understand that the earliest Cretaceous Tyrannosaurs were relatively small. However, they had distinctive predatory adaptions[303] that promised greatness in their descendants. Ancestors of the famous T-Rex include Moros Intrepidus. This creature hunted in the shadow of older lineages such as Allosaurs, who were at that time the top predators in North America. We have all heard of the awesome Tyrannosaurus rex, but no Asian, Australian, European, or South American dinosaurs lived in fear of them. They would never have seen one. The many families of dinosaurs were spread across vaster periods and more diverse ecosystems than we can imagine.

The following photo is of a Tyrannosaurus rex called Sue, a fossil discovered in 1990. She is in her own way beautiful, as one of the largest, best preserved, and most complete of her species ever to be discovered. She did however have a painful life sustaining a number of healed injuries including broken ribs from struggles with her prey, infections, torn tendons and arthritis. The other dinosaur found with her the even heavier 'Scotty' had broken ribs, an infected jaw, and bite marks on his tail bones, probably caused by a rival of his own species. Their adaptions[304] came with significant costs, including a shortening and shrinking of their front limbs[305]. Their hands were cut back from the usual five to only two digits[306] with limited function[307]. The forearms were reduced to small non-functional structures. This was likely because they were a burden to adults and adolescents during competitive feeding[308] on the bodies of their prey. The bodies of the largest prey were a feast that could feed a pack for

301 A New Hadrosaurine from the Marine Deposits of the Late Cretaceous, Japan – Scientific Reports, vol 9, Article 12,389 – it was a duck-billed dinosaur, 8 meters long, weighing around 5 tons. More recently Mammoths, Siberian lions, Naumann's elephants, moose, Great elks, Yabe's giant deer, wild cattle, bison, asses, horses, bears, wolves, and tigers roamed Palaeolithic Japan until around 12,000 years ago.

302 "*We always think of dinosaurs as huge and lumbering, but actually the dinosaurs started as nippy little insect-eaters. The first dinosaurs were only one meter long, balanced high on their legs, and bipedal. Their leg posture meant they could move fast and catch their prey while escaping larger predators. After the end-Triassic mass extinction, we get truly huge dinosaurs, over 10 meters long, some with armour, many quadrupedal, but many still bipedal like their ancestors. The diversity of their posture and gait meant they were immensely adaptable, and this ensured strong success on Earth for so long.*" - Locomotion and the early Mesozoic success of Archosauromorpha, Shipley, A. E., Elsler et al, 7 February 2024, Royal Society Open Science.

303 All tyrannosaurs were bipedal predators characterised by pre-maxillary teeth with a D-shaped cross section, fused nasals, extreme pneumaticity in the skull roof and lower jaws, a pronounced muscle attachment ridge on the ilium, and an elevated femoral head. - Diminutive fleet-footed tyrannosauroid narrows the 70-million-year gap in the North American fossil record", Communications Biology, DOI: 10.1038/s42003-019-0308-7

304 The large Tyrannosauridae (T-Rex) grouping of species is cool in other ways. They possessed adaptions that made them excellent in their role as top predators. The later members of this family were all at the peak of their local food chains.

305 Tiny front limbs due to adaptive pressures are common in bipedal dinosaurs such as G. shinyae for example, which is not a direct relative of T-Rex. See dx.plos.org/10.1371/journal.pone.0157793

306 The species L. inextricabilis sheds light on how dinosaurs relate to birds with the middle three, of five digits forming its hands as in bird wings.

307 Their forearms were too small to have been of any functional use. They couldn't reach the mouth, touch each other, or reach anything in front of the head, let alone above the head and with just two digits, they weren't doing anything complex with them. Physically they could handle pressures of up to 150 kilograms, assuming optimum muscles, but this is a fraction of the T-Rex's weight and even smaller in proportional to their usual prey.

308 Why Tyrannosaurid forelimbs were so short – An integrative hypothesis. Padian, K. Acta Palaeontologica Polonica, 67 (1) p 63–76, 2022. This is but one likely explanation but it seem to hold true for similar species.

days. Longer arms could have easily been bitten, amputated, or infected, resulting in weakening, sickness, or in extreme cases, death.

Baby Tyrannosaurs needed to grow quickly. To survive against rivals and hunt successfully, they put on two kilograms of weight a day from hatching. It took a lot of food to grow those massive bones and teeth. They were probably opportunistic feeders, hunting but also feeding on dead animals[309] as chance permitted. Adolescents would not have followed larger herds but targeted babies, and the young[310] of any species. Adults would have been able to inflict a lot of damage. As formidable as they were as individuals they likely hunted in family packs[311]. No wonder this king among predators pressured its prey to evolve elaborate armour. They were not just targeting a few large species but were equal opportunity killers. Analysis of their fossil poo shows that they were not picky. It contains a high proportion of bone[312] from other dinosaurs but also fragments from many smaller mammals. They developed the teeth and jaws required, to break bone and armour and consume other creatures whole. Aside from the risk of being eaten, suffering was as common in the dinosaur era as in ours. Diseases such as cancer[313] and arthritis are visible in fossils from this time. That shows, how decay and suffering[314] have not changed since the origin of life on this planet.

309 This view is supported by bite marks on sauropod bones with no signs of later healing, as would occur in a failed attack.

310 They changed diets as they grew up. As seen in the fossil of a juvenile gorgosaurus, a close cousin of the giant T. rex that predated it by several million years. The last meal found inside its fossilised body contained the limbs of two baby dinosaurs. "*smaller, immature tyrannosaurs were probably not ready to jump into a group of horned dinosaurs, where the adults weighed thousands of kilograms*" according to Dr Darla Zelenitsky, of the University of Calgary.

311 Characterised in the past as lone hunters due to their massive appetites and tiny brains, T-Rex were living in such a food rich, yet challenging environment that they could have hunted in packs of close relatives. See Titus, A. L., Knoll, K. et al, Geology and taphonomy of a unique tyrannosaurid bonebed .. implications for tyrannosaurid gregariousness, Paleontology and Evolutionary Science, 2021. This was just one of a number of fossil finds indicating this behaviour.

312 Fossil T-Rex coprolites, the fossilised waste material from their meals, contain significant amounts of phosphorus from bones, while 30-50% of specimens are made up of bone fragments, some as tiny as grains of sand. Based on this predator's fantastic anatomy this confirms what scientists had long suspected. T-rex could break and consume vast volumes of solid bone and meat. "*Certainly, from a bio-mechanical perspective, that's what you'd expect*", according to Mark Norell, Macaulay Curator of Palaeontology. "*Its entire skull and neck are just built for massive, crushing bite force*".

313 Although seldom preserved because cancer tends to arise in soft tissue, jamanetwork.com/journals/jamaoncology/article-abstract/2723578 see also Anné, J., Hendrick, B.P, Septic arthritis in a dinosaur, Royal Society Open Science, 2016.

314 Also painful and annoying things such as mosquitoes, they were worse than at present, larger and both males and females fed on blood. See, earliest fossil mosquito, Azar D., Nel, A., Huang, D. et al, Current Biology, 2023

Endless ecosystems

Not only were Dinosaurs spread out in time but also across continents. Abelisaurs ruled the food chain in North Africa and elsewhere[315], during the period when Tyrannosaurus rex was king in North America. Members of the Abelisaurid family were between 5 and 9 metres long from stubby snout to tail tip. They had powerful hind limbs and extensive decoration of their skulls with grooves and pits. One of these dinosaurs, Carnotaurus, had tiny forelimbs like T-Rex, a shortened bulldog-like head, and bone crests, to protect the eyes from attack. Recent fossils from Morocco show that at least three species of this family lived together 66 million years ago, sharing the role of top predator.

That they were coexisting demonstrates that predatory dinosaurs and their food must have been abundant in North Africa[316] right before the mass extinction. North African dinosaurs came in many sizes and feeding specialisations and were successful until that event. Australia has its own dinosaur fossils including what are probably the first mega-raptors with monstrous claw tipped front limbs. These creatures lived during the Cretaceous and are found at the Winton fossil site. The photo[317] is one of their pointy front limbs.

However, the dinosaurs never conquered the oceans or the skies[318], even at their greatest expansion. The seas remained the home of reptile species, including Plesiosaurs, Ichthyosaurs and gigantic[319] sharks. While reptilian Pterosaurs like Dimorphodon and many others flew short distances, Quetzalcoatlus became the king of long-distance flying, able to circle for hours[320] in search of prey.

One current area of research focuses on recreating preserved and altered proteins to determine how fossilised animals functioned. Were they, for example, warm-blooded? Initial investigations even confirm, known relationships between fossil species based on their use of proteins[321].

As Buckminster Fuller put it "*You never change things by fighting the existing reality. To change something, build a new model that makes the existing model obsolete*". What creationists have tried in the past is to compress natural history to fit the timing of Genesis. This is out of respect for God's word and I admire that motivation. Yet flood based stories are materialistic and local to the surface of just our planet. They cannot fit their explanations on the strict limits of natural, scientific evidence so they will never succeed.

Seventh-Day Adventists are involved in dinosaur research with teams from the biology department of Southwest Adventist University. They are led by professors Art Chadwick and Jared Wood who are ex-

315 The fossil remains of their wider family in addition to North Africa have been found in especially large numbers in South America, as well as the Indian subcontinent.

316 Nicholas R. Longrich et al. New fossils of Abelisauridae (Dinosauria: Theropoda) from the upper Maastrichtian of Morocco, North Africa, Cretaceous Research, August, 2023; doi: 10.1016/j.cretres.2023.105677.

317 See https://en.wikipedia.org/wiki/Megaraptor, also the source for this photo. The source fossils were in bits rather than articulated as in the photo.

318 Excluding their cousins the birdlike dinosaurs who developed from the time of the Jurassic, going from gliding to powered flight, but remaining low key players in the story of life until after the great extinction.

319 See, The rise and fall of the dinosaurs, Stephen Brusatte, ch7, 2018 for a more detailed treatment of this point.

320 Given its physical size and wingspan, estimates suggest flight speeds of up to 130 km per hour for 7 to 10 days at altitudes of 4,600 meters giving it a maximum flight range of around 13,000–19,000 km. Like large predatory birds today it probably also took advantage of updrafts to glide while searching for food but would have preferred a steep drop off from a height to get into the air once landed.

321 See A toast to the proteins in dinosaur bones - Yale News, Ancient human protein could unlock secrets.

cavating dinosaur bones from the Upper Cretaceous Hell Creek and Lance deposits[322]. These are some of the richest fossil beds in North America. Dr Chadwick for example has a particular interest in dinosaur taphonomy. That is studying everything that happens to an organism's body after it dies, including which parts become fossilised. These excavations provide detailed information about the animals, their diet and the greater ecosystem of which they were a part. The university has an extensive fossil collection which is open to the public. However, as some Christian institutions do, they present scientific information and traditional biblical explanations together without attempting to resolve their contradictions. Students and church members are left to decide how they relate for themselves.

Current discoveries uncover not just the overall development of species but regional changes during particular eras. The idea that gaps between fossils are a problem for palaeontologists is untrue. Each new index fossil adds fine details to our picture of life, covering periods in more detail than ever before. With each discovery, the idea that so many species from different eras, including top predators, lived together as most flood models require becomes harder to believe.

Life will find a way, this two meter tall raptor dinosaur died protecting her eggs[323]. Her nurturing was retained in distant relatives like birds. Which conquered environments the dinosaurs never exploited.

Flood-based creationism combines all these species and all intermediate forms, and they somehow function as part of the same oversized ecosystem for a thousand years. It requires that they all began as humble plant eaters and were altered, by unknown means, into the fierce predators and prey animals whose remains we discover today, during a short period. There's nothing in the Bible about alterations as complex as that. Some assume nature changed after Noah's flood, but life on this world has never been without stings and thorns. The effects of sin were immediate and universal and confirmed by every record of the past discovered. For example, early dinosaurs ate large quantities of burnt wood for

322 Biology student volunteers who excavate fossils have this work credited towards their degree. However biology without deep time is a challenge, how to explain why ecosystems or creatures function as they do with only short term adjustments permitted. See geology.swau.edu

323 She was a Citipati part of the larger family of species, the Oviraptors. The fossil is complete excepting the skull. She was found in the same posture that is taken today by modern birds when brooding eggs. Research shows that raptors nested in groups as a defence against large predators. That was a successful strategy, as it is estimated that 60% of eggs survived to hatching. See Tanaka, K., Kobayashi, Y. - Exceptional preservation of a Late Cretaceous dinosaur nesting site from Mongolia reveals colonial nesting behaviour in a non-avian theropod, Geology, 2019, 47(9).

its charcoal[324]. That helped to detoxify the plants and especially the rich ferns[325] they were consuming. These plants were the same species we have today that poison horses and sheep.

Accepting great age or long-term adaption is seen by conservatives as a flaw in personal faith, to the point that some Christians use the terms evolution and atheism interchangeably. However, evolution is only one component of scientific theories and it fits pretty well within some forms of creation. Deep time or genetic pressures do not limit God's role.

Dinosaur descendants & others

The remains of once living creatures witness that nature has passed through many eras of biological life. Consider a few examples. The first is the Hyaenodonts, a family of large mammalian predators. Some grew to a size not seen in living creatures since the dinosaurs' died. They were the size and shape of a miniature rhinoceros and weighed up to 1,500 kg. They thrived as top predators for millions of years over Northern Africa and Europe. Going extinct 15 million years ago as a result of environmental change.

Dinosaur descendants, the Phorusrhacids, or Terror Birds, were gigantic flightless birds. They dominated ecosystems across South America and beyond. They earned the nickname thanks to strong skulls and beaks[326], muscular necks, long sickle-shaped talons, and they were up to three-metres tall. Like the raptor dinosaurs, they were successful. Their family thrived for fifty three million years until less than one million years ago. Individual species didn't survive that long, but this was a respectable run. In New Zealand and Australia, the Moa[327] and Thunder Birds like Genyornis newtoni also became gigantic just like their ancestors. The creator has made biology chaotic yet recurring. It is pushed into fresh forms by genetics and competition. At the same time, life is like jazz music, which continuously riffs on shared melodies.

Long before a sabre-toothed cat or a dinosaur existed, the animals above were fossils deep in the rocks. They were the last of a once dominant family of meat-eating animals known as Gorgonopsids. About the size of a tiger but with skin somewhat like a rhino, they looked reptilian but had some adaptions more like mammals. Also some that were unusual including that grooved tooth pouch in the lower jaw. The specific species in the fossils above was like the Cretaceous dinosaurs, among the largest and last of their family. Well, not quite the final members, as a few Gorgonopsids survived the early Triassic

324 Qvarnström, M., Vikberg Wernström, J., Wawrzyniak, Z. et al. Digestive contents and food webs record the advent of dinosaur supremacy. Nature 636, 397–403 (2024).

325 Large sauropods would have eaten many kilograms of plant matter per day but less than we might imagine. For example a 10.8 ton Diplodocus with a theoretical energy requirement of 280 kJ ME/kg BW-0.75/day would need only 23.8 kg dry matter of Rough Horsetail fern per day. Their foods, horsetails, ferns, and conifers were as digestible as grasses. Horsetail ferns for example are rich but contain toxins.

326 They would kill animals with their huge beaks, while using their talons to pin their prey and create additional damage. Larger prey may have been attacked with a combination of pecking and tearing, or by striking or slashing critical organs with the beak.

327 Moa were the only truly wingless birds, lacking even the vestigial wings that all other ratites have. They were the largest terrestrial animals and dominant herbivores in New Zealand's forest, shrubland, and sub-alpine ecosystems until the arrival of the Maori, and were hunted only by the equally massive Haast's eagle.

period's mass extinction[328]. Only to dwindle, becoming smaller and fewer until they finally disappeared forever. This once successful family, with its many varieties, did not disappear without preserving something good. Some of their distant, smaller, and hairier relatives shared their genes. Those creatures would live on to dodge carefully between the feet of dinosaurs in the next of Earth's great ages.

The dinosaur's long reign was known for its fierce combatants towards the end. It was almost like an ecosystem full of ninjas, especially raptor dinosaurs such as Daliansaurus, Graciliraptor, and Sinovenator. Although sometimes mammals bit dinosaurs back. A recently discovered fossil is described in the science journal Nature. It prompted a headline, like a punchline from the Ice Age movie, - Early Mammal bites Dinosaur, combatants buried by volcano. It is a dramatic fossil with two intertwined skeletons. One is a small but fierce mammal with its teeth and claws locked into the body of a beaked dinosaur, three times its size in a way that suggests attack, not feeding on its dead body.

The eruption that caught both animals mid fight has preserved them in stunning detail. The primitive mammal's paw digs into the dinosaur's lower jaw while the other one grips a hind leg. At the same time, it's lower jaw is biting into the dinosaur's rib cage, as seen[329] in the following photo. This encounter, a smaller mammal attacking a larger dinosaur, was probably not typical. Usually, it was the dinosaurs that devoured the mammals.

For every top predator known from famous fossils, there were hundreds of lesser creatures fighting to get their next meal. It's easy to think of many other examples that were all part of eras of life with radically different conditions. Just how many entirely separate ecosystems are traditional creationists willing to ignore? It's no wonder teens find this form of creationism confusing, especially once they leave church run schools and see the quality of the evidence that was hidden from them. How many educated people have drifted away from Christianity because it takes too narrow a view of our shared history?

328 The Triassic mass dying was caused by a confluence of factors due to eruptions in what is today Siberia. These eruptions came in short intense pulses over a long period. They released massive amounts of sulphur and carbon dioxide into the air which created global winter conditions directly after each eruption. The gasses released also acidified and removed oxygen from the oceans. There was a sharp decrease in species diversity right after the first eruption. That suggests that the immediate effects were the most devastating not the lingering extreme climate change that followed, in a drawn out extinction event that eradicated 76% of the species on Earth.

329 Photo credit: An extraordinary fossil captures the struggle for existence during the Mesozoic, Han, G., Mellon, J. C. et al, Scientific Reports volume 13, Article number: 11221 (2023). Photo used under open access provisions.

God's ancient enemy

As David Bentley Hart writes, death is God's 'ancient enemy,' and its final defeat[330] will show that its entire existence was flawed. The problem of evil, is that in this universe, it seems to rule. Something will come along sooner or later to take you down or even eat you. Life's many eras of conflict demonstrate this. If cancer doesn't kill, a heart attack will. If you avoid all the usual suspects, your stem cells will run out, or you'll die accidentally. Even the stars are going to burn out[331] in time. This state is alien to God's nature and intentions. Until now, creationism has been unable to explain why decay and death affects every living thing. After all only humans sinned, so how did the rest of creation including other planets, and galaxies become affected by our punishment. Understanding the curse of entropy gives us a universe-wide explanation. Decay and death are flaws growing from this universe's laws. They are not only central to biology but damage all of nature. It will not be good or holy, reflecting the creators love, until both are gone forever.

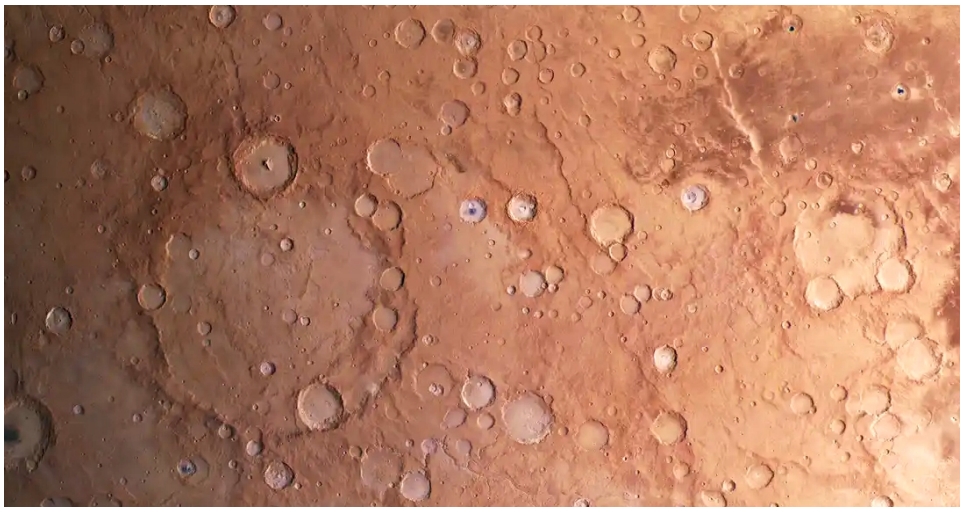
330 The Doors of the Sea, 66, p 104

331 That time being either in the incomprehensibly distant future for dwarf stars or in the next couple of thousand years for giant stars such as Antares or Betelgeuse. See The Life cycle of Stars – How Supernovae are formed.

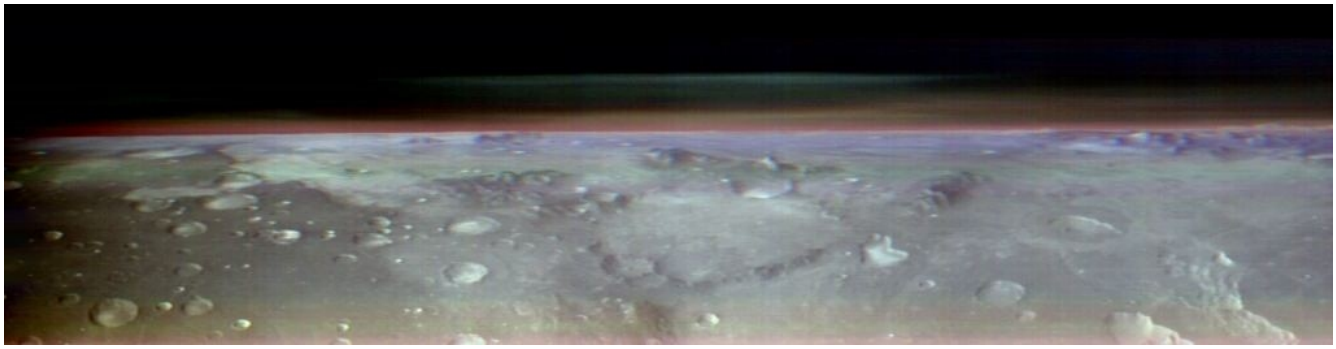
Impact

"Understanding how we decipher a great historical event written in the book of rocks may be as interesting as the event itself.[332]*"* —Walter Alvarez

As Christians, we look for the end of suffering and the coming of a new heaven and a remade earth. Compared with that paradise, our world seems quite broken. It's possible that sin just affects Earth, yet evidence suggests that other worlds follow the same rules as our own. Consider how bleak and wounded Mars is, given that it once had shallow oceans, seasons[333] and a substantial atmosphere. The photo below is 'Arabia Terra' a vast Martian plain about 4500 Km across[334], marked with many layers of craters.



One day humans will live on Mars[335]. Below is the landscape and atmosphere their landing craft will see from space. The large crater on the left above is visible in the centre.



The other planets show scars caused by rocks hitting from space. Many were large enough to have created worldwide destruction if they had crashed here. For example in the outer solar system the planet Uranus was once struck heavily by an object twice the size of Earth[336]. This resulted in its axis being

332 T. rex and the Crater of Doom, Walter Alvarez, Princeton University Press, 1997, p17

333 Mars has a well-preserved sedimentary record dating back to 4.3 billion years. How did Mars evolve from a relatively warm, moist planet to the frigid, arid globe it is today? Understanding that transition is a major goal of the Curiosity Rover mission and one of the primary motivations for exploring Gale Crater. The rover has recently discovered evidence within new exploration areas. These non-lakebed and sulphate-rich sediments suggest that Mars formerly had a wetter climate with seasonal rains that may have included short-term floods.

334 "*This is the northeast corner of the vast Arabia Terra, a huge plain on Mars about 4,500 kilometres wide. The crater on the left is Cassini, which itself is over 400 km across. Whatever hit Mars to form it was big. Way bigger than the Dinosaur Killer that hit Earth millions of years ago.*" - Phil Plait, 'Mars is Heaven', Jul 25, 2020.

335 Credit NASA, Odyssey's THEMIS Views the Horizon of Mars

336 See phys.org/news/2018-07-cataclysmic-collision-uranus-evolution.html. Venus is also odd because it rotates slowly backwards, compared to the rest of the planets, also probably due to an impact. The other possible explanation for Ur-

knocked at a right angle, instead of being upright like the other planets. As a result, one half of the planet faces towards the sun all the time, while its other half is forever dark and cold. Only a couple of years ago, Jupiter was struck by a comet that likely would have wiped out all human life had it hit the Earth[337]. Noah's flood is the largest disaster discussed in the bible, but Earth has experienced widespread destruction from space.

"On Friday the 13th, April 2029, an asteroid large enough to fill the Rose Bowl[338] as though it were an egg cup will fly so close to Earth that it will dip below the altitude of our communication satellites. We did not name this asteroid Bambi. Instead, we named it Apophis[339], after the Egyptian god of darkness and death[340]." - Neil deGrasse Tyson

Earth's neighbourhood

Each May, the Eta Aquariid meteor shower is visible in Australian skies. This happens as the Earth passes through the stream of ice and dust that trails behind Halley's Comet. But there is no need to wait for such an event. Patient sky watchers will see the flare of several meteors hitting our atmosphere every night. It is even possible to see the flash on the shadowed face of the moon as one strikes there, adding to the many craters visible on its surface. Just under 40 percent of these fragments of rock originate from a single group[341] of stony asteroids known as Flora/Ariadne after its two largest members.

To get a feel for just how many asteroids exist beyond the earth take a look over the page at a slice of a scientific info-graphic of the orbits of 18,000 known asteroids by the talented Eleanor Lutz. Asteroids come in families or clans which have a similar character. Over time, their numbers increase as they crash into each other and break up. While gravity now and then fuses some. Most have a common origin in a larger body. Family members are the broken remains of a few larger parent asteroids, so they have the same mix of elements. The Flora/Ariadne clan members mainly come from an original gigantic parent rock about 300 km in size, but include a few rocks from other regions. The ages it takes for significant collisions[342], along with the weathering on the surface of asteroids from tiny impacts, show all these distant objects have endured through many long ages.

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anus' tilt is an oversized moon that gradually flipped its parent on one side then collided with it later.

337 This was Comet Shoemaker–Levy 9 in 1994, as an object of approximately 5 kilometres in size it would have resulted in an extinction crisis, depending on its point of impact. See any astronomical impact simulator for details. Studies of Jupiter's mass distribution show that in the past it has sustained much larger impacts, with objects up to 10 times larger than the Earth – The formation of Jupiter's diluted core by a giant impact, Liu S., Yasunori, H et al, Nature 572, 2019.

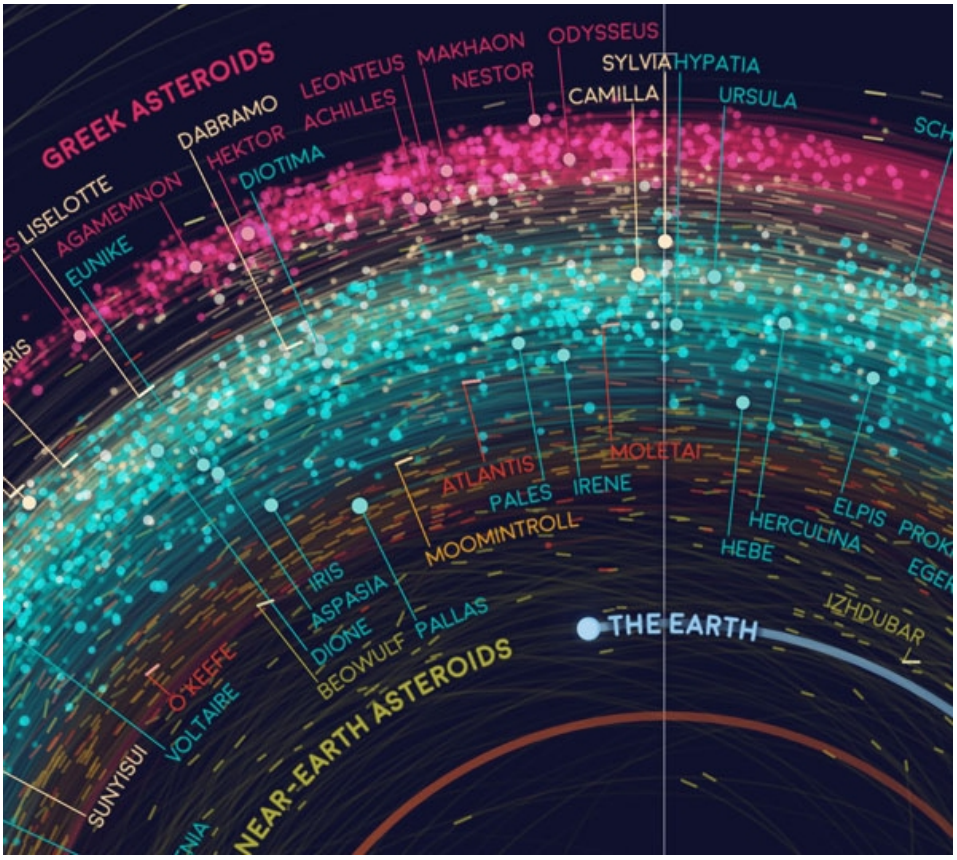
338 The 15th largest stadium in the world it can seat 92,000 people

339 NASA's Osiris-Apex mission will visit the asteroid in 2029 to research the physical changes caused by its close contact with Earth and monitor its orbit and structure. The spacecraft will come close and fire its engines, kicking up loose pebbles and dust. This will allow scientists to examine the composition of material just below the asteroid's surface.

340 Calculations have ruled out a collision in 2029, scientists can't yet rule out possible collisions many decades in the future, and there are plenty of other large space rocks orbiting the sun in Earth's neighbourhood. Not all Asteroids are named after death gods. The photo is not Apophis but Ida, a fairly typical rocky, 60 by 23 kilometre wide asteroid with its own diminutive moon Dactil, to the right, which is just 2 km across. Credits: Credit: Galileo Project, JPL, NASA

341 Often referred to as a clan rather than a family as the Flora/Ariadne asteroids are associated with a number of interlopers from other sources. Clan groupings share similar orbital elements, which are believed to remain stable for millions of years.

There are around 900 asteroids larger than one kilometre in Earth's neighbourhood. One thousand, two hundred that are mid sized, and so on, with increasing numbers, but getting smaller until they are only dust sized fragments. Each of the bigger bodies creates only a tiny risk to Earth. Not however, zero risk. So we have had many fiery visitors over millions of years.



*I'd recommend viewing the complete image at **tabletopwhale.com**.*
The largest dots represent objects over 100 km in size.

Many meteors are no more than tiny rocks that won't reach the ground. Still, the Earth also has craters from much larger ones. The oldest craters are buried, and some are worn away by the natural forces of erosion and hardly visible. All of them can still be identified as an impact site. Usually, from the specific features of the rock layers, they leave buried below. These include shatter cones that point directly towards the impact and small glassy balls of rock melted and thrown up by the force of the strike. Also tiny diamonds formed by the intense pressures on fragments of carbon and rare elements, including iridium,[343] which is uncommon on Earth, but often found in meteors.

Luna history and the Apollo missions.

As Galileo observed, our moon is covered with many layers of craters. Due to the lack of atmosphere, they are not worn down[344]. Even small rocks can make deep sharp edged craters since they strike the Luna surface at speeds of 90,000 km/h or more. Newer impacts are well defined with clear edges. Around each circular crater are the debris from rocks thrown up and melted by the crash. Viewed in in-

342 Surface material recovered from asteroids shows frequent tiny collisions, scaling up over time to less frequent body shattering impacts. See the Hayabusa mission results. Asteroid surfaces are not quiet places, but experience heavy bombardment. See also the Hayabusa Two mission. "*Hayabusa Two samples revealed that Ryugu, as we see it today, was born from a collision that shattered its parent asteroid and turned it into what scientists call a rubble pile, a loose collection of rocks and pebbles held together just by the power of gravity*".

343 The K-T boundary – Disaster from Space. Glassy spheres of melted rock are found throughout the KT boundary layer in the region of the original impact.

344 There is slow erosion due to dust sized and larger, micro-meteorite impacts and the effects of cosmic rays.

frared light during the dark of the moon, the ring of each crater and its surroundings glow with heat. That is soaked up on days when these rocks are lit by sunlight. This fact provides an accurate measure of the age of the craters. Newer craters are taller and have cleaner, and sharper rock surfaces. So they absorb more heat from sunlight and can be labelled as recent. Also, some craters overlap others, showing that they definitely occurred later. That helps with dating since larger craters are showered with a steady rain of minor impacts. Online geological maps of the moon provide a sense of its age and complexity. More evidence lies beneath the Luna surface. A 2012 gravity map of the moon was completed by the Grail mission[345]. That shows it has a thin crust that is deeply excavated by impacts. It also has many older buried rings from early impacts that are now hidden by later eruptions of lava.

When the Apollo missions explored the moon, they returned with many samples. In later decades, satellites have undertaken sensitive measurements of the moon's magnetic fields, revealing its structure. Also, several meteorites discovered here on Earth were blown into orbit from impacts on the moon. Similarly, small amounts of Earth's rocks have ended up on the moon when enormous collisions with our planet threw debris into space. By recording newly formed craters[346], and the other techniques I've mentioned, and by directly dating the Apollo samples, we can calculate the age of the whole moon.

Science has identified two periods of Luna impacts. The first period[347] had frequent impacts from large objects. The solar system's early years were violent and unstable compared[348] to the calm of the present. After the destruction caused by the first massive impacts ended, smaller strikes continued until the present. This long period included occasional temporary increases due to distant events in the asteroid belt, such as collisions breaking up larger bodies. These collisions between colossal asteroids scattered fragments across the solar system. Since that first wild period ended, the record of strikes on the Moon and the Earth have been closely synchronised, and both records can be matched up. For example, when the Moon had a period of increased impacts 290 million years ago, that is matched by a similar increase in the number of craters on Earth[349] of the same age. As identified by the geology in which they occur, erosion and other methods.

The solar system's largest crater is on the moon's unseen side that always[350] faces away from the Earth. It stretches across a quarter of its surface down towards the Luna south pole. Its vast size at 2,500 Km wide and 13 Km deep makes it unique in the solar system. It is also one of the oldest, covered with numerous smaller craters both inside and intersecting its rim. The comet or asteroid[351] that created this

345 The gravity map shows a shattered lunar crust. "*It was known that planets were battered by impacts, but nobody imagined that the (moon's) crust was so beaten up*", said MIT's Maria Zuber, mission leader. The crust underneath several big basins (seas) is practically absent, implying that early impacts may have excavated the lunar mantle, exposing the moons interior.

346 A few craters have been added to the moons surface even in the years since the Apollo missions, sservi.nasa.gov/articles/new-impact-crater-on-the-moon.

347 "*Rock samples brought back by Apollo astronauts reveal an odd fact: the big impact craters all seem to date to the same time, around 3.9 billion years ago. This is concrete evidence of a violent period in the solar system's history known as the late heavy bombardment*" NewSci - Cosmic accidents: Blasting the Earth into life

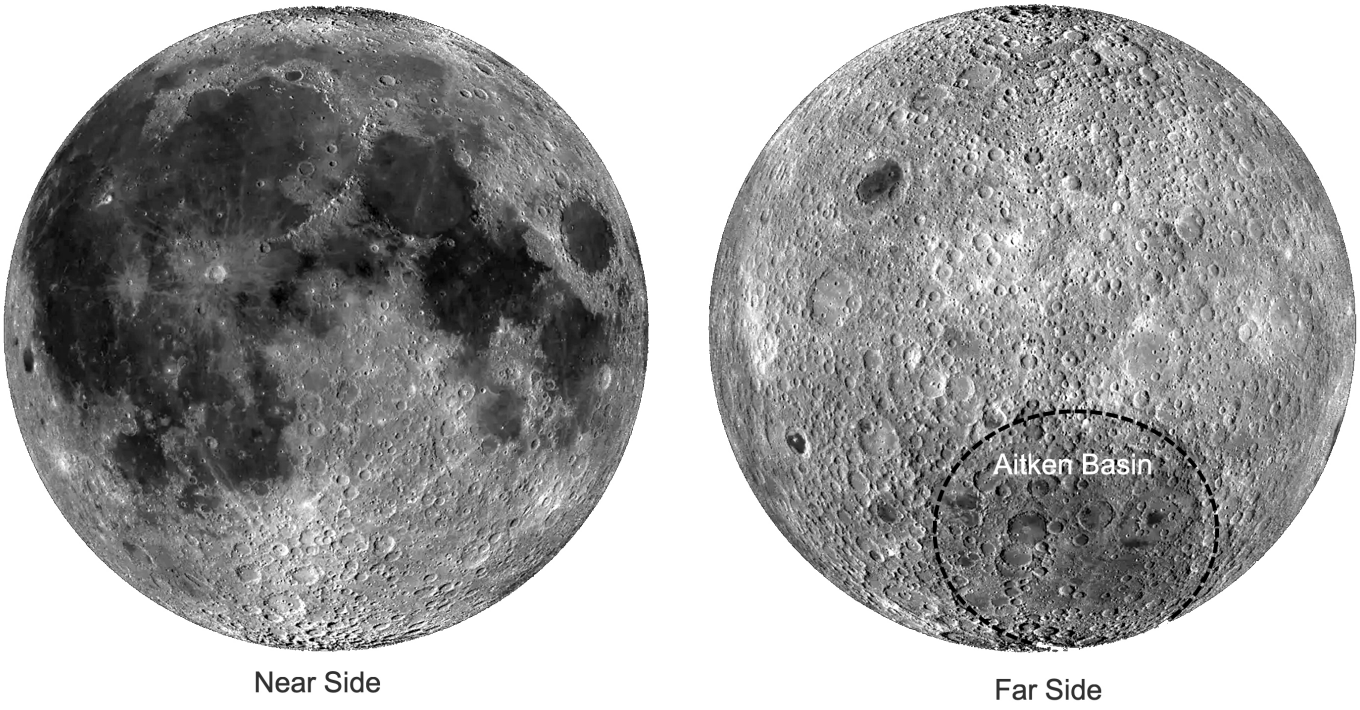
348 The Hadean Earth, scientists believe was struck by many large asteroids up until 3 billion years ago with a frequency of as often as every 15 million years leaving layers of spherical particles, condensed from clouds of rock vaporised by impacts. The moon also bears scars of major impacts from that period. - see Early Earth was bombarded by series of city-sized asteroids – Goldschmidt Conference, July 8, 2021

349 See https://www.nasa.gov/feature/goddard/2019/scientists-find-increase-in-asteroid-impacts-on-ancient-earth-by-studying-the-moon ref Earth and Moon impact flux increased at the end of the Paleozoic, Science, Vol 363, Issue 6424, 2019, pp. 253-257

350 The moon itself is tidally locked so we always see the same side pointing towards Earth, this likely occurred when it orbited closer to the earth and the tides were much larger. That was maintained as the moon moved outward from around four times Earth's radius to its present distance of 384,000 km, which is around sixty times. It still rotates but its Earthward side remains facing in our direction as it orbits around our planet. The far side was first seen directly by human eyes during the Apollo 8 mission in December, 1968. Astronaut William Anders described it, "*The backside looks like a sand pile my kids have played in for some time. It's all beat up, no definition, just a lot of bumps and holes.*"

351 Comets are made largely from ice which sublimates into space creating their tail, they tend to originate beyond the original frost-line of the solar system. While asteroids are rock or even iron and come from closer regions such as the asteroid belt beyond Mars.

crater is estimated to have been around 170 km[352] across. The giant impact produced a plume of hot rock that speared right through the moon's centre. It carried many volatile and radioactive chemical elements from the moon's deep core to the near side facing the Earth, the upper and opposite side to the impact point. In time, that created darker melted volcanic regions or seas on the Earth-facing side that are missing from its hidden face. That has more craters but less[353] volcanism. So when you observe the moon rising over the horizon with its dark seas, you are witnessing the effects of a world-shattering impact[354] that occurred in deep time.



Worst day ever (so far)

Nature can recover from immense damage to ecosystems, given time. Sixty-six million years ago, this resiliency was put fully to the test. A rocky asteroid, laced with metals struck just about the worst possible place on Earth. The shallow coastal seas off South America's Yucatán Peninsula[355] gave no protection from the impact. The asteroid hit the Earth at more than 240,000 kilometres per hour. The explosion released over two million times more energy than the most powerful atomic bomb. Just after the impact, deep granite bedrock flowed like a liquid. It rebounded into a central tower of fiery destruc-

352 Making it at least ten times larger than the one that struck the Earth ending the age of the dinosaurs

353 '*The impact was nearly a thousand times more explosive than the dinosaur-ravaging Chicxulub impact. The energy of the impact was so large that it destroyed a significant fraction of the lunar crust and melted a huge region of the lunar interior, producing an instantaneous sea of molten rock that flooded the southern hemisphere of the lunar far-side. Eventually the molten pool cooled and solidified, but it nonetheless permanently altered the shape of the Moon*'. See Constraining the size of the South Pole-Aitken basin impact, R.W.K. Potter, G.S. Collins, Icarus, v220, Is 2, Aug 2012 also https://www.brown.edu/news/2022-04-08/moonfaces

354 If secondary crust building was initiated during this stage of early mantle convection, the geological timing requires that the impact be at the same time as primary crust formation. This was around 4.361 billion years ago. A minimum age of around 4.3 billion years has been calculated for the impact site based on an examination of the density of later impact craters using Gravity Recovery and Interior Laboratory data. That is consistent with the impact having the proposed effect, however surface samples from the site will provide confirmation – Rapid transition from primary to secondary crust building on the Moon explained by mantle overturn, Prissel, T.C, Zhang, N., et al, Nature Communications, 2023.

355 The Chicxulub crater is an impact crater buried underneath the Yucatán Peninsula in Mexico. Its center is located near the town of Chicxulub, after which the crater is named. An unusually thick deposit of impact melt spherules was discovered at the K-T boundary on the island of Haiti. That was a key discovery because it indicated the source crater was in the region. The composition of the spherules was also a key point, they indicated the impact occurred in an area with continental crust, rather than oceanic. The composition of the relic glass was later shown to have its origin in the Chicxulub crater, demonstrating that the Chicxulub impact occurred precisely at the K-T boundary and was it's cause.

tion, as tall as ten kilometres at the centre of a deep, circular crater. The whole region was then covered by falling jumbled-up rocks and impact melt. In the following hours, ocean tsunami dumped vast amounts of sandy sediment into the hole[356] in Earth's crust.

Earth's history is forever marked by this impact when a 10 to 15 km sized asteroid caused the Cretaceous–Tertiary (K–T) extinction. It wiped out many thriving ecosystems[357] and species, including the dinosaurs. Due to its effects, many other species became extinct, including mammals, Pterosaurs, and most birds, lizards, insects, and plants. In the oceans, even creatures such as sharks died in great numbers, leaving layers of their teeth on the ocean floor.

Vast as this event was, it is not the greatest or even second largest extinction. It was only the third largest of these events, that Earth has suffered. Why is this significant for Christians? First it shows that the rest of nature is consistently hostile to living things, and this flaw extends beyond our own world. Second, it illustrates how incomplete the Bible is. If we try to use it as our only source of universe wide history. This great dying and many other events must have occurred after the origin of sin. Yet they are not explained by any flood no matter how complex. An explanation such as a gap in Genesis does not help because they are not events from any 'good' creation but chaotic in every sense of that word.

Scientists examined the original site of the impact crater in 2010. Samples showed that vast amounts of rock were shattered and vaporised at the site. The impactor was so large that when the asteroid penetrated the seabed, its upper half was still above the atmosphere. The collision force liquefied granite, causing it to explode kilometres outwards, into orbit around the globe and back into space within minutes from the wound in the crust. The clouds of carbon rich pulverised rock it threw up were a

356 Drilling of dinosaur-killing impact crater explains buried circular hills – Eric Hand, Science 2016, and The formation of peak rings in large impact craters, Morgan J.V., Gulick S.P., Bralower T. et al, Science, Vol. 354, Issue 6314, 2016, pp. 878-882. - "*The discovery of shocked, granite rocks from deep in the crust placed out of order on top of sedimentary rocks validates the dynamic collapse theory of formation. Chicxulub is the only well-preserved crater on Earth with a peak ring, but they abound elsewhere in the inner solar system*"

357 The climate of regions in which most dinosaurs lived just prior to the impact was similar to previous eras in which they had thrived. See also www.nature.com/articles/s41467-019-08997-2. While the largest-brained species of dinosaurs evolved right at the end of the cretaceous period, just before they were wiped out. Although diversity of dinosaur species and especially herbivores was in decline in North America, mammalian species remained static. Unexpectedly it was not the dinosaurs that were preventing mammalian species from developing but older relatives of today's mammals competing with them.

primary cause[358] of the extinction that followed. They blocked sunlight, halting plant growth across the planet for years and created extreme climate change.

The K-T boundary clay[359], which is found across the world, was created by this cataclysm. Its effects spread across the entire planet. Antarctica, which was not yet over the pole, experienced a 65-70 percent loss of many plant, insect and animal species. That loss is shown[360] by more than 6,000 fossils sampled from Antarctic islands. Pollen is a fine powder produced by many different types of trees, flowers, grasses, and weeds. It's grains are sturdy, so it is often retained in geological layers along with spores from plants like ferns. Even the simplest plants suffered greatly due to the impact. Especially in the Americas closer to the impact site[361], while seawater temperatures[362] were also affected.

The impact waves spread around the world in a predictable path. These super tsunamis eroded the sea floor as they passed and left deposits as far away as the east coast of New Zealand and all around the Atlantic. The initial wave is estimated to have been over four thousand metres in height. Modelling shows it took the first waves just an hour to expand past the Gulf of Mexico and into the North Atlantic. Four hours later, it passed through the wide gap where today North and South America are joined and into the Pacific. One day after impact, the waves had crossed most of the Pacific from the east and most of the Atlantic from the west and entered the Indian Ocean from both sides. By the second day, gigantic tsunami waves had flooded most of the world's coasts, crossing and recrossing the globe[363]. The impact created earthquakes larger than any in human history, with shaking and aftershocks for up to a month[364].

The view from Tanis

At the Tanis[365] archaeological site, a record of the impact event is preserved. This area was a long, narrow valley at the time of the extinction. A meandering river flowed down with many bends to an inland sea. It was a vibrant, green country with tall ferns and mature trees. Many fish were found in its large river, and marine reptiles, Pterosaurs, turtles and even small mammals climbed, landed on and burrowed in its banks. There were many dinosaurs, in the surrounding forest. Just about all the major families from this era have been found. Wildflowers added colour to the scenery. From the fish and flowers buried, it was late spring or early summer when the asteroid struck. The valley was over three thousand kilometres from the impact. It was just as doomed as closer sites. All that remains of this landscape today is a thick, crumbly layer of rock. It is in what is today North Dakota and the rock is crowded with beautifully preserved fossils.

358 That is based on particles retrieved from a North Dakota location where a layer of dust from the Chicxulub impact fell. This was largely fine silicate dust. After being blasted into the sky, rock particles of such size would have lingered in the atmosphere for decades. According to models, it would have blocked the sun's rays and caused a worldwide long winter in which two-thirds of species disappeared. Up to 2,000 billion tonnes of material shut off photosynthesis for nearly two years and cooled the earth by up to fifteen degrees. See Chicxulub impact winter sustained by fine silicate dust, Senel, C.B., Kaskes, P., Temel, O. et al. Nat. Geosci. (2023).

359 The boundary clay consists of a basal kaolinitic claystone layer containing hollow goyazite spherules, overlain by a 2-3 mm smectitic layer containing both shock-metamorphosed minerals and an iridium anomaly of 21 ppb.

360 Seymour Island is one of the sites sampled, to the east of the Antarctic Peninsula ref www.nature.com/ncomms/2016/160526/ncomms11738/full/ncomms11738.html

361 The global vegetation pattern across the Cretaceous–Paleogene mass extinction interval: A template for other extinction events, Vajda, V, Bercovici, A., Image used under a Creative Commons license, Science Direct - Global and Planetary Change, Volume 122, November 2014, P 29-49

362 On impact and volcanism across the Cretaceous-Paleogene boundary, Pincelli, M, Bornemann, A., Penman D. E. et al, Science, Jan 2020, vol 367, iss 6475 and discussion

363 'The Chicxulub Impact Produced a Powerful Global Tsunami', Range, M.M., Arbic B.K, et al, AGU Advances, Vol 3, Iss 5, October 2022.

364 'Impact that killed the dinosaurs triggered mega-earthquake that lasted weeks to months', The Geological Society of America's GSA. 6 Oct. 2022. Release No. 22-54e.

365 New Fossils Might Capture the Moment of Mass Extinction That Wiped Out the Dinosaurs

The first effect was a wave of heat that flash-burned trees and animals near the coast. The impact threw material[366] into space as far as the moon. Its return into the atmosphere then released so much heat that firestorms would ignite across the planet, and air temperatures briefly rise to oven-like heat. Later would come acid rain, a years-long winter and, finally, more than five degrees of global warming after the sky cleared.

Within minutes of the impact, earthquakes created a 10-12 meter surge[367] of water at the site. This wall of destruction roared up the narrow valley from the sea, carrying a tangled wreckage of mud, fish, plants, tree trunks and dinosaurs. The surge pushed this material and many of the broken trees and creatures against a sand bar. This was high up the river and today forms the base of the fossil bed. They were lined up with the direction of the surge, against the usual river flow. The fiery sky continued to rain down glassy beads of molten bedrock, called tektites, across the planet, but many more landed on Tanis. These left tiny impact craters in this material where they landed. Today's site includes fossils of salt water sharks and ammonites[368] washed in by the surge from the ocean and buried. Also, freshwater bottom feeders like sturgeon and six-foot-long paddle-fish. Many with tiny spheres still stuck in their gills from the vaporised rock falling from the sky. These spheres impacted[369] with great force, penetrating the layers of debris.

Some tiny spheres were preserved in tree resin from the surrounding forest. This solidified into amber that was buried with the other fossils. They were found together with a few fragments from the metallic asteroid itself. Clear proof of both the impact and the destruction that followed. After the earthquake surge buried the remains, the sky continued to rain ash and more rock from the comet. It created a layer that is rich in the key element iridium[370] a reliable signal of asteroid material. Any life that remained would have had to cope with the wildfires ignited by the burning fallout. The fertile river valley was transformed swiftly into a hellish wasteland. Worldwide a few birds survived, but all were ground living or burrowers living off worms and insect life. They were the only ones to survive the impact and what followed. All living birds today are descended from these survivors.

The many dinosaur fossils at the site prove that non-bird dinosaurs were still doing well[371] until the day of the impact. However, dinosaurs are only one part of the story. The impact caused the death of entire, complex ecosystems on land and at sea. Only creatures living on the deep sea floor were unaffected in the oceans. The catastrophe caused a collapse of the entire ocean eco-

366 http://www.nytimes.com/2019/09/10/science/chicxulub-asteroid-impact-dinosaurs.html

367 Such waves are called seiches. The 2011 Tohoku earthquake near Japan triggered 1.5-meter-tall seiches in Norwegian fjords 8000 kilometres away.

368 Ammonites were relatives of sea creatures such as the modern chambered Nautilus. Having been successful for eons they became extinct at this time.

369 The impact left a layer of glassy 'spherules' (tiny spheres) a few millimetres thick worldwide. Contrast this with the layers from massive impacts early in Earth's history (3.47–3.23 Ga) which left layers 30 to 40 cm thick seen in eastern South Africa in a geological formation called the Barberton Belt. Such thick layers suggest asteroids of at least 20 km cross section and possibly as large as 70 km. Gargantuan impacts like that would have vaporised the top 100 meters of ocean and heated the entire atmosphere to hundreds of degrees.

370 An uncommon element in Earth's crust, but often found in asteroids. Also ejecta spherules, microkrystites, shocked minerals, and unaltered impact-melt glass. All features that are commonly associated with the Chicxulub impact. Tanis is only the fourth known outcrop to contain unaltered Chicxulub impact glass. The glass is dark and vesicular, with pockmarked surfaces. It includes some internal crystals of melilite and encapsulated debris, and has extremely low water content consistent with an impact origin. The size of these spheres is consistent with the distance to the impact site. Closer deposits have larger average diameters.

371 Evidence for a long-term dinosaur diversity decline prior to the impact is limited to Ornithischian dinosaurs in North America. Globally, there is no evidence of a decline for other dinosaur groups or any loss of major species. While similar and sometimes extreme diversity fluctuations occurred repeatedly throughout dinosaur evolution but did not result in vast extinctions.

system and the extinction of many oceanic species worldwide, with flow-on effects[372] lasting for eighty thousand years.

A postscript to Armageddon

A lost world

Walter Alvarez[373] was one of the researchers who discovered evidence of the impact and linked it to the extinction of the dinosaurs. He put the event into context, "*The sudden loss of two thirds of the genera of plants and animals on Earth is a catastrophe almost incomprehensible to us. It truly marked the end of a world. And yet, the darkness eventually faded, the heat died down, and the acids were neutralized.. Our nostalgia for the lost world of the Cretaceous is tempered when we realize that it was a world that held no place for us – for large mammals.. We are the beneficiaries of Armageddon*"

The K. T. Boundary layer, as seen above in Long Canyon, Trinidad Lake State Park, Colorado[374]

For the dinosaurs and so many others, the impact ended their existence. A few may have survived[375] just as Gorgonopsids did after the end Triassic extinction. The idea of dinosaurs, living on, protected in isolated refuges is disputed[376]. Their fossil bones may be relocated from[377] older

372 That is proven using boron isotopes in fossil Foraminifera, a species that scientists often use since their very common remains effectively capture the makeup of ocean chemistry during their lifetime in a particular location. Acid rain would have fallen across the planet for years after the impact while carbon dioxide rose dramatically – see Rapid ocean acification and protracted Earth system recovery followed the end Cretaceous Chicxulub impact, Henehan, M.J, Ridgewell A, Thomas E. et al, 2019, PNAS 1905989116, Oct 21, 2019

373 Walter Alvarez, was one of the most prominent scientists who discovered evidence of the impact, see his book T rex and the Crater of Doom, Princeton University Press, 2015, P17. As quoted from the original study in 1986 "*We have very strong physical and chemical evidence for a large impact; this is the most firmly established part of the whole story. There is an unquestionable mass extinction at this time, and in the fossil groups for which we have the best record, the extinction coincides with the impact to a precision of a centimetre or better in the stratigraphic record. This exact coincidence in timing strongly argues for a causal relationship.*" Note – Percentage of loss in quote adjusted to reflect current estimates, original source reads half of the genera of plants and animals.

374 This layer marks the impact. It varies in thickness from a few centimetres to just under a hundred metres in parts of Mexico, but can be found in rocks from all over the world.

375 Some eggs of smaller dinosaurs may have survived the first events of the first two years completely buried in their nests, beneath ash, and some protected vegetation may have survived as spores ie ferns, although the dating of content from the best known site with such fossils is disputed however the question remains open. There would have been severe inbreeding and population fragmentation in the survivors however, ensuring extinction. Whether the asteroid was the final push towards extinction after a protracted decline in dinosaur diversity due to other factors or the primary cause makes no difference to creationists especially those who reject an old Earth.

376 Critics of suggested prehistoric refuges argue that the source layers of possible post-impact fossils span the impact period. The dinosaur materials and, particularly teeth found, are most likely migrated fossils, or not yet fossilised material that became mineralised later.

377 For example in the case of the Ojo Alamo Sandstone dinosaur fossils, see Provenance of Cretaceous through Eocene strata of the Four Corners region: Insights from detrital zircons in the San Juan Basin, New Mexico and Colorado, Pecha, M. E., Gehrels, G. E., Karlstrom, K. E., et al, Geosphere, Vol 14, Num 2, 2018. - "*Only five of the 295 U-Pb DZ*

layers, but it might be true. Could most of a world die without a few pockets of survivors? Sadly, the dinosaurs were fast-maturing giants needing much food. Earth's climate had changed forever and filtered out the species they depended on. So, any survivors were doomed, relics of a vanished age. The mammals and birds would spread to take advantage of the devastated world, but these species had a challenging start.

The survivor's history continues at Corral Bluffs in present-day Colorado. It was September. 10th, 2016. Tyler Lyson a palaeontologist, at the Denver Museum of Nature was searching for fossils. Although, the area had been searched by fossil collectors since the 1930s. As he recalled, in an interview with the Washington Post[378], they were coming to the end of a collecting season with few discoveries. Tyler then remembered a technique he learned from South African palaeontologists – search for unusual looking rocks instead of bones. His attention was drawn to a pale lump, a glob of rock looking like a squashed loaf of bread. The moment is fixed in his memory: "*I picked it up and cracked it with my rock hammer and broke it in two. And I could see the cross-section of a mammal skull staring back at me. It was just, you know, I almost had tears in my eyes*". Other researchers in the group looked for similar conglomerate rocks and quickly found two more skulls. Palaeontologists might not find a single early mammal skull in a lifetime of searching, so it was a magnificent discovery.

This was just the beginning of their discoveries and research. Altogether his team found an astounding collection of fossils at Coral Bluffs. This included more than 1,000 vertebrate remains, mammal bones, turtle shells and crocodilian skulls. There were more than 6,000 petrified leaves and other plant parts and 37,000 grains of fossilised pollen. As well as seeds, leaves, roots, branches, complete sapling trees, and large stumps and logs. This deposit had been laid down over a million years and covered the period before, during and after the impact. The remains were dated using volcanic ash and other indicators providing a timeline of events. Before the asteroid struck the Coral Bluffs region of Colorado was wooded with a tropical climate. The woodlands were home to triceratops, armoured ankylosaurs, tyrannosaurus rex, and duck-billed dinosaurs.

Until a gigantic chunk of rock and metal striking near Mexico, punched a hole in the Earth. The fossils Tyler discovered showed that mammals were horribly affected by this disaster. The largest survivor was only about the size of a rat. Bigger mammals had been completely wiped out. The diversity of all plant life had more than halved. From the fossils it was possible to trace not only changes in plant species but temperatures at the site. Including the global winter caused by the impact itself and the following spike of extreme warming. One hundred thousand years after impact, ferns were still the main type of plant life. The first post extinction mammals were tiny omnivores most living on insects.

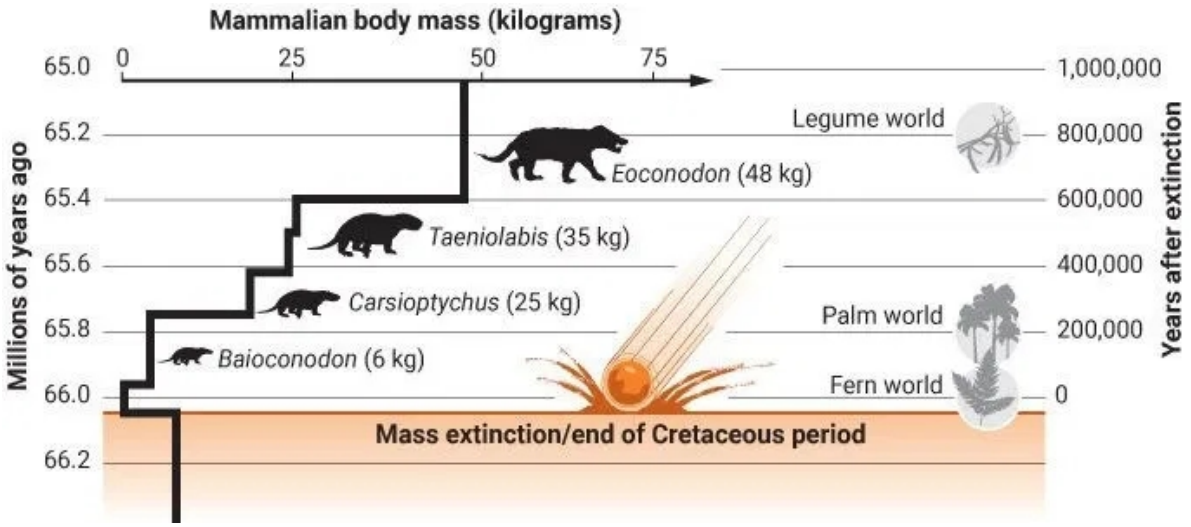
Gradually over the next hundred thousand years the plants recovered, and palm trees returned. Mammals such as Loxolophus grew to the size of a small cat, and Carsioptychus which was about as large as a small pig. There was a shift in species to more plant eaters as plants grew taller and more diverse. It took until 300,000 years after the impact for mammals to recover, along with richer plant life. By then, animals had reached a maximum of twenty two kilograms in weight. Discoveries of new mammal species continue at this Coral Bluffs site. In 2024 the skull and jaw of Militocodon lydae[379] was discovered. This species was about the size of a large rabbit and likely a ground living, omnivore. It lived 610,000 years after the extinction event. Dr Lyson commented "*How and when life rebounded in the aftermath of the extinction of the dino-*

ages from the Ojo Alamo Sandstone overlap the bio-stratigraphic age. The paucity of depositional-age grains suggests that the Ojo Alamo Sandstone was largely derived from reworking of Jurassic and Cretaceous cover".

378 Stunning fossil trove shows how mammals flourished after the dinosaurs died, Ben Guarino, Washington Post, October 24, 2019.

379 Weaver, L.N., Crowell, J.W., Chester, S.G.B. et al. Skull of a new periptychid mammal from the lower Paleocene Denver Formation of Colorado (Corral Bluffs, El Paso County), Journal of Mammal Evolution, 31, 16 (2024). Also Newly-Discovered Species of Mammal Lived 610,000 Years after Dinosaur Extinction, Natali Anderson SciNews.

saurs has been shrouded in mystery due to a poor fossil record. But thanks to an extraordinary discovery of remarkably complete fossils from Corral Bluffs, we are now able to paint a vivid picture of how and when life rebounded after Earth's darkest hour."



Credit: Denver Museum of Nature & Science

During this creatures era, full sized trees also returned to the site, with pollen from walnut trees appearing in the fossil layers. It was not until 700,000 years after the impact that the capybara sized[380] Taeniolabis and the wolf sized Eoconodons appear[381] in the fossil record. They were well above the average for mammals in the time of the dinosaurs. This was the beginning of their dominance in todays ecosystems.

Other cosmic impacts

Apart from the formation of the moon, there have been many other impacts in Earth's history. About 800,000 years ago, there was an enormous one, striking somewhere in Indochina. This may have been an air burst from a comet since no crater has yet been found. It dropped materials eight thousand kilometres away in Australia[382] and as far as Antarctica. Around twelve thousand years ago, a large comet[383] of a similar type may have exploded close to the Earth's surface. That event likely contributed to the

380 The size of a big dog such as a Labrador retriever, or about 100cm long and 50 cm in height

381 See Exceptional continental record of biotic recovery after the Cretaceous–Paleogene mass extinction, Lyson T. R., Miller I.M., Bercovici A.D., Weissenburger K., Fuentes A.F. et al, Science, 24 Oct 2019 – The Corral Bluffs study area, contains a single continuous, physically traceable, approximately 27 square km outcrop from the Denver Basin that preserves the biotic recovery of a terrestrial ecosystem in the first million years post-impact This fossil record has been dated using the Geomagnetic Polarity Time Scale (GPTS 2012) using paleo-magnetics and CA-ID-TIMS U-Pb-dated volcanic ash. The study area contains an exceptionally dense vertebrate (299 localities) and megafloral (65 localities) record with fossils occurring at more than 150 stratigraphic levels in the approx 250 m thick sequence. The extensive and nearly continuous outcrop belt spans the last 100 thousand years of the Cretaceous and first 1 million years of the Paleocene eras.

382 The chondritic impactor origin of the Ni-rich component in Australasian tektites and microtektites, Folco, L, Rochette, P, D'Orazio, M., Masotta, M., Geochimica et Cosmochimica Acta, Vol 360, Nov 2023. See the impact map which shows the broad scale of this event. See also Multi-collector 40Ar/39Ar dating of microtektites from Transantarctic Mountains (Antarctica): A definitive link with the Australasian tektite/microtektite strewn field, Vincenzo, G., Folco, L., Suttle, M. D., Geochimica et Cosmochimica Acta, Vol 298, April 2021.

383 This is known as the Younger Dryas Impact Hypothesis, and while contested it has also received support. For example - Sedimentary record from Patagonia, supports cosmic-impact triggering of biomass burning, climate change, and megafaunal extinctions at 12.8 ka, Scientific Reports v9, 4413 (2019). Premature rejection in science: The case of the Younger Dryas Impact Hypothesis, Powell J. L., Science Progress, Jan 2022.

extinction of many large Pleistocene creatures. At the same time, human cultures in Europe and North America disappeared or were severely disrupted. This event has been confirmed by geological sampling[384] in North America and elsewhere[385]. In December 2018, a meteor only 10 meters across broke up above the ocean near Russia's Kamchatka Peninsula. It exploded with a force ten times larger than the bomb that annihilated the city of Hiroshima. Fortunately, it broke up in a remote location. While very recently, a thirty-five meter rocky asteroid[386] had a near miss in July of 2023. It was only discovered a few days after safely passing the planet. Had it struck a major city, it could have been deadly. Impacts this size or near misses, like the Chelyabinsk meteor, occur every couple of decades.

Other planetary surfaces throughout the solar system share the same pattern as the moon. That is an early major bombardment by gigantic rocks followed by regular hits by smaller bodies over a long period. That has left widespread scars across the planets. Consider Mars, which has 635,000 impact craters of one kilometre or larger. Mercury also has prominent features such as the Caloris impact basin[387], which is 1,550 km across. For scale, Earth's largest known crater was only 280 km across when formed. The asteroid that caused our largest crater two billion years ago was twice[388] as large as the one that killed the dinosaurs. Yet its impact was a pinprick compared to strikes on other planets. As described, Mars shows signs of being hit by several rocks exceeding one hundred kilometres in size in its deep past.

Can humans expand from a purely Earth-focused future? Like the dinosaurs, we are at risk. To guard against such threats, spreading Earthly life to other planets is one option. That would protect civilisation against extinction events. Mars would be a harsh but viable place to live as an initial world. Buildings would need to be partly underground[389] or within domed cities. Essentials like sufficient air and water would be a struggle. It could be many decades before Martian colonies were well established. While full independence from Earth would take centuries. There will, I hope, be many Christians living on the Moon and on Mars[390] someday. Living their whole lives[391] beyond our world.

Luckily for us Earthlings, monster-sized asteroids are uncommon, but a peppering of meteorites continues to rain down on us. An expedition to the Atacama Desert in Chile[392] recovered many meteorites. They had rested on the surface since colliding. Some for a few decades, others up to two million years. Their ages showed steady impacts over time, with only minor variations in the rock's makeup.

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384 Evidence for deposition of 10 million tonnes of impact spherules across four continents 12,800 y ago, National Acad. Science, Wittke, J. H., Weaver, J. C., Bunch, T. E. Bunch, 2013. - "*Twelve locations rank among the world's premier end-Pleistocene archaeological sites, where the YDB marks a hiatus in human occupation or major changes in site use. Our results are consistent with melting of sediments to temperatures >2,200 °C by the thermal radiation and air shocks produced by passage of an extraterrestrial object through the atmosphere; they are inconsistent with volcanic, cosmic, anthropogenic, lightning, or authigenic sources.*"

385 Sediment Cores from White Pond, South Carolina, contain a Platinum Anomaly, Pyrogenic Carbon Peak, and Coprophilous Spore Decline at 12.8 ka, Moore C. R., Brooks M .J, Goodyear A. C., et al, Scientific Reports Vol 9, Article 15121 (2019) - from White Pond in South Carolina one of the oldest and most complete paleo-environmental records in southeastern North America, which has a basal core date of at least 22,000 years ago.

386 Asteroid 2023 NT1: A Cautionary Tale, Bailey B. K., Cohen, A. N., Patel, D et al, arXiv preprint arXiv: 2310.13112, 2023

387 Among the rocky planets Venus and Earth are two exceptions, Venus has a thicker atmosphere causing smaller meteors to fragment and burn up, it has only around 900 visible craters, while the Earth has continental drift and erosion which tends to recycle or cover up craters.

388 https://www.rochester.edu/newscenter/vredefort-crater-earth-asteroid-impact-structure-534222/. See also https://geology.com/articles/vredefort-dome.shtml

389 As a protection against solar storms and cosmic rays. Sufficient water does seem to be locked up in the poles and underground. The best option seems to be as close as possible to the equator in a region that has pure buried water. A self sustaining Martian colony is possible but hard to achieve. Its likely that they would be dependent on Earth for many years. Unless key advances in robotics and 3d printing occur.

390 If some are from my own denomination quite possibly working as a medical doctor or nurse. Thank you Avondale University!

391 If this is you, then hello there!

392 Oldest Meteorite Collection on Earth Found in One of the Driest Places - www.geosociety.org/GSA/News/pr/2019/19-21.aspx

Australia[393] has some of the earliest dated rocks in existence. These are found in the cratons[394] of Western Australia. They preserve the remains of impacts so old that they are only visible in deeply buried impact structures. One of these is the Yallalie impact feature two hundred kilometres north of Perth. We also have the currently oldest known crater in the world at Yarrabubba, which is east of the inland town of Meekatharra. That was once a large crater but is now detectable only in shatter cones and other rock traces and in magnetic maps[395] of the area.

Earth has essential geological systems, which support life by recycling older rocks and bringing up new material. The evidence from the rocks of Western Australia and South Africa shows that this flexibility owes a lot to the impacts from space that Earth experienced early[396] in its history. Like a volcano's slopes where the soil is fertile, Earth is rich in life because it is unstable and dangerous.

The surfaces of large and small asteroids are cratered. So are the rocky and ice-covered moons of the outer gas planets. Since all bodies in the solar system share a history of being struck violently by rocks from space, finding craters everywhere is natural. Geology and deep time is not just about the one planet we live on. According to Craig O'Neill[397], "We tend to think of the Earth as an isolated system, where only internal processes matter. Increasingly, though, we're seeing the effect of solar system dynamics on how the Earth behaves." and how it came to be.

How can these long-term impacts and the history of the solar system fit into a young creation? We'd have to explain the levels of erosion on craters right across the solar system. There are so many other physical features that require an explanation. For example, how the rest of the universe was putting out millions of extra cosmic rays[398] per hour compared to today. At the same time, the solar wind from the sun needs to increase to age[399] surface rocks. In addition, an explanation is needed for the consistent rates of radioactive decay of the Uranium, Thorium, Rhenium, Samarium, Rubidium and Potassium-40 in samples taken from the Moon and Mars and beyond the solar system. Since none of these things were anywhere near either the Earth or any flood. It's really a lot of work to explain away the dates coming from places so far from our planet. Unfortunately, things are not likely to get easier to explain as we return to visiting the moon and travel deeper into space. Defending the accuracy of the Bible is wonderful but being convincing in our explanations is equally vital. We should shake off the limitations

393 Precambrian and younger terrains on the Australian continent have a great number of impact structures and likely impact structures because of their long-term geological stability. These include 43 known ring structures, 38 verified asteroid impacts, and many likely impact structures. They include buried structures greater than 100 km in diameter, such the Woodleigh impact structure and the Warburton likely impact structure, down to smaller craters, such as at Henbury and Veevers. Including Deniliquin which may turn out to be one of the worlds largest.

394 From the Greek '*kratos*' meaning strength—an ancient stable block of theEarth's crust forming the core of a continental plate or the central basin of an ocean, usually quite large. May be exposed in the form of a shield or be buried forming the foundation for younger layers.

395 This impact is implicated in a period of global warming, as it would have blown much water vapour into the atmosphere, up to half a trillion tons. "*The Yarrabubba crater was made right at the end of what's commonly referred to as the early Snowball Earth, a time when the atmosphere and oceans were evolving and becoming more oxygenated and when rocks deposited on many continents recorded glacial conditions*" - Precise radiometric age establishes Yarrabubba, Western Australia, as Earth's oldest recognised meteorite impact structure, Erickson, T.M, Kirkland, C.L, et al, Nature Communications, Vol 11, Article 300, 2020.

396 "*Our work shows there is a physical link between impact history and tectonic response at around the time when plate tectonics was suggested to have started. Processes that are fairly marginal today—such as impacting, or, to a lesser extent, volcanism, actively drove tectonic systems on the early Earth*" - see The role of impacts on Archaean tectonics, Neill C.O, Marchi S., Bottke, W. Fu, R. Geology (2019)

397 A/Prof. Craig O'Neill is the director of the Planetary Research Centre at Macquarie University, Sydney and an Associate Professor in Geo-dynamics and planetary science, in the Department of Earth and Planetary Science. He is a Chief Investigator and board member of the Core to Crust Fluid Systems (CCFS) ARC Centre of Excellence. "*When not staring bleary-eyed at screens of rolling numbers, or attempting to inject coffee intravenously, he can often be found fighting people whilst wearing baggy pyjamas, or wandering the outback sticking things into rocks.*"

398 Most cosmic rays are atom fragments created when stars explode in a supernova. They rain down on the moon and earth from outside the solar system and strike from all directions equally.

399 The effects of primary cosmic rays on rock are well understood, luckily the Earth's atmosphere screens us from most of these because they destroy living tissues, but the moon has no such shield.

of young Earth theories. They cannot provide any explanation that works, no matter how complex they become.

Particles from deep space

Except for the moon and a few stray planets, the night sky appears empty and peaceful to human sight, but it is far from tranquil. If you could view it in every frequency of light, it would look like an immense fireworks display. There would be constant blossoms of light and background glow all through the electromagnetic spectrum, from radio to gamma rays. Apart from light small matter particles rain down all the time on the Earth. You are being hit by several hundred secondary particles from cosmic rays as you read this paragraph. The rays are actually high-energy particles arriving from distant galaxies. The most energetic of them are produced by enormous black holes devouring stars in the centres of neighbouring galaxies[400]. When one of them hits an air molecule secondary particles spark away from the impact in showers. Equally significant is where the rest of these particles come from. The majority were once just normal space debris including widely scattered atoms from nebula's or tiny remains from broken up planets or asteroids. However when a nearby star exploded they were hit by its shock wave. Extra-ordinary amounts of energy are released when a star blows up, releasing a supernova. Struck by this wave of energy, the tiny harmless particles were transformed into bullets fired across space. The highest energy cosmic rays generated by black holes are even faster than bullets. They are more like the particles produced by the most powerful atomic accelerators[401].

Stars do not change much across geological time. Instead they move through their life in stellar time, recorded by the expansion of the universe, and the spin of galaxies. Still the larger they are, the faster their time comes to an end and they shatter. That seeds space with their glowing remains. Striking Earth from every direction all of the time, cosmic rays are the most dangerous effect of these explosions. Gigantic rocks hitting the earth, show us the long term dangers of our universe. These tiny speeding particles are also a risk. They affect the long term development of species. Along with natural radioactivity they damage cells instructions. Mutations from repairing these breaks are one of the sources of variation in species. That is the pool that adaption draws on for new body parts, behaviours and abilities. The main source of mutations are chemicals and copying errors[402] when cells divide. However damage from interstellar particles[403] may also be quite high.

Solar activity and the Earth's own magnetic shielding are also part of this situation. For both affect how many of the really dangerous particles make it to the ground. Wherever we are on Earth, we are all being struck. Unless you're deep underground or living under thick lead roofing. Compared to boulders and other heavy objects, our bodies are not dense. Rocks and especially crystals collect a lot more radiation from cosmic rays. As a result, their structure alters. Depending on the composition of the exposed rock, some of its crystals build up a trapped electrical charge within tiny flaws. The remaining charge is one way of figuring out how old a sample or artefact is. It indicates the amount of time since a fragment of rock was last exposed to sunlight or to the cosmic ray showers that fall constantly[404] from space.

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400 Otherwise known as an active galactic nucleus, these black holes can make the inner parts of a galaxy an unhealthy place to live. Looking on the bright side the Milky Way's black hole is mostly dormant, at present.

401 How fast? '*The Large Hadron Collider accelerates particles here on Earth up to a maximum velocity of 299,792,455 m/s, or 99.999999% the speed of light, cosmic rays can smash that barrier. The highest-energy cosmic rays have approximately 36 million times the energy of the fastest protons ever created at the Large Hadron Collider.*' - https://www.forbes.com/sites/startswithabang/2018/10/09/the-universe-has-a-speed-limit-and-it-isnt-the-speed-of-light/

402 Also the effects of regulatory networks of genes responding to environmental conditions, i.e. heat shock gene regulation in response to stress.

403 Muons, mutations, and planetary shielding, de Groen P. C., Frontiers in Astronomy Space Science, Vol 9, 2022 doi:10.3389/fspas.2022.1067491.

404 See https://www.sciencedirect.com/topics/earth-and-planetary-sciences/luminescence-dating. This uses common single quartz or feldspar crystals so its easy to find the material vs carbon based dating.

Why do astronauts see mysterious brilliant flashes, when they enter deep space, even with their eyes closed? Cosmic rays make many other particles[405] when they collide with materials. The sun releases these high energy particles which flood into space constantly. They are likely to hit something as they pass though the fluid inside the eye. A strike, causes a storm of secondary decay particles which include light generated inside the eye. These dangerous particles pass right through the rest of the body, sometimes hitting cells. If the cosmic ray and radiation exposure is severe enough, it may be fatal, making lengthy journeys, like those to the Moon or Mars risky.[406] Cancer or even death from radiation sickness are a possibility if a major solar flare floods out from the sun[407] in the travellers direction. Severe solar storms, generated by our sun, can disrupt the protective magnetic field of the Earth[408] that keeps us safe from space weather. Plants retain a record of the damage when this occurs. These high radiation episodes cause up to 20 times the typical amount of the isotope carbon fourteen[409] to be formed, That carbon then stored within plant cells, and their buried remains. Since it has two more neutrons in its nucleus than regular carbon atoms, it is somewhat radioactive. The outcome is similar in ice cores[410] which are also altered. We can use these changes along with volcanic eruptions, and other processes to date extreme events on the sun, during human history and beyond into deep time.

Widespread effects of the fall.

These features of our universe have no rational explanation in flood theories unless we imagine a lot of other strange and non-biblical things happening too. Planets and moons throughout the solar system and around other stars show the effects of chaos and the fall. While flood based theories cannot provide any explanation beyond our own world.

Earth itself has experienced impacts, and icy glaciations sometimes reaching right to the equator and vast eruptions. The composition of the atmosphere has also changed over time. The planet Mars too has a layer cake of ice and dust under its present polar caps, charting millions of years[411] of climatic change. With the exception of impacts, these eras of fire and ice occur in geological time, not during a couple of years of upheaval.

405 Cosmic rays can generate up to ten billion secondary particles, only some of which can be seen as light.

406 Low Earth orbit where current astronauts spend most of their time is within Earth's magnetic field so much safer, but contingency plans are in place for really large storms.

407 NASA timed their exploration of the moon during periods when the sun was expected to be relatively quiet.

408 This didn't always exist, but dates from the formation of Earth's outer core, 4.2 Billion years ago around the time of the impact that formed the moon. See A massive space rock impact may have kickstarted Earth's magnetic field - Elizabeth Howell (Space.com)

409 Creating a jump in the radioactivity of any plant materials buried during or soon after the storm.

410 Ancient ice reveals mysterious solar storm - Lund University, Nature Communications, 2022; 13 (1) DOI: 10.1038/s41467-021-27891-4

411 See Planetary Scientists Find Ancient Ice Caps beneath Martian North Pole,

Seeing the Past

"Let us choose to be taught by Him who created the heavens and the earth, by Him who set the stars in their order in the firmament and appointed the sun and the moon to do their work" - Ellen White, CT 387.2

Space is so vast, even light is slow to show us events in distant galaxies. That causes delays in learning what's going on beyond our local neighbourhood in space. However, patient searching is rewarded. In 2017, a team of astronomers started a major radio sky survey. This search was at greater sensitivity than ever before. That is because they are using the Low-Frequency Array[412] telescope. It offers data on various topics, such as studying feeding black holes and how galaxy clusters grow. More recently, the James Webb telescope is more powerful than any previous space telescope. It is located at a stable orbital point very far from Earth. It focuses its cameras on the edge of the universe and on mysterious objects closer to home. Information is flooding in which is transforming our understanding of the deep past, but also confirming much that was already known.

Clusters are hundreds to thousands of galaxies bound together by gravity. When clusters of galaxies merge, they produce radio emissions covering millions of light years. Although our galaxy, the Milky Way, is vast in a way our mind can't entirely take in, this radio survey has already discovered millions of new galaxies beyond our own. When completed, astronomers will have added over fifteen million extra objects to northern sky maps. Most of these will be galaxies. Radio telescopes completed a more advanced survey of just a portion of the southern sky in 2022. That added an extra three billion stars and galaxies to the records. With such numbers, it can feel like the universe must be beyond our understanding. Yet its laws generate that complexity. How they work together to make a universe is something humanity is starting to understand.

Our solar neighbourhood

The "Milky Circle" or pathway[413] as the early Greeks first named it, spreads across our night sky. It is formed by light from our own galaxy's stars, but what you see in the previous photo isn't the whole galaxy or very much of our galactic arm. Nearly every visible star in the sky is within the solar system's extended neighbourhood. The visible band of stars belongs to the closest part of our arm. The solar system passes in and out of this arm during our long orbit around the galaxy's centre. The other arms are too far away to make out except with powerful telescopes.

412 astron.nl/new-sky-map-detects-hundreds-thousands-unknown-galaxies – using one meter wavelength radio telescopes to detect the emissions of central black holes and merging galaxies. "*If we take a radio telescope and we look up at the sky, we see mainly emission from the immediate environment of massive black holes. With LOFAR we hope to answer the fascinating question where do those black holes come from?*"

413 From Wiki-Media - "*The Milky Way arching at a high inclination across the night sky, This composited panorama was taken at Paranal Observatory in northern Chile. At 2635 metres above sea level in the Atacama Desert of Chile, one of the best astronomical observing sites in the world. The bright object is Jupiter in the constellation Sagittarius, and the Magellanic Clouds can be seen on the left; galactic north is downward*"

An edge on view of the Needle Galaxy (NGC891) as seen by the Hubble telescope, credit NASA

Seen edge-on, the galaxy contains three layers. Ignoring for the moment the bulge around the central core. They are somewhat different. At the top and bottom are layers of smaller more mature Sun-like stars, built from recycled materials. The middle layer of the arm is crowded and hydrogen-rich. It has many short-lived and less stable massive stars. Our sun regularly dips into the central zone, the plane in which the spiral has formed. Then the stars crowd together in Earth's sky. At other times, as at present, we remain at a safe distance, closer to deep space.

A few of these stars would make great hosts to an Earth like world, but most would be too large and hot, cool or unstable. Our galaxy has many more worlds than stars, with one estimate putting the total in the trillions. One in every five of these planets is estimated to be Earth-sized and currently orbiting inside the Goldilocks, or livable, zone of their suns where water remains liquid.

Just how rare is our planet? Consider our Sun. Habitable stars have internal temperatures from 3,700C to 6,700C. Our Sun, a G2 class star, is well within those limits at 5,500 degrees Celsius. Stars in this life-friendly range account for between 5% and 10% of stars in our galaxy[414]. But life-friendly is more complex than flowing water. Stars do not always burn cleanly. Flares can be hazardous to a star's planets if they do not have a strong protective magnetic field. Also, the habitable zone moves outward over a star's lifetime. That process leaves dried-up and burnt inner planets behind and thaws cold outer ones. For planets, there is also the risk of a nearby star exploding or as has already happened several times to our own, being hit by a massive asteroid.

A large geologically active satellite like our moon was essential for keeping our planet's outer core[415] and oceans moving via tides. Its magnetic field helped our world weather the solar storms that occur in the early years of a star's birth[416] without too much loss of atmosphere. Having a gigantic satellite, compared to Earth's size, has stabilised[417] our seasons. The moon gave creatures a reliable cycle of

414 See https://astrobackyard.com/types-of-stars

415 The Earth's mantle deforms elastically due to tidal effects caused by the Moon. This effect could continuously stimulate the motion of the liquid iron alloy making up the outer core, and in return help generate Earth's magnetic field, see The deep Earth may not be cooling down, Earth and Planetary Science Letters, 2016; DOI: 10.1016/j.epsl.2016.03.020

416 Lunar samples gathered by NASA's Apollo missions recently revealed that the Moon once had its own magnetosphere. According to this research, the Earth-Moon coupled magneto-spheres presented a previously unrecognised protective barrier against the solar wind for our home planet, sheltering its atmosphere from erosion by intense solar wind, ultraviolet, and x-ray radiation from the young Sun. This would have preserved the Earth's atmosphere, including water – When the Moon had a magnetosphere, Green J, Draper D., Boardsen S., Dong, C., Science Advances, 14 Oct 2020

417 Without the Moon and to some extent Jupiter our planet would have a tilt that varied up to eighty degrees, like Mars which tilts between zero and sixty degrees over time. Winters in particular would be longer and harsher and so glaciers would tend to expand towards the equator, allowing a narrower band for life to survive. For a discussion of recent con-

breeding, growth and rest. On some planets, summer and winter lasts for much longer and are more intense. That pressure would have reduced life to a few tough survivors. That is seen in deserts, where diversity is damaged by extremes of hot and cold. Along with the Moon, Earth's life depends on a rare chain of events. The earth has maintained its magnetic field and turnover of minerals, to support life, due to strong plate tectonics. That force constantly moves the rocks under the ocean and beneath our feet. It is a power that most[418] other planets lack. The movement of geological plates depends on the right quantities of long-lived radioactive elements in the crust[419], particularly potassium, thorium, and uranium. According to the recently developed science of cosmo-chemistry[420], these elements influence the development of rocky planets and are found in star nurseries enriched with radioactive materials. These minerals were made long ago before our solar system formed, generated by exploding[421] stars. Both radioactive heavy elements, and an oversized moon might be required for a living world.

The geological forces of life

There is a community of creatures in the rocks beneath our feet. The deep Earth has more life than scientists used to imagine. Despite great heat, meagre food, and the pressure, bacterial life endures. Earth's underground biosphere contains between 15 and 23 billion tonnes of living things[422]. That is about twice as much life as every species in the ocean. These creatures have affected Earth's geology. Along with deep time simple lifeforms like lichens that break up rocks have had a huge effect. But long before today's life, along with massive asteroid impacts[423], early life may have helped start continents moving by creating heavy iron layers[424]. These sunk quickly and deeply, disrupting the liquid rock closer to the core and making plumes of rising lava[425] more common. Iron-rich and sedimentary rock layers link ancient surface changes, such as the birth of photosynthetic life, to planetary processes, like volcanism and plate tectonics. Then the first tall plants changed not just the Earth's surface but also melting processes[426] in the Earth's mantle, the deepest layer under the crust. If that is confirmed then life is partly responsible for the volcanic extinctions that plagued later eras. As well as the death of many later species in the ocean[427] during the Devonian period. This entanglement of life and geology

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tributions between tilt and other factors in the development of ice ages, Persistent influence of precession on northern ice sheet variability since the early Pleistocene, Stephen Barker et al, Science 376, p961-967 (2022).

418 While no other planet in the solar system possesses plate tectonics, there is no physical reason why exoplanets around other stars couldn't. Venus is believed to have experienced signs of it, although its volcanoes were far more active, causing the entire planet to be resurfaced by volcanism. Mars never developed plate tectonics, due to its inability to hold enough heat in its core and mantle. Although it has some core activity.

419 Our solar system has a medium amount with some stars and their planets having only half as much as our solar system and others having more than double, see Francis Nimmo et al. 2020. Radiogenic Heating and Its Influence on Rocky Planet Dynamos and Habitability. ApJL 903, L37; doi: 10.3847/2041-8213/abc251

420 It includes among other things the study of the composition of meteorites and other solid Solar System samples aimed at explaining the origin of chemical matter in the Solar System and in the Universe.

421 Supernovae which are explosions of stars more than ten times as massive as the Sun produce vast amounts of dust. "*Analyses of carbon-rich dust grains extracted from meteorites show that these grains formed in the outflows from one or more type II supernovae more than two years after the progenitor stars exploded. This dust was then blown into space to be eventually incorporated into new stellar systems, including in this case, our own*" - Late formation of silicon carbide in type II supernovae, Liu N, Nittler, L.R, Alexander, C., Wang, J. Science Advances, 17 Jan 2018, Vol. 4, no. 1, DOI: 10.1126/sciadv.aao1054

422 Scientists identify vast underground ecosystem containing billions of micro-organisms, The Guardian, Geology, Johnathan Watts, Dec 2018.

423 Giant impacts and the origin and evolution of continents, Johnson, T. E., Kirkland, C. L., et al Yongjun Lu, R. Nature vol 608, pages 330–335 (2022).

424 Plate tectonics is thought to have become a well-established global process on Earth no earlier than around 2.8 billion years ago. Bacterial contribution to the formation of iron peaked about 2.5 billion years ago. See Links between large igneous province volcanism and subducted iron formations, Duncan S. Keller, D. S., Tassara, S., Robbins, L. J. et al, Nature Geoscience, 2023; DOI: 10.1038/s41561-023-01188-1

425 Or more properly magma, since it begins far below the Earth's crust.

426 Composition of continental crust altered by the emergence of land plants, Spencer, C. J., Davies, N. S., Gernon, T. M, Wang, X. et al, Nature Geoscience volume 15, p 735–740, 2022.

427 "*Our analysis shows that the evolution of tree roots likely flooded past oceans with excess nutrients, causing massive algae growth. These rapid and destructive algae blooms would have depleted most of the oceans' oxygen, triggering catastrophic mass extinction events.*" - Enhanced terrestrial nutrient release during the Devonian emergence and expansion of forests: Evidence from lacustrine phosphorus and geochemical records, Smart, M. S., Filippelli, G. et al, GSA Bulletin, 2022, DOI:10.1130/B36384.1

demonstrates why a gap theory of Genesis, based on a lifeless world cannot be correct.

Lighter layers containing water and organic sediments get pulled down into the planet's interior via oceanic trenches. Thick layers of sediment, including the remains of plants and living creatures, collect in ocean trenches. Along with sinking rock, these contain water and carbon that the process of subduction carries to great depths. The heat and pressure of these depths allows the crust to melt and magma to develop. In time this lightweight liquid rock with its trapped gases rises to the surface, generating volcanic chains but also assisting[428] with plate movement.

That is why explosive volcanoes are more common around such zones. Areas where the crust is being pulled down and recycled. For example the Pacific Ocean's infamous Ring of Fire volcanoes and island chains like the Philippines. Due to eruptions, some of this material will be returned to the surface as carbon dioxide, a key ingredient for growing plants. The living geology that powers Earth could be rare, but across our galaxy, there will be many Earth-like worlds and many that are less fortunate but could still support simple life.

By the light of exploding suns

"Space is big. You just won't believe how vastly, hugely, mind-bogglingly big it is. I mean, you may think it's a long way down the road to the chemist's, but that's just peanuts to space" - Douglas Adams

The Voyager One spacecraft was launched in 1977. It is the most distant man made object so far and still transmitting data. Unfortunately it was never intended as an interstellar explorer. Sometime around 2025, its plutonium-238 powered transmitters will send their last signal. So distant is this spacecraft that when its power runs out, radio telescopes on Earth will continue to receive its previously transmitted signals for more than 24 hours. As that last radio wave makes its way across space and back to Earth. As fast as this spacecraft is moving, it has not yet reached the point where the sun's gravity no longer dominates space. That boundary is about half the distance from our sun to the nearest star, which is Proxima Centauri. Travelling at a speed of over 61,000 km per hour, the remains of Voyager One will take more than 40,000 years to reach that halfway point and go beyond the sun's influence. Yet this is a distance of only two light years. Compare this with the distance to our closest galactic neighbour. This is the Andromeda galaxy which is 2,500,000 light years away. Then you begin to sense just how mindbogglingly large and far apart the stars and other elements of the universe are.

How do astronomers measure such distances? By waiting for stars to explode. When two stars orbit each other, they can trade material. In time, this will generate a star destroying explosion as material suddenly undergoes fusion throughout the oldest of the two stars[429]. The death of a white dwarf orbiting in a two star system, creates an explosion with known brightness. If you measure how bright a supernova is and you can observe how much of its light is reaching Earth, that gives a reliable way to estimate its distance. Since these supernovas are consistently bright, and occur wherever there are stars, they give astronomers a reliable measuring stick for the universe.

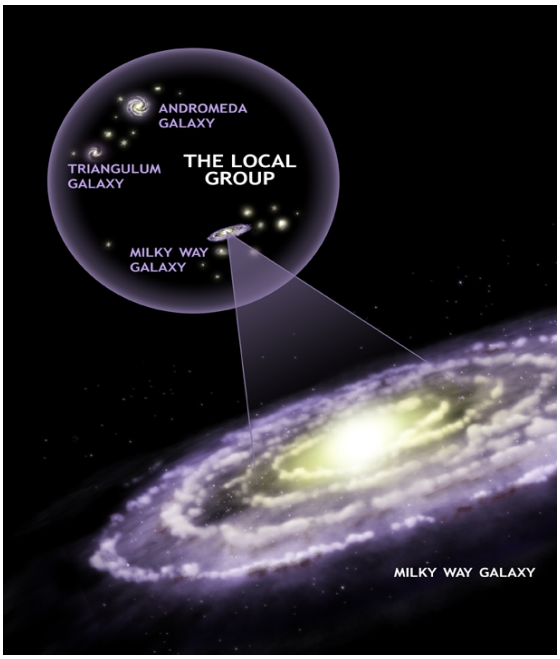
Unimaginable scales

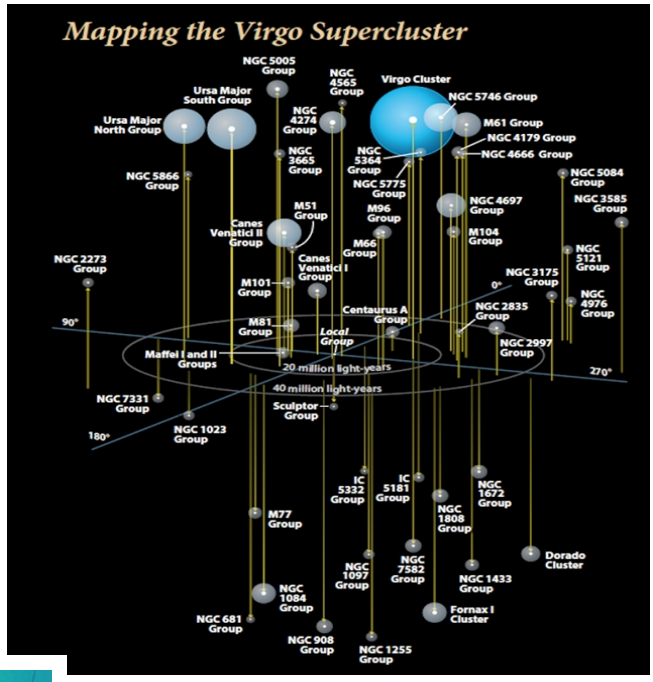
The Milky Way sits in its own region of the universe. Andromeda is the largest galaxy in our local neighbourhood, followed by the Milky Way at number two. Triangulum at number three, and possibly sixty or so, much smaller, dwarf galaxies spread throughout an area covering a few million light-years.

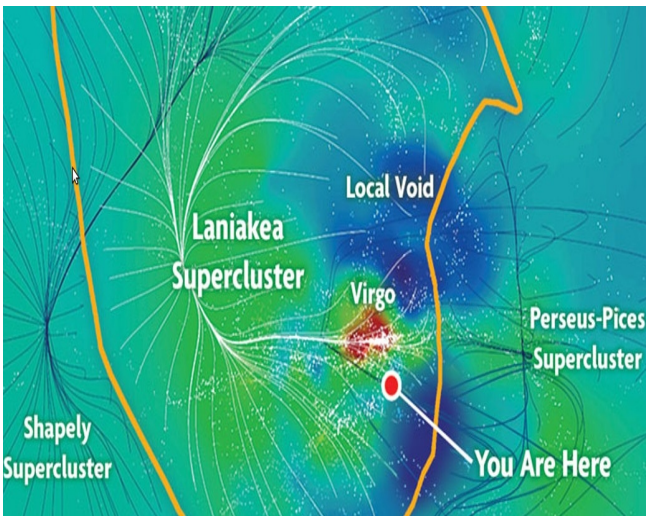
428 Seismic evidence for partial melt below tectonic plates, Debayle, E. Bodin, T., Durand, S., Ricard, Y., Nature vol 586, pages 555–559 (2020).

429 For this reason Type 1A supernova are known whimsically as standard candles. "*A substantial fraction of the carbon and oxygen in the white dwarf fuses into heavier elements within a period of only a few seconds, with the accompanying release of energy*" - one-A type supernova

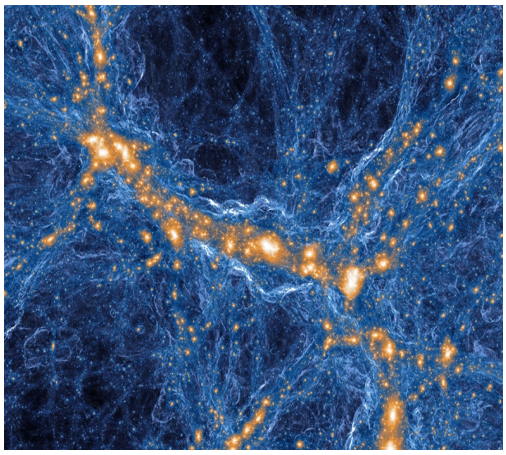
Galaxies are just the building blocks for larger structures called clusters. When these are linked together into groups they become superclusters. When you look up at the night sky or even at a map of nearby galaxies the distribution seems pretty random and certainly at that scale it is. Our local group is one of several modest groups in the area, including the M81 group, the Sculptor group, and the Maffei group. But the local heavy weight is the Virgo cluster with around a thousand galaxies the size of the Milky Way. This concentration of matter is so large it has drawn in many smaller groups, including our own, creating a supercluster. Zoom out even further and take a look at the Virgo supercluster in which our local group of galaxies is just one small dot at the centre. Then pull back still further because this is just one bump of matter. It is projecting out from a structure containing approximately 100,000 galaxies called the Laniakea Supercluster. Laniakea being the Hawaiian word for immense heaven. However, these vast structures will not last. If we trace their development in cosmic time as the universe develops they are temporary. They are like puffs of dust suspended in flowing air. They do not have sufficient mass for stability. They cannot resist the accelerating expansion of the universe. That force is separating all matter in our universe.







Yet superclusters are elements of even larger structures. These are cosmic webs of gas and galaxies stretching out across the visible universe.



On the previous page is a simulation of part of our local cosmic web[430] showing some of the voids and gas distribution pulled together by dark matter[431]. Where these cosmic threads cross each other, superclusters of galaxies form, leaving voids that are empty of gas and matter. In the image you can see superclusters picked out in white points and surrounding clouds of displaced gas in gold. These concentrations are of interest because they originated at the beginning of the universe. They are proof of quantum fluctuations when the universe was very tiny indeed[432]. I shall discuss that in more detail in the context of the proof that multiple universes exist.

Matter in the universe is woven together by these connected filaments of galaxies and gases, that also create enormous spaces between them. The Hercules-Corona Borealis Great Wall of galaxies, which is a whopping ten billion light years long and includes several billion galaxies, is the biggest of these cosmic fibres found so far[433]. If confirmed it would be the largest known object in space at around ten percent of the size of the visible universe[434].

Astronomers can see only a restricted region of space due to the link between distance, time and the speed of light. They can only see to the cosmic horizon, like a sailor looking across a calm sea from his ship. This horizon[435] is only 13 billion light-years in all directions. That doesn't place us at the centre of anything, its just a measurement of what's currently visible. What we can see, at that distance is visible because of the light from the first generation of stars. At this limit 46 billion light-years from Earth, the volume we can observe grows, increasing by six light-years every year[436].

Measurements show that the universe is likely much larger, than this visible region of space. How much larger is the surrounding universe? There's no upper limit but its likely more than 250 times the area[437] we can directly view. That can all make humanities concerns seem insignificant. Still though nature is vast, it is equally astounding that humans have the ability to map and study these patterns and structures in deep space.

It is intriguing that nature develops structures of various sorts at every size, with the greatest scales we can see seeded by concentrations left over from the Big Bang. Carry this principle to the next level and we can predict other universes. They could exist at the largest possible scale, but beyond direct observation by humanity.

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430 See also the IllustrisTNG project

431 One of the most startling truths in astronomy is that, despite steady progress, we still do not understand what most of the matter in the universe is. All the matter we can see—stars, planets, immense cosmic clouds of gas and dust, and even us, accounts for just 15% of the universe's stuff. Excluding the pure energy of light from the list, the remaining 85 percent of particles affected by gravity in the universe are made from dark matter. This mysterious substance is nearly undetectable since it does not interact with light, other matter, or even itself. Dark matter is one of the great mysteries in astronomy and is critical to understanding the universe's destiny.

432 See https://en.wikipedia.org/wiki/Inflation_(cosmology) and The most beautiful idea in science you've never heard of: Quantum Inflation, Will Franks, Aug 27, 2018, "The cosmic web is an immortalised fossil of one the earliest phenomena ever to occur in the universe, some unimaginably small random quantum fluctuations that occurred in the first 10−36 seconds after the Big Bang. An ancient imprint of the primordial universe. That modern physics has been able to make this vastest of connections is, surely, one of its greatest achievements."

433 Although some objections have been made to it being a single continuous structure, its discoverers maintain that it exists. Confirmation may have to wait for the THESUS mission. There are other known great galactic filaments such as the CfA2 Great Wall, and the Sloan Great Wall (SGW), discovered in 2003 in the Sloan Digital Sky Survey.

434 Which is about 90 Billion Light Years across, although the whole universe is somewhere between 250 billion light years and infinite in size, since measurements, so far, show that space-time is nearly perfectly flat, apart from insignificant things such as stars and galaxies which cosmologists tend to ignore at this scale.

435 Although limited in practical terms by expansion red-shifting the light from distant stars down to infrared wavelengths, which is why JWST has to be cooled down so much to view the early universe.

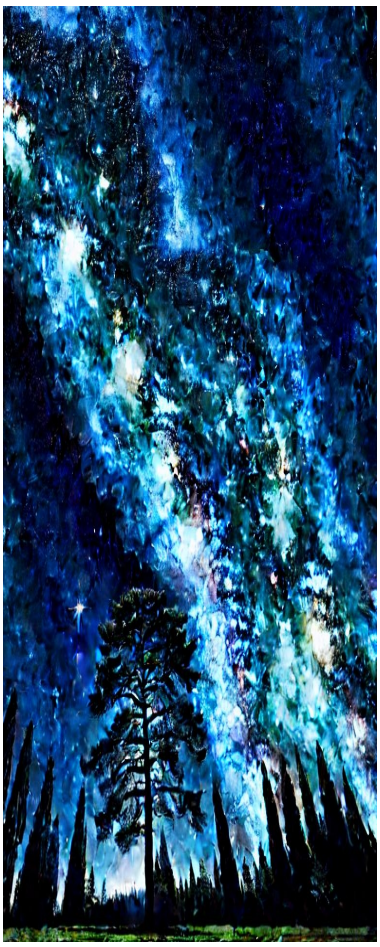
436 Not one light year per year, as you would expect due to the expansion of the universe.

437 Based on the flatness of space/time, i.e close to perfectly flat, and probable minimums of existing models

How stuff gets made

"Astronomy is older than physics. In fact, it got physics started by showing the beautiful simplicity of the motion of the stars and planets, the understanding of which was the beginning of physics. But the most remarkable discovery in all of astronomy is that the stars are made of atoms of the same kind as those on the earth." — Richard P. Feynman[438]

Planets and Moons



Astronomers learn about the oldest building blocks of our solar system using materials from asteroids and comets. Beyond our own solar system, we can see baby planets developing. They form from revolving discs of material that surround newly formed stars. These developing planetary systems are referred to as solar nebulae. That is a dense cloud of material in the process[439] of becoming a solar system, with a central star. T W Hydrae, is the nearest to Earth. It is located at less than one percent of the distance to the centre of our galaxy away from us, or 196 light years. Which is very close as astronomers measure our surroundings. Such discs are rich in water[440] like that of Earth's oceans. That ingredient is vital for living worlds. There are thousands of developing solar systems known[441] to astronomers.

The type of planets that form is determined by the composition of the stuff in the disc. The disc of material that created our own solar system was gathered together by gravity from different sources, and carries traces of several origins. For example, our planet was enriched with heavy elements like gold and radioactive materials from nearby neutron star[442] collisions. Light elements also show traces of our planet's origin. Our planet's core leaks a rare isotope[443] of helium. Its source is solar nebulae material that was exposed to high levels of radiation. That material was absorbed into the Earth during its early formation. It is now being carried to the surface by lava from sources close to Earths core.

Asteroids threaten life on planets but at the same time are the key to building new ones. Mature solar systems contribute to this process as their asteroids can be catapulted[444] into deep space at high speed. Also, a lot of material is left over from the formation of planets. On the larger end, at hundreds of kilometres or more in size, these objects are known as planetesimals. They exist in great numbers in the vast spaces between the stars.

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438 The Feynman Lectures on Physics Vol. I Ch. 3.

439 Not every solar nebulae generate planets, but planetary formation is a robust process that happens in most examples.

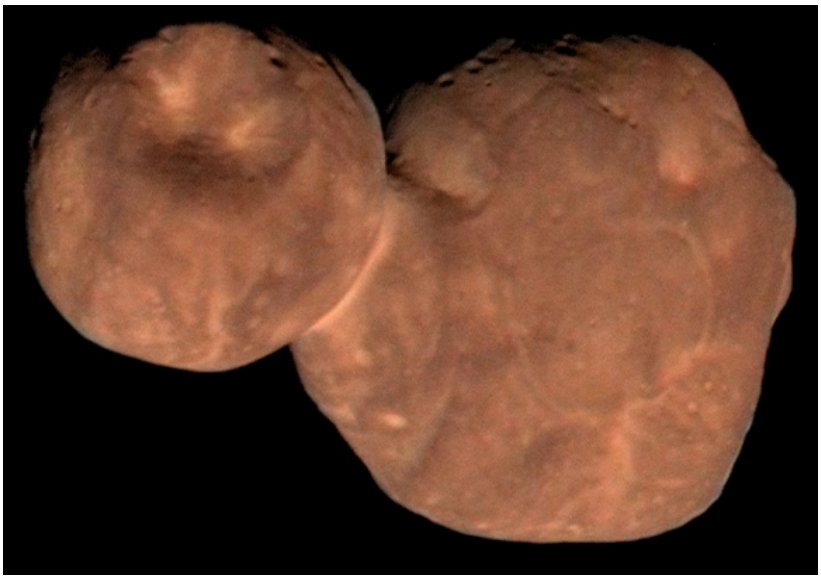
440 Astronomer at the University of Milan, Italy Stefano Facchini, was delighted by this recent discovery. "*I had never imagined, that we could capture an image of oceans of water vapour, in the same region where a planet is likely forming*". He led the study, Resolved ALMA Observations of water in the inner astronomical units of the HL Tau Disk, Feb 29, 2024, Nature Astronomy. Observations reveal at least three times as much water as in all of Earth's oceans in the inner disc of the young Sun-like star H L Tauri, located 450 light-years away from Earth in the constellation Taurus.

441 Many photos of solar nebulae, can been seen online, although more are known from the spectrum of the light they give off. That shows the elements present in the disc that will later be incorporated into its planets.

442 www.nature.com/articles/s41586-019-1113-7 - nearby neutron-star merger explains the actinide abundances in the early Solar System. Nearby is relative here as the merger would have been approx 1000 light years away.

443 Highest terrestrial 3He/4He credibly from the core, Horton, F., Asimow, P. D., Farley, K. A. et al. Nature (2023). This conclusion is based on high 3He ratio readings from 61 million year old olivine rocks sampled from Baffin Island lava's. This material is believed by geologists to come from a plume of molten rock partly originating from Earth's core. There is very limited 3He (helium-3) in the universe. It is generated and usually observed only in space.

444 Also entire planets, as binary star systems in particular are known to eject planets at high speed.



Arrokoth (above) is composed of two planetesimals 21 and 15 km across. It was found in one of the solar system's most distant regions, the Kuiper Belt, which is beyond Neptune. Its two connected halves contain dust and rocks but they are mainly mixed ice. They have not been heated or significantly altered since their formation and are still cold at minus 231 degrees Celsius. Astronomers believe them to be remnants of the planet's formation built up from a cluster of smaller icy bodies. Their components made up the solar nebula and built the solar system's planets and our star. They are still visible, as lumps in the texture of Arrokoth's combined body.

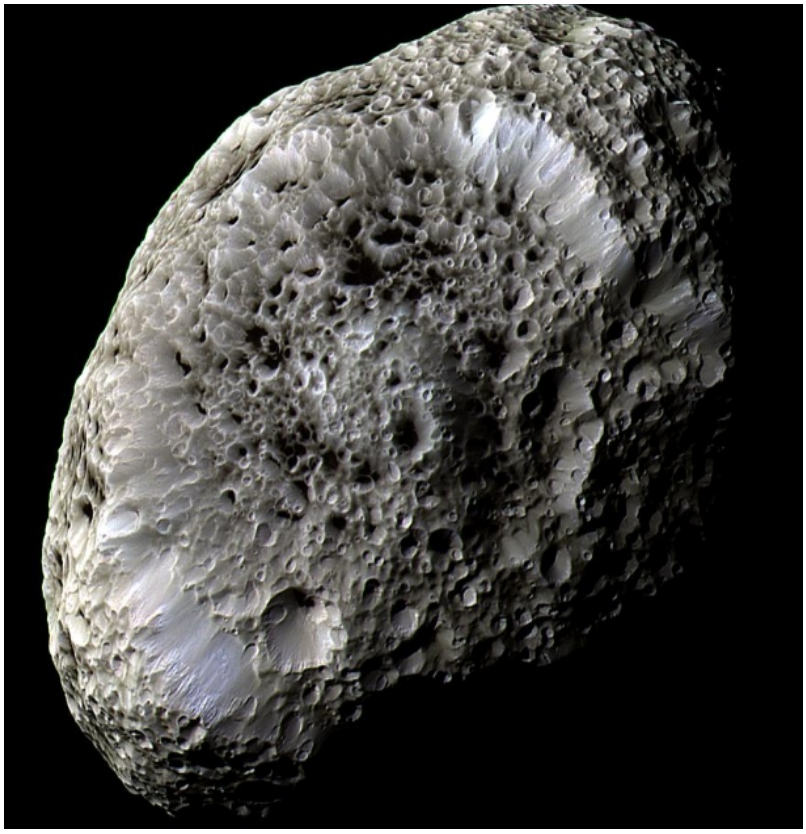
After wandering through deep space for long ages they will be captured by gravity or be included as part of a nebula. There, like an impurity added to super-cooled water, they seed the formation of planets. Their mass attracts drifting particles and larger chunks of matter. The process soon becomes unstoppable as the growing planets suck up all the matter in their orbit, leaving a visible gap[445] in the disc. Some of the material within Earth is likely recycled from these cosmic wanderers. It is expected that the average solar system forming disc will include at least 10,000 giant rocks from earlier solar systems that will be one hundred kilometres or more in size, and many more smaller objects. Across the galaxy, the debris of past planetary systems assist with future generations. "Every fresh generation of stars increases the abundance of interstellar objects through space."[446]

Mars is smaller and with less material compared to Earth and Venus. That is because Jupiter took up a lot of raw materials from that orbit, starving the region of planet building materials. Jupiter had moved inwards from its point of formation and was orbiting at almost the same distance as Mars sits at present[447]. At that time, the solar nebula was feeding the growth of the planets. Currents within those materials could still alter orbits. Such movements also help explain the makeup of the asteroid belt beyond Mars which is a mixture of icy and rocky objects.

445 Although other feature of the disc can create temporary gaps, flows within a disc are chaotic. They form vast circular rivers of material surrounding the growing core of a star.

446 "*Right now, within the orbit of Neptune alone, there could be around 10,000 Oumuamua sized interstellar objects*". - The Interstellar Interlopers, Annual Review of Astronomy and Astrophysics, Jewitt, D., Seligman, D. Z., Vol. 61, p197-236, August 2023.

447 While Mars had not yet formed at that time. Later gravitational interactions with Saturn drew it further out to its present orbit. See A low mass for Mars from Jupiter's early gas driven migration, Nature 475, 206 (2011)



Saturn's moon Hyperion[448]

Within our solar system most bodies, like Saturn's moon Hyperion as seen in the photo have a deeply cratered surface. It looks more like a sponge or a wasps nest than a moon. That is because it has no geological activity, so every impact leaves a scar on its icy surface. Hyperion is probably a remnant of a larger moon that was destroyed by an impact.

Our planet had a liquid rock ocean billions of years ago. The period was the Hadrian epoch, which marked the final stage of world and star formation in our solar system. Like the other planets, the Earth had absorbed smaller bodies in its orbit, eliminating most debris around it. However, Earth had a companion because extra material had been available. It was trailed or preceded at a distance of 400,000 km by a sister planet in a stable orbit. This planet, known today as Theia[449], was roughly the size of Mars with a similar dense makeup.

However, Theia's trajectory altered as other planets moved and material flowed around the solar system. Some of these changing gravitational forces pushed it out of its formation point[450]. Its altered orbit caused it to collide with the early Earth. The collision altered most of the Earth's surface, launching vast amounts of material into space. Once it cooled, along with Theia's rock, that became our planet's moon. Had Theia been much larger the impact would have created many smaller moons, rather than one large satellite.

448 Image from Cassini's close flyby on Sept. 26, 2005 - credit NASA/JPL-Caltech/Space Science Institute with enhanced contrast to better show the edges of the many craters that cover its surface.

449 Theia is named after the Greek Titan who gave birth to the Moon goddess Selene.

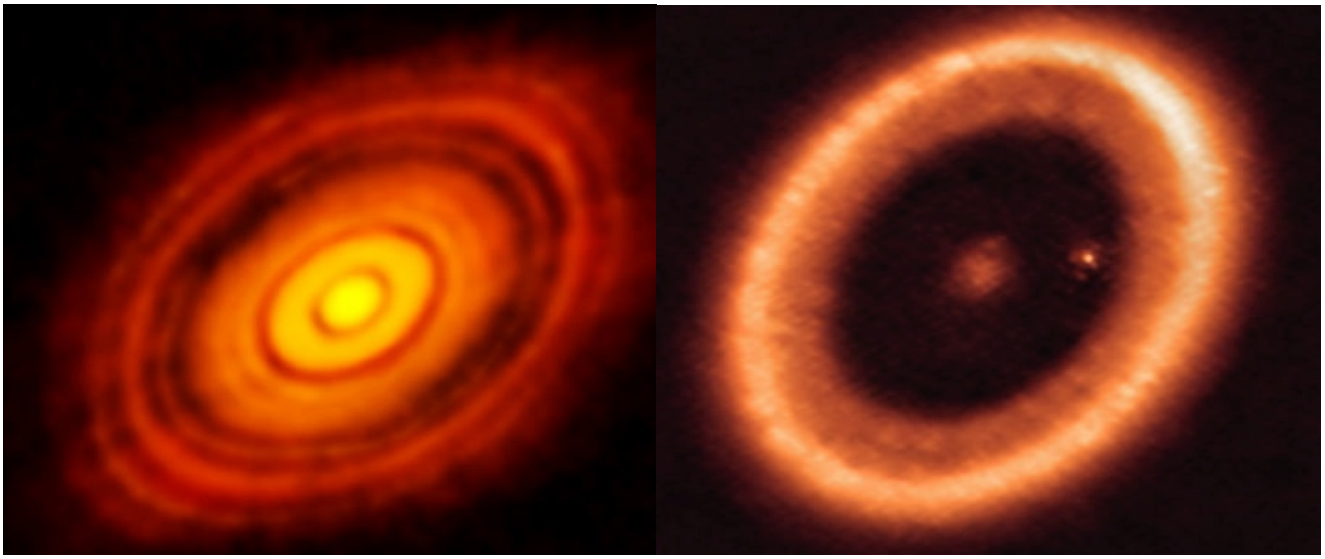
450 Theia probably coalesced at Earth's L4 or L5 Lagrangian point. These are regions of zero gravity with respect to the Earth-Sun system, effectively it was a gigantic trojan point asteroid.

The remaining material was absorbed into our planet including Theia's core. This scenario explains the differences in the moon's geological makeup such as isotope ratios and a lack of iron. Also predicting the increased velocities in the combined earth / moon system. Compared to the rotation and movement of other planets in our solar system. Scientists believed that any shards of Theia that remained on Earth were lost. The colliding fragments had been melted and completely dispersed by the tumultuous currents of Earth's geology.

However, some of them may have been located. Two giant blobs of rock can be seen deep beneath the Pacific Ocean and below the African plate. They have long been mysterious. Each of these unusual rock formations is within the lower mantle of the Earth, just above the core. They make up about eight percent of the Earth's mantle layer. Investigations show that these ancient collections of iron rich material are candidates[451] to be from Theia's middle layers. They're distinct and in plausible settings. They could penetrate deeply because the surface of the early Earth was a lava ocean after the impact rather than being solid as it is today. Material recovered from these heaps after eruptions has found an unusual isotope ratio compared to typical Earth rocks, but they are not original unchanged fragments. They are collected puddles of material that were melted and later concentrated. If confirmed, this discovery implies that the Earth still carries the remnants of its most significant impact. This first impact would have influenced our planet's development[452] since its origin. Earth's oversized iron core has been critical to defending life against space storms and replenishing the surface with new mountains as erosion wears them down. Our planet has more iron than can be accounted for based on its size. The difference may be the additional iron from the core of Theia added to our own. Other planets have geology and cores that are nearly dead or, like Jupiter's, dispersed. Future astrophysics and solar system exploration will determine whether Theia is the best explanation for the moon's creation and the rest of these discoveries.

451 Moon-forming impactor as a source of Earth's basal mantle anomalies, Yuan, Q., Li, M., Desch, S. J. et al, Nature 623, 95–99 (2023). Based on Theia's mantle and the Moon's greater iron concentration, the study concludes that these regions are fundamentally 2.0-3.5% denser than proto-Earth's mantle. Convection simulations reveal that following the impact, thick blobs of tens of kilometres in size could sink and gather into thermochemical piles above the Earth's core, where they would have persisted to the current day. These regions could represent a natural result of the Moon-forming massive impact. Because enormous impacts are widespread at the conclusion of planet formation, comparable mantle variations induced by impacts may be common in the interiors of other planets.

452 With effects that are yet to be assessed.



Left: image of HL Tau, a young star with a protoplanetary disc. This planet formation image shows several rings and gaps that reveal the formation of new planets as they clean their orbits of dust and gas. ALMA(ESO/NAOJ/NRAO); C. Brogan, B. Saxton (NRAO/AUI/NSF). Right: Circumplanetary disk around young planet PDS 70B, ALMA, Benisty et al. 2021.

Solar Systems

The orange wheel shape, with multiple rings in the photo on the left, is a solar nebula. It is in the final stage before becoming a solar system with many planets. In this photo seen from above the disc. Astronomers also referred to these structures as protoplanetary discs. Some half-formed planets are growing within this structure around the star. They are scooping up most of the matter in their orbit, carving visible gaps. This causes the darker circular tracks that you can observe in the photo. Around this particular[453] star, there are already two giant Jupiter sized planets. The picture on the right is a close up of a more developed system with a planet and its own massive disk. That is feeding the planet material and can be seen to the right of the central sun. Both of them are visible in the photo because they are glowing hot, although not as much as the protostar in the centre.

The planet's positions and materials have been identified by examining the spectrum of their light. At the centre is a newborn baby star, only six million years old. Also being built up by material from the disc. Over the last few years, space telescopes have photographed many planets that are still forming. The James Webb Space Telescope is examining many more developing disks and planets. Providing us with direct evidence of this stage of planetary development.

This disc and its star, and the other T Tauri[454] stars are proof of the way planets and stars form from a solar nebula. Forming solar systems are common in areas with the right conditions. For example, astronomers have found over 97 discs of gas and dust, many with new planets in the molecular clouds around the constellation of Orion[455] and even in other galaxies. Some of these systems are so young that their discs are irregular. With central stars that are not yet generating light by fusing atoms.

No special intervention is required for solar systems to develop. Only a collapsing nebula with materials of a sufficient density and the steady work of Newton's laws. An ice skater, doing a spin will pull in their arms tight against their body to increase their speed of rotation. In the same way, gravity will fuel rotation as part of a massive nebula shrinks. Rotation in turn will help form a planetary disc. From that point on, only time is needed for a solar system to come into being. How does the nebula collapse in the first place.

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453 Two accreting protoplanets around the young star PDS 70, Nature Astronomy, Letters, June 3rd, 2019.

454 T Tauri star: *"any of a class of very young stars having a mass of the same order as that of the Sun. They are known to have erratic changes in brightness. They represent an early stage in stellar evolution, having only recently formed by the rapid gravitational condensation of interstellar gas and dust. They do not have a high enough temperature to ignite fusion of hydrogen or helium and are therefore considered proto-stars."*

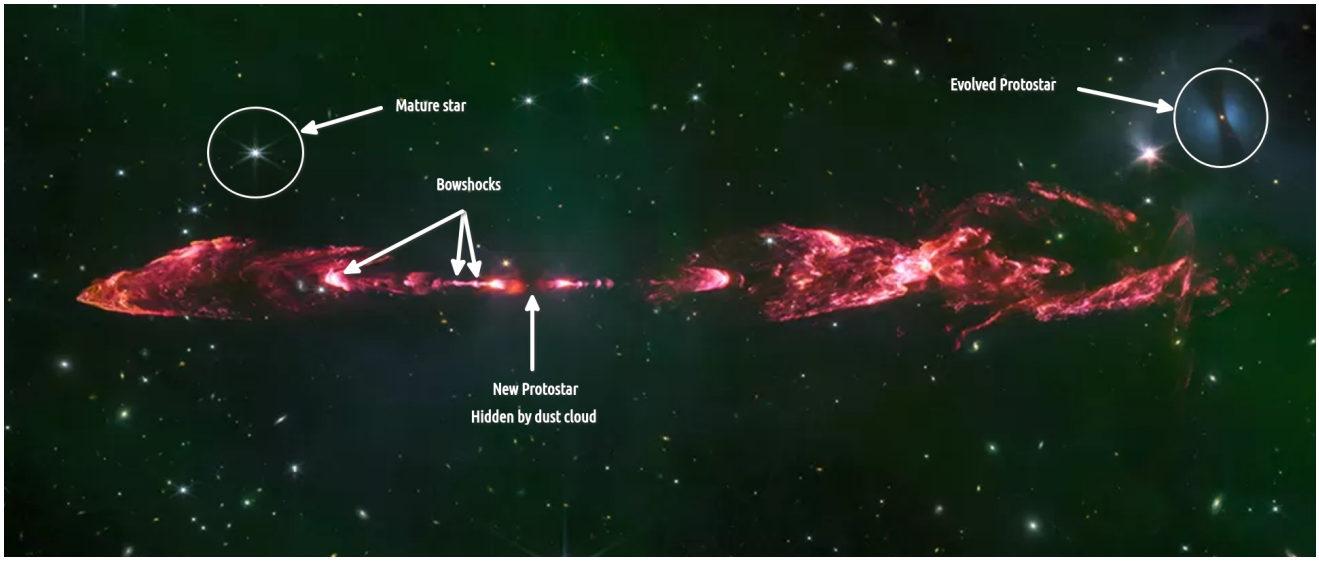
455 Patrick D. Sheehan et al. 2022. The VLA/ALMA Nascent Disk and Multiplicity (VANDAM) Survey of Orion Protostars VI. Insights from Radiative Transfer Modeling. ApJ, in press; arXiv: 2203.00029

Models show that a nearby explosion can push enough matter together for gravity to do the rest. Old stars provide flows of enriched heavy materials made in their cores. Their solar winds and eventual death are essential triggers[456] for the next generation. Solar nebula's compressed by the shock waves of a nearby supernova have been observed. This shows how the life of a star is a cycle, just like living creatures.

The Stars

The following image shows a baby star as seen by the James Webb Telescope. It is identified as protostar HH212. Like the previous example, it is in the constellation of Orion. It can be seen by telescopes near the three dazzling stars that comprise the famous hunter's belt. Although obscured by its birth cloud, it is extremely active, ejecting rivers of hot hydrogen[457] gas. This whole area is currently generating many new stars.

The enormous discharges of gas around every newborn star, are a natural consequence of the physics[458] of its birth. The bow shocks in the pair of jets[459] show where faster moving streams are hitting slower moving material and bunching up. They are vast, light years long streamers, much larger than our whole solar system. Forming planets have a lot of their material stripped away by ultra violet or x-rays from their parent star during this stage. This period of formation, is when planets can migrate inwards or outwards, or even collide. However, there is no life to experience any of this chaos, because rocky planets like the Earth are molten at this stage of their development. The energy from combining planetesimals fuels the heat of a growing planet and melts its liquid core. In turn, the core generates a magnetic field. Without this protection, life on the surface would be impossible even after it cools.



Credit – NASA / ESA / CSA / M. McCaughrean & S. Pearson

An older but still-forming star can be seen to the upper right. The shadow in front is its protoplanetary disc, which is still growing its solar-system. The star within, has developed enough to emit light, so it can be seen. It is no longer a newborn, but has moved on. It is entering the longest stage of a star's life. That includes generating nuclear fusion in its core, just like our own sun.

These jets are the teething cries of a young star. Jets can be dramatic, stabbing through the star's birth cloud. The baby star generates rapid and focused flows of material[460] in both directions from its poles.

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456 Insights on the Sun Birth Environment in the Context of Star Cluster Formation in Hub–Filament Systems, Arzoumanian, D., Arakawa, S., Kobayashi, M. I., et al, The Astrophysical Journal Letters, Volume 947, Number 2.

457 Molecular hydrogen in fact, made from paired up atoms.

458 They shed angular momentum via these jets, because mature stars can't stabilise until they slow their spin.

459 Also called Herbig-Haro objects should you want to learn more.

460 Seen here in infrared light translated into visible colours. Two other new born stars appear just above the source. All these stars are forming inside the birthing ground known as the Orion B molecular cloud complex, located only 1,350 light-years away within our home galaxy – Herbig-Haro Jet HH 24

These rivers of hot gas are still much wider than any planet. Their material is moving at hundreds of kilometres per second away from the star.

Solar nebulae do not last. After some time, the star at its core ignites with nuclear reactions like the one above. At that time, any remaining excess material will be pushed outwards. The star's solar wind pushes lighter materials outwards until they reach the distance known as the 'frost line'. At that point, the push of the particles in this stellar wind slackens, and lighter elements like gas and ice are easier for growing planets to retain. Beyond it, giant planets can keep their gas atmospheres. This is visible in the makeup of Jupiter and Saturn and beyond. The once gigantic disc will be blown away, if not already absorbed into a planet. Only a distant shell of icy planetesimals will remain, which Astronomers call the Oort cloud.
The rocky inner planets like Earth and Mars are found within the frost line. This cut-off is a few times the distance from the Earth to the Sun for smaller stars like our own. For giant stars, it may be twenty times that distance. The solar system's structure is chaotic in detail, but it developed under well-understood laws over a long time. The resulting planets fit a pattern of random events and developed under the present laws of physics.
Astronomy shows that the Big Bang and a period of inflation explains the history of the early universe down to the present. The making of complex elements in the core of stars is well understood. These are released into the universe by the explosive deaths of existing stars and their planets and from collisions. These are the elements and forces that have built our solar system. We are made of dust that is the ashes of stars. This is an elegant solution by an adaptive God. The best that can be achieved in a fallen creation. It is also a more useful and accurate answer than just shrugging our shoulders and saying, God just made it that way. This process is exactly how God makes the stars, in our universe at least.

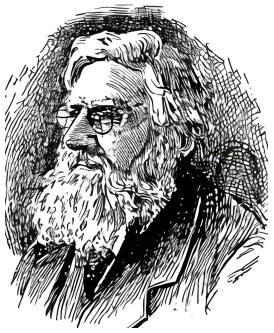
"The atoms of our bodies are traceable to stars that manufactured them in their cores and exploded these enriched ingredients across our galaxy, billions of years ago.. We are not figuratively, but literally stardust.[461]*"*

- Neil deGrasse Tyson

461 Image: Looking towards the heart of the Crab Nebula, the dust and gas remains of a famous supernova, Credit: NASA, ESA, CSA, STScI; Tea Temim (Princeton University). See also Carl Sagan – "*The nitrogen in our DNA, the calcium in our teeth, the iron in our blood, the carbon in our apple pies were made in the interiors of collapsing stars. We are a way for the universe to know itself. Some part of our being knows this is where we came from. We long to return. And we can, because the cosmos is also within us. We're made of star stuff*" - PBS TV series Cosmos, 1980.

Chapter 4 – Bridging Deep Time

A Cosmic Context



"Whether there be a God and whatever be His nature; whether we have an immortal soul or not, or whatever may be our state after death, I can have no fear of having to suffer for the study of nature and the search for truth" - Alfred Russel Wallace[462]

The size of God's creation in Genesis is a question worth considering. Does Genesis refer to the creation of only the Earth, our solar system, or the entire universe? Related to that, is our current creation alone or a component of a larger whole? Jews and Christians have offered varied responses to this question over the years.

I believe only the creation of a whole universe honours the intention of the Bible writers. They were unaware of the differences between planets, galaxies, and their stars. But they recorded God's revelation just as they received it. Christians can assume any events depicted to be truthful and factual unless proven otherwise. The creation week is God's description of his own actions. Not human myth making. Since it is accurate history, the creation of the stars is part of those recorded events. Including the stars implies a scale to the events of creation that we cannot ignore. As we observe them, the stars of this universe, have a long and complex history that is still unfolding. Our sun and its planets are part of those events. That brings us close to the heart of the central issue, of the Bible and deep time.

One of the several potential scopes for Genesis is a local one. That only Eden, a patch a few kilometres in size, was flawless. While sin had already polluted the rest of creation. As seen in the various gap theories. This Eden-only model can be ruled out. It would be against God's nature to make a flawed world unless events forced his hand. Also, this view is not biblical because God declares in Genesis that the completed creation was exceedingly good[463]. There is no hint of trouble, death or suffering until humankind rejects God. That leaves only two possible scopes for creation. One includes just the Earth or the solar system. The other is universe-wide, including distant stars and galaxies.

Why not just our galaxy or solar system? Both are a part of galactic history and share the same laws of physics. Other larger structures affect the fate of galaxies. Our galaxy is linked to others by hidden cords of matter, mainly gas, that fall towards it and feed its growth. The matter between can suppress star formation through shock-waves, draw galaxies together or separate them. Galaxies are like the bulbs on a string of fairy lights, seen in the night. They are bright but invisibly powered and joined. Mixed viewpoints, such as Genesis, covering the creation of only a few local stars[464] are not supported by scripture but also ignore science. Nothing in creation stands alone. Everything is connected and sustained by something greater.

Part of a wild galaxy

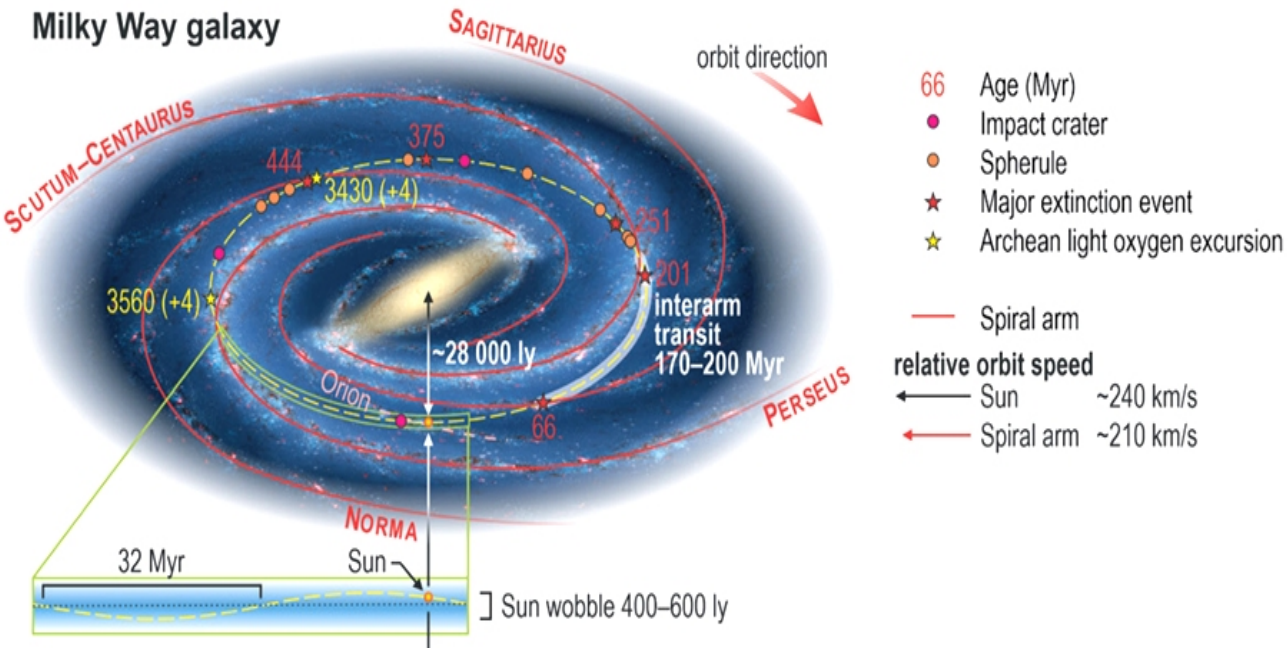
According to astronomers, our solar system has an individual history but remains integrated with its parent galaxy. As previously discussed, our star sweeps around the galactic centre and is currently

462 In a letter to his brother, 1861. Echoed by Thomas Huxley *"Science seems to me to teach in the highest and strongest manner the great truth which is embodied in the Christian conception of entire surrender to the will of God. Sit down before fact as a little child, be prepared to give up every preconceived notion, follow humbly wherever and to whatever abysses nature leads, or you shall learn nothing. I have only begun to learn content and peace of mind since I have resolved at all risks to do this".*

463 מְאֹד (Strongs H3966) – usually translated as exceeding / very good

464 Local is quite relative, as we can easily see stars with our own eyes that are 4000 or more light years away. In astronomical terms 'Local' could include quite a bit of our own galaxy.

within the undersized Orion[465] arm. Environmental changes, such as supernovas[466] have affected Earth during its galactic journey. It takes about 230-240 million years, also known as one cosmic year, to complete one orbit. As our star circles around it also moves vertically, dipping in and out of the galactic plane which contains most of the stars. Our star and its planets move faster around the galaxy centre than its arms rotate. We gradually overtake and pass through them. Just like a wind surfer racing ahead of incoming waves. Surfing the spaces between arms, then riding the next wave, before moving ahead.



Some researchers believe[467] that major extinctions[468], tectonic cycles[469] and periods of geological stability are influenced by the solar system's movement through the galaxy. Aside from these nearby events, the formation of our home galaxy[470] is just one part of the complex history[471] of the galaxy cluster we live within.

How does Christianity deal with new knowledge about the universe that is either difficult or shocking? Because we are focused on God's revealed truth, rather than abandoning past beliefs, we reinterpret existing models. Change can take decades, much like in science, where unsupported hypotheses die off as their adherents retire from teaching. It can be even slower for churches since written creeds lock organ-

465 The Orion Arm, or Orion–Cygnus Arm, is a minor spiral arm of our Milky Way galaxy. It is of interest primarily because our Solar System is inside it. Our spiral arm is some 3,500 light-years across and approximately 10,000 light-years in length. Inside the Orion Arm, the Solar System is close to the inner rim, within a low density region called the Local Cavity created by a number of exploding stars (supernovae). It is about halfway along the Orion Arm's length, about 26,000 light-years from the Galactic centre. (see also Orion Arm). References: Orbit of Our Solar System Through the Milky Way Helped Form Earth's First Continents, Did transit through the galactic spiral arms seed crust production on the early Earth, Kirkland, C. L., Sutton, P. J., et al, Geology, 50(11), Aug 23, 2022.

466 A supernova is the usual explosive end of life event for larger stars helping spread its material through the universe, although it can be triggered by other things such as an exchange of matter between pairs of stars. It may also help seed the formation of new stars. There is evidence that Earth has been within the danger zone of more than one of these astronomical explosions in the recent geological past.

467 Reconciling the Earth's stratigraphic record with the structure of our galaxy, Gillman, M, Erenler, H., Geoscience Frontiers, 10, 2019.

468 Aside from creating a surge in the number of impacts on planets, the spiral arms are the source of much of the cosmic rays that reach Earth since they produce many supernovae. Cosmic rays are known to cause DNA damage. Moving through an arm would amplify this effect, causing extinctions and speciation.

469 The Milky Way's Spiral Arms May Have Carved Earth's Continents, Hall, S, Scientific American Sep, 2022

470 In the form of collisions with dwarf galaxy's, activity of the central galactic bar and black hole etc.

471 The nearest galaxy to our own, Andromeda also shows signs of a recent merger, likely with a dwarf galaxy since there are plenty of those nearby.

isations into traditional explanations. If an understanding of truth is entirely fossilised, then only forming a new church permits mistakes to be revised or new explanations considered. That is an unhappy and drastic solution.

Where incorrect theories are cultural and not part of the Bible's fundamental principles, progress can be more rapid. For example, we reject traces of slavery, racism and sexist views of women since they are opposed to Christianity's core truths. The same can be true, if Christians revise their view of science along the lines I propose. Liberals can reaffirm the importance of creation and stop assuming its events are mythical. Conservatives can improve the quality of their witnessing, by taking all the evidence into account. Including that from nature, not just the Bible. Since the basis of existing creationism is an entirely different Greek faith, now long dead and flawed ancient logic, as well as doubtful research, then there are reasons to change their mind. It is essential that both sides not look away from scientific knowledge, complicated as it might appear.

We can see the effects of entropy and chaos on planets in our solar system and on those circling other stars. That shows that Genesis describes changes to everything in this universe. It represents the creation of a whole universe and how it was turned upside down at the fall of humanity. But what about the instigator, that promoter of rebellion, the devil himself? What did Satan want to achieve by tempting Adam and Eve to reject God? The Bible implies that he intended to use them as a power ploy and a shield from God's interference. He had reason to believe that, despite our guilt, God would still desire to safeguard humanity and that our failure would increase his power. That did occur since he was granted the authority to reign over all living creatures in this world[472] and over death[473]. As the god of this world, some of his principles replaced the original plans for this creation.

Not because God would purposefully create evil. However, the rules of life and energy would be open-ended and flawed. Living systems would deteriorate and compete. That allowed death and corruption to flourish. Lucifer sought freedom to use others for his own ends, and this selfish principle dominates all aspects of biology. The devil would enjoy the adoration of fallen humanity by setting up his own religions. Something that he had desired since the rebellion of the angels. To stand on the high places of the north and be worshipped. At the same time, the creator would only sometimes defend nature or prevent destruction, precisely as Job experienced.

Glory and separation

Human sin blocked Adam and Eve from remaining in a holy creation. The Tree of Life represented their love for God. Like the second tree indicating rebellion, it wasn't magical. It was just a typical tree, valuable for what it meant, like the ring on a newlywed's finger. After it happened to humanity, sin's most significant effect was a broken relationship, not a seismic shift in nature. But nature did have to change. Adam and Eve's task was to look after a small area of the creation, a play garden[474] for two newly made creatures. The glory of his presence, representing God's love and protection, might have kept them alive eternally. However, God was the keeper and guardian of their universe. He chose to create a separation not just spiritually but physically withdrawing his protection and light from his whole creation. That would have tragic consequences. He could have done something different. For example, purging everyone's memories and restoring their status with that implied deception. He might have decided to kill them immediately, taking back their life. Alternatively, he could have contained sin by preventing them from having children, making nature sterile. He punished sin in that way elsewhere in the Bible. There are many other possibilities. According to the evidence, separation is what the creator selected. Allowing Adam and Eve to live, under different laws and have space for children was now a problem. They would receive their inheritance, a living world, but stripped back to the es-

472 John 12:31 – Now is the time for judgement on this world; now the prince of this world will be driven out.

473 Hebrews 2:14 – Since the children have flesh and blood, he too shared in their humanity so that by his death he might break the power of him who holds the power of death—that is, the devil.

474 The biblical analogy is a royal garden which creates an inaccurate sense of excessive order and angels running around raking the gravel paths and clipping the roses. It must have been beyond our wildest dreams but was probably more rainforest than an Edwardian gentleman's country garden.

sentials. That is what awaited any species that chose rebellion. They got what they asked for, a life free from God's supervision, if not from his love.

That required a massive shift in the functioning of the universe. Until that event, God was present to shape every function of nature. A flourishing and inventive creation that only a loving Father could stabilise in harmony. Eden's universe was one of a vast multiverse containing living worlds, not any static or mystical perfection. Because of sin, God's intimate supervision of our universe would end. Therefore, natural law had to dominate and operate independently. Nature, divorced from God's glory, can function but at a great cost. Our universe's unfolding history shows the price of separation: imbalance, conflict and death. Extraordinary cold pitted against blazing solar fire, but on a few worlds, temporary havens for life.

We honour God as the creator and giver of all wonderful things. Traditional creationism confines the consequences of sin to this world. It has no explanation for how it affects every planet in our universe. Our universe is decaying, from massive stars to basic atomic structures. We must account for this profound truth because decay contradicts God's character. The solution is simple. The whole universe has fallen. The Shekinah[475] glory, the visible symbol of His active presence, directing nature, is withdrawn. Due to sin, entropy rules nature, no longer balanced by a living God and laws of loving grace.

The reconstruction of our universe due to the fall has no effect on our understanding of the Bible, the first days of creation or God's divine rest afterwards. The universe was without flaw as the days of creation occurred. Its laws were the same as God's own realms during the creation week. It was made complete from the first, unlike our own. It had the ideal balance that only a loving creator who had built many complete universes could construct. This original cosmos[476] was completed in six real days, just as the Bible describes. There was no working of natural laws to reach a stable condition. Nature would continue to diversify and explore its potential but was already mature. Today's Earth and our universe have little in common with such a magnificent creation.

The gift of human choice

The remade universe would be a balance of compromises. Decay and chaos would lead to suffering and death. So vast was this change that it required, in effect, an eighth day of creation. This is the best fit for what science has discovered. God remade nature in the image of the curse that humanity had chosen and stretched space and time to create them a new home. Species were no longer independent but required a web of relationships, built on death. Life forms struggled for a while and were swept away by uncaring forces. The remade universe was a lifeboat to keep humanity alive after sin. A boat drifting on a wild sea. That is precisely what the scientific evidence shows to be true. Everything from atoms to humanity obeys the most fundamental law: "Thou shall surely die".

Suppose the present universe is just as God intended it to be. If unleashed entropy and chaos represent God's character, then the creator belongs equally to the light and the shadows. Against all of Jesus's teachings, God is partly love but also death. Equally, if nature is bound to an unalterable future determined before creation, doomed from its first moments, the creator is not the God of the Bible. God respects our freedom and that of nature itself. Our God sacrificed his own life to rescue us. In the future, he intends to recreate nature with better laws. The new Earth being the seed from which a cosmos full of life grows in time[477]. The infinity of a universe with all its stars can be contained within other larger infinities. Our universe is one of a family of universes. Such a collection of universes, is also known as

475 God's presence can be felt in a variety of ways. The divine glory is God's visible presence. Even though humans are generally blind to spirits, it floods a person or location with light that everyone can see. Examples include the light seen at Jesus's transfiguration, the splendour of his second coming and the wilderness pillar of fire. The Hebrew word glory has a root, that when translated, means weight. Later writers, however, use Shekinah when referring to God's unique splendour.

476 Cosmos is used here in the sense of an ordered planned creation, but I will usually refer to universes, given that the orderliness of our own universe is doubtful, and referring to 'cosmoses', or 'cosmoi' is obscure and awkward.

477 Since in a living world without death, infinite space to allow for natural population growth is a basic requirement.

a multiverse[478]. Current astronomical theory strongly suggests that a multiverse exists. The whole of God's works makes up an interconnected structure linking every creation.

My proposal combines an accurate Genesis with our universe's long-term physics, biology, and deep time. That solves most of the problems that science identifies in traditional Christian beliefs. It avoids any conflict between the ages of the planets and stars and a seven-day creation week. God caused time to accelerate[479] throughout the universe to allow this to happen. That is compatible with the shifts in time that the special and general relativity theories make possible. Under the laws of sin and death, the remade universe was just a rough sketch. Its elemental forces were unbalanced, splitting from a point of unified pure energy. It lacked stability or even matter until time could balance its raw fury. God sped up[480] time from this compacted, fiery beginning to give us the universe we see today. Science identifies this event as the Big Bang.

This shift in time allowed the remade universe to develop into a survivable state with stars, planets, and a stable ecology. This planet formed where Adam and Eve might spend the rest of their lives. Eden was the only place unaffected by this rebuilding, and they were protected there as nature changed, only to be released into a creation totally different[481] from their previous home. Nature is scarred, yet God placed a promise within the darkness. Our Earth[482] echoes the lost universe of Eden; beauty and resilience are written into nature's laws. Life struggles and fails but finds a new balance in time.

Traditional creationism's focus on just one planet is not just wrongheaded. It is nonsense, given what we have discovered about natural law. The frequent use of miracles to repair broken creationist models and save a young Earth is absurd. As C. S. Lewis said, "You may attribute miracles to Him, but not nonsense[483]".

We should believe in a God great enough to make universes better than our flawed one. Marcos Torres, writing in the Signs of the Times,[484] agrees. Accepting multiple universes magnifies our ideas about the Creator, "*I found the multiverse idea, if true, merely adds to God's Majesty. He is a being so incredible that he sustains not merely our observable universe but a host of other universes.. That is who the Creator really is – a God of endless awe*".

478 The term multiverse here refers to many universes with differing laws as generated by cosmic inflation rather than the many worlds interpretation of quantum physics. While other inhabited worlds and observers 'watchers and holy ones' were seen in vision by various prophets their physical location remains unknown.

479 Compared to events elsewhere, see my discussion of the multiverse and its relationship to the Big Bang and creation.

480 As noted elsewhere calling it acceleration may not be meaningful, another equally useful way of thinking about it is that other universes timelines do not map lineally to our own. See also the physics of wormholes.

481 Yes this includes all the astronomical history of the standard model including the Big Bang, and depends on it. This model explains <u>all</u> of the science. Eden itself was removed from the Earth at some unknown time, see indications of it's presence within Revelation.

482 Although the first version of our solar system had its own moon, this was different to our present one which is the result of a massive collision during the Hadrian era. It is likely that life bearing planets need the presence of a large moon for several reasons.

483 C. S. Louis, The Problem of Pain, p379, writing of square circles etc but the principle also applies to breaking universal laws to make a single fallen world.

484 November 2021, p26-30.

Resiliency

"The hardest choice I had to make in my early scientific life was whether to give up the beautiful puzzles of quantum mechanics, and cosmology for something equally arresting.. What finally pulled me over was that the theory of natural selection was itself such an extraordinarily beautiful and elegant inference engine. Wearing its theoretical lenses was a permanent revelation, populating the mind with chains of deductions that raced like crystal lattices through supersaturated solutions. Even better, it starts from first principles such as set theory and physics, so much of it is non-optional" - John Tooby

That other Darwin

In a study by Newman University, about one in three Canadian atheists and nearly one in five UK atheists believe that evolution cannot explain human consciousness. This result shows that rejecting God's existence does not automatically lead to an acceptance[485] of science. In the same way, evolution by itself does not lead to rejecting God. Most believing scientists are comfortable with long-term Evolution. They accept it as God's way of making new life in our universe. It is an essential biological process because the laws of biology are both chaotic and competitive.

Traditional Creationism tends to describe modern biology poorly, with many misunderstandings or wrong information. It is also treated as a competing faith, so creationists refer to 'Darwinism' as if it were some rival cult rather than a term only historians would use.
There is a significant difference between the terms 'evolution' and 'theory of evolution'. The first is merely changes in the biology of groups of creatures. This was a fact which was already well-known in Darwin's grandfather's time. Although no human has ever directly witnessed historic changes, the fossil record and a wealth of additional data confirm that genetic change happens all the time. The second explains how that pressure to change has grown the whole tree of life across vast periods. If you confuse the two, you won't understand most modern biology. The first is a fact. Something that farmers and biologists observe happening every day.

The second is science's best model of the effects of genetic forces on groups of creatures. Just some of these many pressures include: competition, cooperation, sexual selection, mutations and random genetic drift, local geography, climatic changes, epigenetics and regulatory networks, interspecies cross-breeding, disease and genetic parasites, major extinctions, etc. All being applied to life over vast periods. The Theory of Evolution could be defined as a developing model of how species' survival and reproductive rates vary, resulting in long-term change. Fitness is a short description, but rather than classifying creatures as more or less fit, biologists are most interested in predicting how many children and grandchildren they can have under specific conditions. In that technical sense species only compete in an abstract way and can just as easily coexist or support each other. This model of natural biology explains the details of fossil discoveries and why creatures have changed in particular ways over time. Many things contributed to life's present state. Some of them were more important than others or were random. God determined some aspects, with universe wide laws but the truth of biology is: life has never been static. Due to sin and decay, it must continue to adjust[486], or risk extinction.

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485 See sciencereligionspectrum.org/about-2/ and blogs.scientificamerican.com/observations/how-many-creationists-are-there-in-america. Also for the first time in 2019 people with no religion are at equal numbers with the largest faiths. The failure of religion to address the meaning behind scientific discoveries is I believe a factor in this change. Faith becomes much less relevant if it locked away behind a pre-scientific worldview.

486 Co-evolution or the idea that most competition comes from related species sharing an ecological niche as well as a changing environment makes sense. After all they have similar needs and adaptions. This is known as the Red Queen hypothesis from a footrace in the storybook Alice in Wonderland where the participants did not seem to be moving. As the character of the Red Queen explained they were forced to run, as fast as possible, just to maintain their place. "*biologists think of the Red Queen hypothesis, not only as an explanation for sex, but also as a means of explaining rapid evolutionary change in hosts and their parasites in general.*" - Royal Society, Revisiting the Red Queen, 2014.

Erasmus Darwin, was an unorthodox thinker and long before Charles' birth, he developed his own ideas that explained changing species. Although he was aware of fitness as an explanation,[487] he was closer in his views to French naturalist, Jean-Baptiste Lamarck than his grandson Charles. His ideas were referenced in his poem of 1802, The Temple of Nature:

Organic life beneath the shore-less waves
Was born and nurs'd in ocean's pearly caves;
First forms minute, unseen by spheric glass,
Move on the mud, or pierce the watery mass;
These, as successive generations bloom,
New powers acquire and larger limbs assume;
Whence countless groups of vegetation spring,
And breathing realms of fin and feet and wing.

"*would it be too bold to imagine*" he wrote in his book Zoonomia "*that all warm blooded animals have arisen from one living filament which the Great First Cause endured with animality, with the power of acquiring new parts, attended with new propensities .. Thus possessing the faculty of continuing to improve by its own inherent activity*". In a different section of the poem, he showed an understanding of the great suffering built into biology, "*Air, earth and ocean, to astonish'd day. One scene of blood, one mighty tomb display! From hungers arm the shafts of Death are hurl'd. And one great Slaughter-house the warring world.*" This was the cause of the evolution of species, as Erasmus understood it. The mechanism of change was built into the animal's design by the creator. A divine drive to improve and learn from experience and conflict. Then, they pass on those improved skills to their offspring.

Nature struggles and as it does so the environment shapes it. However, the laws of genetics rule out species improving themselves through daily experience. His explanation was clever but on the wrong track[488]. There was a superior explanation waiting to be discovered. Many years later his grandson Charles would identify some of the essential biological laws of living things and write the Origin of Species. Charles did not choose to discuss when these laws came to exist and why. This is a pity because his sensible and moderate approach might have prevented a lot of later conflict. A Theology of Species might have become essential reading[489] for Christians.

Self-balancing Ecosystems

The food web in the ocean possesses a terrible beauty despite being based on feeding arrangements where each creature lives off those below. For example, the gigantic armoured predator Dunkleosteus[490], the most well-known placoderm. With massive bone plates that make up the skull and jaws and some individuals estimated to have reached lengths of 10 metres or more, this ancient fish was likely a top predator of its era. Its advantages were that, like fish, it possessed a flexible spine that

487 He wrote "*The final course of this contest among males seems to be, that the strongest and most active animal should propagate the species which should thus be improved*" so he seems to have been aware of the concept but not given it much weight compared to self improvement in individuals.

488 Until the discovery of the importance of Mendel's laws at the start of the 20th century, no one understood the mechanisms of heredity, and Lamarckian inheritance was a reasonable hypothesis. However, Lamarckian inheritance, at least in the sense Lamarck intended, conflicts with genetics findings and has rightfully been discarded.

489 As cheekily suggested in The Science of Discworld Vol III – Darwin's Watch, In spite of nearly becoming a Church of England priest earlier in his career writing 'Theology of species' was unlikely. Especially given Charles' Unitarian religious background, which has been aptly described as 'belief in a maximum of, at most, one God'. Charles was a gentleman and a humble person who tended to avoid verbal conflicts. He was too reserved for any theologising and would probably have thought it an intrusion into those other fellow's area of expertise. Besides, he had all the religious controversy anyone could handle from writing the Origin and its delayed second half, The Descent of Man, and Selection in Relation to Sex.

490 Image credit, a rendering of Dunkleosteus terrelli by Julian Johnson-Mortimer (CC BY 3.0). Some reconstructions suggest they were shorter than this rendering, basically a gigantic mouth with a tail, which is equally terrifying.

allowed for quick turns. It also had strong jaws[491] to cope with its armoured prey and any rivals. It was more than a match for the first sharks that lived beside it. Unfortunately, its considerable bulk and energy requirements made it ravenous for oxygen. Sadly, this species perished in the second of life's great extinctions[492] when ocean oxygen levels suddenly dropped.

The early predator Dunkleosteus terrelli, and size vs a human

Is it possible that nature's elegant balance is the devil's workmanship as an alternative to God? Such ecosystems are too sophisticated and abundant to have evolved independently in just a thousand years. So that seems like the only alternative. For long-lived creatures, the time from creation to the flood when they were fossilised would have been, at most, a couple of generations, not sufficient time for natural forces to have any effect[493]. There is not enough time in a few thousand years of minor adaptions. It could only be due to a major shift in nature after the fall. God allowed finely constructed natural laws to create many ecologies, each in turn sheltering life for millions of years at every location on Earth's surface. A dynamic balance for an unstable, predatory world. In contrast, just like a planned economy, a handmade ecosystem fails as soon as the environment changes.

491 Movable jaws were a new innovation at the time, unlike sharks Dunkleosteus had sharp bone ridges not teeth.

492 The Netflix series 'Life on our Planet' does an excellent job of bringing Dunkleosteus back to life on screen and profiles many other species and scientific concepts I discuss.

493 The current record holder is a kind of clam the Ocean Quahog which can live up to 500 years or more by growth ring count of its shell, but there are many others. For example the Greenland Shark is slow to reproduce and can live for more than 300 years, which would mean only a couple of generations for it to evolve into a predator's niche between creation and the flood.

God set up natural laws to create diverse living things over long ages. So he cannot be held responsible for random flaws. Suffering is unavoidable because nature is free but also fallen. Any species that lives off others, and adapts, will cause suffering in its prey and, in time, become food for others. Plants are going to develop poisons, and insects grow stings. That contrasts with the notion that God created everything by hand, although almost all creationists have given up on that idea. Years ago, the concept that God created broad Kinds of creatures and gave them the ability to adapt, quietly replaced the idea of unchanging species[494]. Creationist's adopted Darwin's views[495] because the evidence gave them no choice[496] but tried to limit evolution as much as possible.

You may believe that God hand-constructed, and set in stone each creature's instructions as Aristotle imagined. A particular set of genes for a given role in nature. However, nailing down genes in that way would have resulted in more misery and death. That is what happens when creatures become over-specialised in a single way of life. When things change, they go extinct. God has given species the best chance of surviving by equipping them with the capacity to alter their instructions given enough time, and by necessity there is no limit to that ability. However, it is a slow process that requires a species to cycle through hundreds of generations, because it is driven by indifferent forces rather than managed by a loving creator. Yet macroevolution is still God's gift to his only fallen creation. It is biologies' defence against the assaults of chaos and decay.

Defending against sin and death

Complex ecosystems where species can transform over time and are interdependent reduce suffering. Creatures benefit most when a balance is maintained. Consider the reintroduction of wolves to Yellowstone Park in 2011. The wolves' return was a tiny pebble starting an avalanche of changes. Initially, prey animals like elk, had a terrible time. Their numbers in the park dropped. Unexpectedly, as wolf numbers increased, positive effects were seen, such as on the native vegetation, like the willows that the elk had been destroying through overgrazing. Wild animals like beavers recovered, as they depended on these plants. In turn, more beavers helped to renew the waterways. The park's rivers started running slower and cleaner.

Then scientists noticed that the prey species like Elk were recovering as a new balance with the wolves was reached. The herds were smaller and more vigilant but much healthier, as old, injured and sick animals were the easiest targets. They learned techniques for avoiding the wolves, such as feeding in less open country and relocating frequently. The wolves quickly found that healthy, fast moving groups of Elk are tough to attack. Elk numbers have increased to three times the levels seen before the wolves' arrival in the last few years, yet without environmental damage. Many additional species benefited, in-

494 Ironically this leaves traditional creationists arguing against their previous statements, they have moved from Evolution cannot make anything new that is useful, to proposing that Evolution has superpowers that will create vast numbers of related new species overnight. Although they are probably saying both at once, because logic is less important than muddying the waters.

495 Charles Darwin is frequently portrayed as a self-sufficient thinker, but he was not an isolated individual theorising alone. According to Dr. John van Wyhe, historian of science, at the University of Singapore. He was "*an expert of his time building on the sophisticated science and studies and other knowledge of thousands of people. Indeed, the size and range of works in the library makes manifest the extraordinary extent of Darwin's research into the work of others*". His synthesis of their work was groundbreaking, but his theory was built on the efforts of countless scientists.

496 Darwins insight that competition works to stabilise new species is demonstrated by one of biologies longest running experiments. "Landis et al. studied the dynamics of adaptation using data from composite cross II, a common garden experiment in barley that began in 1929 with all possible crosses from 28 diverse varieties. They found that genetic diversity quickly decreases, with about 30% of the genome essentially fixed and about 60% of progeny descended from one parent line by generation 50." - Landis, J. B. et al, Natural selection drives emergent genetic homogeneity in a century-scale experiment. Science, 12 Jul 2024, Vol 385, Issue 6. Death and competition does weed out the unfit but benefit the species. Fortunately environments are always changing and there are many equally optimal niches for life, so this process can build ecosystems.

cluding ravens[497], eagles, magpies, coyotes and bears. Studies of reef ecosystems show that the number of large predators such as sharks is the best predictor[498] of the overall health of an area of ocean.

Consider the significance of that, death and suffering was going to exist in any event because of Adam and Eve's choice. So God in his wisdom, has enabled animals to adjust their functioning in large and small ways in order to fight back. To strike a difficult balance across the knife edge between life and death.

Even though this reconstruction method is far from ideal, it is still better than rigid alternatives.
Set up a particular environment, with energy levels, rainfall, rocks and soil, and the rest, and you define the lifestyles into which species will try to fit. Creatures with the same roles in nature will develop similar capabilities and appearances,[499] using different genetics[500]. In this way, God ensured that the environment and lifeforms would match human needs,[501] and equipped with technology such as portable use of fire, animals would not threaten human existence[502].

Rewilding Humanity

The help given to Adam and Eve after the fall is like a species that has gone extinct in the wild, being reintroduced from a zoo population. Settling them on a protected island is a standard method. An isolated environment can be tailored to the creature's requirements. Our world is humanity's island. Like all islands, it is more vulnerable to chaos than we think. Some argue that there is no proof of God abruptly changing our world or creating new families of life. That is expected. Species will develop spontaneously since He incorporates creative power into the environment via its laws. However, when ecosystems collapsed, some guidance may have been required.

Given that this was God's goal, we do not need to be uncomfortable with large-scale biological changes. Such changes are essential. God is not dictatorial. Even our flawed world has an open future where species can freely develop. There is freedom for experiments and even significant surprises. Life's ever-expanding diversity is part of the original laws, which carry over to the present. At the same time, he has permitted local and even worldwide extinctions, a side effect of chaos.

Instead of remaking the universe, did God change just life on Earth while leaving the rest untouched? We have proof from the Bible, astronomy, and physics that the change was much larger. In particular, we see the effects of increasing entropy, one of nature's most fundamental laws. Instead of placing limits on our creation model, we should be confident of God's infinite power! Certain, that He can create more than one universe and overhaul existing ones.

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497 It turns out that the Indian legends of ravens following wolves are true. They do follow them because wolves mean food. More information here www.yellowstonepark.com/things-to-do/wolf-reintroduction-changes-ecosystem

498 See The Importance of Marine Predators in the Provisioning of Ecosystem Services

499 "*A key question in evolutionary biology is the reproducibility of adaptation. This question can now be quantitatively analyzed using experimental evolution coupled to whole genome sequencing*" - The Reproducibility of Adaptation in the Light of Experimental Evolution with Whole Genome Sequencing. - Achaz G., Rodriguez-Verdugo A., Gaut, B.S., Tenaillon O., 2014, Ecological Genomics. Advances in Experimental Medicine and Biology, vol 781. Springer, Dordrecht.

500 Studies show that for similar selection pressures, populations will often produce convergent outcomes. However most convergent adaptions are in lifeforms that already have complex body plans, i.e. in the Eumetazoans. Given complex bodies as a starting point the ecosystems of the creation week are quite broadly defined and therefore probable. Apart from humans, there are birds, cattle ie domesticated animals, fish and small ground creatures. Its an excellent bet that any form of adaption working over long ages would generate lifeforms that fit those same general categories. Directed evolution in labs has been widely applied for protein and bacterial engineering and it demonstrates the principle that species converge on similar patterns of life based on their diet.

501 Genesis 9:2 – *The fear and dread of you will fall on every living creature on the earth, every bird of the air, every creature that crawls on the ground, and all the fish of the sea. They are delivered into your hand.*

502 This is different to design, machines are engineered, but nature grows. Other species do represent a risk but are not an existential threat to humanity.

Above is a photo of a cosmic collision known as the Antennae Galaxies. The shock wave[503] from the impact caused a starburst of new suns to be born, seen as blue stars. At the centre is a hot gas cloud which is all that remains of the dwarf galaxy that collided. More than just a radiant astronomical image, it also shows that the universe has a deep past. Since this is the way galaxies, including our own grow, they experience many collisions in their lifetime and show visible scars and bumps. Collisions can result in an elongated galaxy with two cores[504] or other distorted shapes.

A Scientific Genesis

"The Bible's message must not be subjected to cultural imperialism. Its message transcends the culture in which it originated, but the form in which the message was embedded was fully permeated by the ancient culture. This was God's design and we ignore it at our peril." - John H. Walton[505]

Making a whole universe.

The author of Genesis intended to describe the creation of a whole universe, because phrases such as "*and He created the stars also*" and Nehemiah 9:6 "*You made the heavens, even the highest heavens,*

503 Central black hole collisions are the most likely cause of the long wavelength gravitational waves first detected in 2023 using pulsar timing arrays although they could be relics of the Big Bang. Impacts and starbursts can also render large regions of colliding galaxies uninhabitable due to radiation from an active core black hole, or ultra-violet light from new stars in a galaxy undergoing a starburst. Starburst events in turn are due to impacts from shock-waves or an influx of new hydrogen gas.

504 Like the double nucleus found in Galaxy NGC 4490

505 John H. Walton is an Old Testament scholar and Professor at Wheaton College, the quote is from his book the lost world of Genesis One, 2009, p21. This principle does have limits, for example taken to its logical conclusion it could make any revelation wholly restricted to the prophets own knowledge and culture, ie entirely fact free in the case of Genesis. But it should rule out Biblical dinosaurs, Genetic manipulation by pre flood humans and other fantasies.

and all their starry host, the earth and all that is on it.." appear frequently in scripture without isolating any part of the universe or changing the timing of Genesis. A complete creation respects the Bible's culture in a way the gap theories do not. Many commentators also agree that the fall of humanity is the only possible explanation for natures flaws, "*When humans fell, the curse affected the entire creation*", according to astronomer and pastor Mart de Groot[506]. He describes astronomy as the study of, "a dying universe" which supports the same point. The alterations caused by the fall reached from Eden to the furthest stars.
How is it possible to rebuild things into the state we observe today? In particular, physics and biology? Physicists often construct toy universes in model form. Start with a set of laws, kick off the Big Bang, and then work forward to the present. Then, check how well their model matches reality, if stars and then galaxies form, allowing life-bearing planets and that kind of thing. The nature of a universe is due to a handful of physical constants. These critical and sensitive numbers define how the forces in physics act. Physicists call them fundamental constants because they are not generated from other forces and can take any possible value. By varying these constants by a tiny amount, almost any mix of planets, stars, and creatures can be brought into existence. They are the cosmic levers that set up a universe to become whatever the creator desires.

All of nature is presently fallen. That is an obvious truth when you consider the evidence from science. Everything is prepared to fight against the laws of nature to survive. Exercise for example is just artificial stress and damage to simulate the conditions our ancestors endured, without it we quickly fall apart. Nature is also ancient when compared to a human time scale.

Considering the timing of the fall in Genesis, it does not include significant delays. From a human perspective, the consequences were instantly effective. Adam and Eve did not linger in Eden. Apart from anything else, they did not live long enough there before the fall to have children. Genesis describes God's decree of banishment. It was an urgent decision, to isolate them from the tree of life and the garden. That was a symbol of their new state but this decision was only the beginning of God's response. After the fall, God needed an environment suitable for fallen human beings. He chose one with vastly different laws to Eden. He started the whole universe off again from the Big Bang[507]. Then, let it develop through its life history under those new laws while adjusting Adam and Eve to fit into the remade environment. God protected both Eden and them from the reconstruction of the universe. How exactly this cosmic engineering took place can only be a matter of conjecture. As a manipulation of spacetime, it is possible even as humans understand physics today. They were forced out of the garden and entered known history at a time just before the transition to cities, farming and agriculture.

Not any kind of paradise.

In some recent era, they were returned to the remade universe when it was ready to support them[508] and their descendants. The area within the garden remained exempt from any effects of the fall. However, because of their sin our first parents were changed and made compatible with the new laws beyond Eden. Only a few genetic changes separate us from other hominids[509] such as tighter controls over mutations and brain development. The changes caused by the fall also affected genetic viability, which has significant consequences that I shall discuss. This model fits the well-known discoveries of physics, biology, genetics and astrophysics. We are children of Adam and Eve but at the same time are a species affected by long ages of natural evil.

506 Adventist Review – Searching for God in Space?, July 2, 2019, www.adventistreview.org/1906-46

507 This is the nature of a universal law it either exists throughout all space and time or decays into something else. For examples of that see the theory surrounding colliding universes and false vacuum decay.

508 From Adam and Eve's perspective this all occurred instantly, just after the fall. The effects of the curse were immediate as they and probably any other observers saw it.

509 Recent experiments focus on a gene, TKTL1, involved in neuronal production in the developing brain. The Neanderthal version of the gene differs by just one letter from our own. The Neanderthal variant leads to fewer neurons, in the frontal lobe of the brain, where key human cognitive functions occur. Human TKTL1 implies greater neurogenesis in frontal neocortex of modern humans, Science, 9 Sep 2022. PCDHB11, the human-specific neuronal surface protein has many changes in our species, it is another key since it allows neurons to diversify into many specialised forms.

The present laws, including decay and randomness, have been operating throughout our universe's history. As we observe the light from distant galaxies, which was transmitted long ago, it shows no change in how chemistry or physics behaves. Astronomers confirm that to be true, as they measure the effects of gravity on the movement of early stars and by examining distant nebula's and planets. Even a tiny change in the force of gravity, the speed of light or other fundamental constants[510] would be visible in the physics of distant galaxies. A given cosmos can have only one set of laws. Each universe[511] that forms is isolated from the laws and physical events of its siblings.

One discovery of Einstein's Relativity is that the flow of time will not be the same everywhere. Independent observers, separated by distance, may disagree about the order of events and still both be correct. It is hard to model connections between creations. It's not possible at present to predict how causal relationships might work between universes. That will have to wait for future discoveries about time within a united theory of physics.

I believe that the early events in Genesis One, did take only seven actual days, just as the Bible teaches. That was the time it took for the original universe, that God called: very good, to be brought into existence. While our current fallen universe is very old, when seen from a different cosmos, its whole history could seem brief. For observers watching events from other creations, the remaking of the universe may have even appeared to be instantaneous. Time here on Earth may have appeared to pass very quickly[512] but still included the many ages visible in the evidence.

However, nature's laws changed, that was part of God's plan to preserve humanity. Both Genesis and the New Testament make it clear that nature was condemned to suffering That was due to human choices, but it was God who made the changes. The new laws made themselves felt immediately after leaving Eden. God reconstructed nature to meet humanity's needs within new laws of death and chaos. That led to new rules for nature, including biology. Some of its original beauty is still seen. Although now turned savage and selfish. The flaws in natural law are not missing from the Bible. They are from the time of the fall, a constant background to the ongoing struggle between light and darkness. As it unfolds across the Middle East, and expands to take in the whole world.

Eliminating the impossible.

As my father David was fond of quoting to juries, "When you have eliminated all which is impossible, then whatever remains, however improbable, must be the truth[513]". In some situations this advice is flawed[514]. How can we research every possibility? However, we can eliminate traditional creationist explanations based on scientific evidence. Histories that throw doubt on God's goodness or the existence of human sin should be ruled out as impossible by Christians. So, our search for solutions can focus on a narrow range of possibilities.

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510 Among many other effects of altered constants see Nuclear binding energy, Fine structure constant etc.

511 M. Theory physics explains our universe as having three spacial dimensions, that we can see, plus a time dimension, and seven extra hidden dimensions that we can't see but which power electromagnetism and atomic forces. If multiple universes exist then what lies beyond them? According to Brane Cosmology and M-theory, this is a not yet observed higher-dimensional space. Multiple universes can coexist within this space. It includes the eleven dimensions of our universe, plus extras, supporting the various fundamental forces.

512 Time may have been accelerated in our universe, but this is not a requirement for cosmic creation to work. Immortals with the power to travel between universes are likely to think of a few million years as not very long. So long ages, that are seen as such by outside observers, are equally acceptable.

513 This is a comment by Arthur Conan Doyle's character, Sherlock Holmes. It is practical in a situation with a few possibilities but not a universal logical proof. In the context of the story, when other theories are ruled out by evidence, the only remaining one becomes the best explanation, even if it initially appeared implausible.

514 In pure logic, the Holmesian fallacy assumes that we can rule out all other explanations, including things believed to be impossible but this requires perfect knowledge of all alternatives. However ruling out the completely impossible is a useful first step.

Assuming that the Bible describes actual events, natural evil does flow from universal laws, and including the latest scientific research can further narrow our search. That does not prove that only one remaining possibility exists. We can keep an open mind about the nature of creation in the Bible. Future discoveries may allow for alternative models, with scientific support. However, the cosmic form of creation that I have described, has both biblical and scientific foundations. It explains the broadest range of evidence. It can also help Christians to integrate our beliefs as scientific knowledge expands.

Was the perfect Earth a substantially different planet from our own? Can we still call the creation week part of our history? The answer to both questions is yes. Yet there is more to these events than the bare text reveals. Genesis is not just the story of our world's creation. It is part of a conflict between half-seen giants. In which the fall and its consequences were but the second act of a war across universes. A rebellion with a history and scope we can only guess at. God had strong reasons to remake our universe and the Devil had his own motives for triggering that event. The balanced universe of creation week was replaced by our own after the fall. Exactly as, one day, our world and even the elements, will be dissolved in fire. Then, the Garden of Eden will sit again at the heart of a final cosmos with heaven's laws restored.

One objection, to the scientific record of life found in fossils, is that it requires biological evolution as an explanation. I am not suggesting that the need for new or changed species is desirable or that it was part of God's original intention for life. We cannot prove that one way or the other. However, in a fallen universe, such changes cannot be avoided any more than gravity can. Nature will mutate into new forms because reproduction is flawed, and these forms will adjust to their environment and competing species or die. All that is required for new species to develop is sufficient time.

There is no built-in limit to adaption. The code of life, like computer code[515], can describe anything you can imagine. If it can be constructed from cells. Nature's exceptional flexibility is what allows life to thrive in so many environments and be so diverse. So why does conventional creationism attempt to limit species' ability to adapt and survive? The idea of biology having fixed boundaries, or being limited to micro-evolution, is Greek religious philosophy. It was adopted by Christians but ought to have been dropped centuries ago when proven false. There is no evidence from biology that any such barrier exists, and a lot of proof, that huge but slow changes occur. The evolution of new species shows life inventing new ways to resist death and thrive just as God intended.

Current biology requires both new life and death for species to adapt. The living stand on the bodies of many who die young, even before they take their first breath. Now, it is true that significant adaptation is not an immediate requirement for survival. Some species do fine for a long time in a niche of life where nothing much alters. But change and chaos are relentless and exist everywhere. Sooner or later, you must move or go into a decline. Even the famous Coelacanth, that mighty deep ocean predator with armoured scales that looks unchanged from it's fossils, has recent[516] adaptions internally.

God killed a living creature so that humans could wear its skin after humanity rebelled. This act illustrated the tragic effects sin would have on all innocent beings. The consequences of natural evil are also built into all living things. The armour, mighty fangs, and spikes on the bodies of dinosaurs are one clear example[517], but the effects of unregulated chaos are everywhere.

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515 There is, much competition in computing and engineering to create working, living processors from cells that can run programs stored in their DNA.

516 'Not a living fossil: How the Coelacanth recently evolved dozens of new genes', Smith J.J, et al, Molecular Biology and Evolution, Vol 29, Iss 3, March 2012, P 985–993. - while the Coelacanth's body may have changed little, its genome tells another story. The African Coelacanth, gained 62 new genes through encounters with other species only 10 million years ago." These jumping genes are of unknown function but have been widely conserved so likely have been repurposed since they were acquired. The coelacanth has an intracranial joint, a hinge in its skull that allows it to open its mouth extremely wide to consume extra large prey. They also retain primitive features, instead of a backbone, they have a notochord. This is an oil-filled, hollow, pressurised tube that serves as a backbone. While they retain these features they are not unchanging, in fact they have more variation than many younger species in order adapt to various undersea regions.

517 Although bony spikes served as a defence they were also stores of available calcium, ie for egg laying in females.

Improving Creationism

"Only lately have we begun embarking upon a fourth way of looking at the world and our place in it. A new view of life. If we evolved, one must ask, are we then not like other mammals in many ways? Ways we can learn from? And where we differ, should that not also teach us? Murder, rape, the most tragic forms of mental illnesses – all of these we are now finding among the animals as well as ourselves. Brainpower only exaggerates the horror of these dysfunctions in us. It is not the root cause. The cause is the darkness in which we have lived. It is ignorance ... The fundamental premise of science fiction is not spaceships and lasers – it's that children can learn from the mistakes of their parents." - David Brin, futurist and author.

Will my pet go to heaven? Children often ask this question when some loved animal dies of old age. That is one example of an area where the Bible gives limited guidance. Genesis says[518] that just like Adam and Eve, all creatures are made with both hay-yāh and ne-p̄eš the vital ingredients of life. All animals share God's gift of existence and his breath of life. They living souls as we are and belong to this world.

Character is our guide

These questions are connected to what happens to people who die without having heard of God and children who die in infancy. Job asks whether a man may be more virtuous than God. No, of course not! Aside from purity and holiness, no human being can be more kind or compassionate. We do not need to check the Bible to respond to such questions. If we could, we would bring a cherished pet to heaven because they are loyal and loving despite their mental limitations. After all, compared to heavenly entities, our intelligence and powers are as low as animals are to us. Anyone with a heart would save a baby who dies before or during birth. So God will undoubtedly do the same, if not more. If that is not true, then impossibly, humankind is more compassionate than God.

We can be confident even when we have imperfect knowledge of God's actions. Our ideas can be based on his previous decisions and his character. There is nothing God would not do to save His children, and all of the natural world. In the legal sphere, this is called reasoning from precedent and analogy. We can apply this method to understand the events of creation. The curse recorded in Genesis depends on the core laws of nature. Even though there is only a partial record in scripture of all its effects. In the present, we observe dangerous forces, universal laws powered by chaos that randomly cause evil events and a long history of this occurring. This was not planned by God. He would not have created a universe so fragile that a single human sin would by itself break everything or introduce death and suffering without sound reasons.

It not respectful to a book that is as old as Genesis, to change the flood into a complex geological epic that caused most of the disorder in nature. Most kinds of creationism extend the flood's function well beyond what the Bible tells us. We should believe in Bible events, but we don't need to assume the author understood everything about their context or effects. They knew the stars were created by God for example, but would not have understood a Galaxy. In Genesis a vast flood is definitely present, but there are few specifics. The text is brief. The crucial sections are only a few verses long. How did we go from a torrent of water to the world we see today? Even the finest efforts to complete flood theories are riddled with unproven assumptions and inconsistent models. This process is different from testing the predictions of an existing theory, as science usually does. The cause is presumed to be a worldwide flood, and any discovery that appears to support that conclusion is included, while findings that don't fit are discarded. If we block out inconvenient information, we succumb to our biases. Nothing new can be learned, and mistakes go uncorrected. We must allow the evidence to speak for itself and only

518 Both are used in Genesis 1:30, to describe living creatures.

employ high-quality information verified by independent sources. Since we desire to understand both the Bible and nature, this helps us avoid spiritual and scientific errors.

We should trust the Bible writers' witness because they accepted the fact of a massive flood. However, the flood need not be made ridiculous and complicated to explain challenging elements of nature, such as radioactive decay. Its actual size and effects are open questions for the future. If flood evidence exists as it should in the Mediterranean, future discoveries will offer more light on this issue. The flood was just water, not magical fairy dust, no matter how much destruction and erosion it left behind. It would have displaced a lot of muck and sand but not formed any new solid rock. It would also have had little effect on the basement granite rocks. Not without a massive discharge of energy that would have shattered a wooden ark. The flood was not even powerful enough to alter the paths[519] of major rivers described in Genesis chapter two, like the Euphrates and the Tigris. While the mighty and long-lived descendants of Noah and their children established small local kingdoms afterwards, that are specifically named, using easily dated technology[520]. Specifically fire hardened mud bricks, that technique being a requirement to build any tall structure without stone. That was no earlier than 3500 BC based on the very first use of such building technology. That pinpoints exactly when all this occurred. If you assume the flood, really was universal, that requires an absurd compression[521] of history. Such squashed timing affects events in every other prehistoric society on Earth, including remote areas and isolated islands. It is the same problem as the genetics of post-flood species. The flood cannot credibly explain, fossils or their dating, or Earth's species distribution. On the other hand, deep time and the consequences of the fall, generate precisely those things.

Some creationists feel secure enough to dismiss discoveries they dislike. The only Biblical event they are willing to talk about, to explain nature, is the flood since their attention focuses on the Earth. However, the flood needs to be incredibly sophisticated and well-managed to explain Earth's geology. They disregard wider evidence including the galaxy's history, cosmic impacts like the one that nearly killed all higher life in the time of the dinosaurs, volcanism, the migration of the continents, radiation from supernovas, and development of the solar system[522]. In addition, the recently discovered relationship between the orbital influence of Mars and Earth's climate[523] over millions of years cannot possibly be generated by a flood. Whatever its nature, no Earthly event altered the regular changes in orbit seen in the Grand Cycles of the solar system. These are all things, that show how our universe including the

519 Unlike climate change which is likely to shrivel up both rivers to a trickle by 2040, placing many livelihoods at risk. Something that's been a symbol of terrible oncoming events for a long time. See Revelation 16:12.

520 Genesis 11:3. Such hardened bricks were valuable. Records from the third dynasty of Ur (2111-2003BC) tell how a piece of silver could buy 14,400 mud bricks but would buy you just 504 fired bricks. They can be dated with ease because every fragment of iron in the mud preserves the state of Earth's magnetic field at the time of heating just like a tiny compass. This changes globally but also has regional fluctuations that can date a dried mud brick that's been burnt due to the sacking of a city to within a few years. Such dating has confirmed reports in the book of Kings.

521 If you examine the durations of the archaeological records and the interactions with extinct animals of the more remote human settlements. Then a traditional explanation requires early humans reaching Argentina, Northern Australia and the tip of South Africa in the first couple of generations after Noah. This migration occurring during a glacial maximum in which most of the planet was covered in ice, making it a very difficult time for humanity. Small groups of humans using just fire and stone tools wiped out megafauna worldwide in a slow extinction event that is recorded on just about every continent. There simply isn't any way to integrate these events into a short timeframe. A recent discovery is described by M. Del Papa et al. 2024. Anthropic cut marks in extinct megafauna bones from the Pampean region (Argentina) at the last glacial maximum. PLoS ONE 19 (7): e0304956; doi: 10.1371.

522 See in particular the solar storm of 1859, sometimes called the Carrington Event, or the Storm of May 1921 which, in the event of a recurrence, might destroy the majority of human technology throughout a large geographic area. Despite these dangers, our sun is thought to be quite stable when compared to most other stars. Along with the lesser-known Miyake events, the most significant of which happened 14,300 years ago, a catastrophe like this would probably cut off a sizeable portion of the planet from electricity and communication, likely for months.

523 Dutkiewicz, A., Boulila, S., Dietmar Müller, R. Deep-sea hiatus record reveals orbital pacing by 2.4 Myr eccentricity grand cycles. Nature Comms, iss1998, 2024. "*Astronomical grand cycles with periods of millions of years modulate climate variability. We used sedimentary sequences from more than 200 drill sites to discover a previously unknown connection between the changing orbits of Earth and Mars, past global warming cycles, and the speeding up of deep-ocean currents. The interaction of Earth and Mars drives a 2.4 million year cycle of more sunlight and warmer climate alternating with less sunlight and a cooler climate.*" Such world wide, astronomical signals cannot be reproduced by any other natural process.

Earth, is old, without precise design and randomly flawed. That is all explained by the fall, since it had widespread effects, in both time and space. The evidence that explains nature comes in part from the planets and leftovers from our solar system's birth. All of that, is a consequence of the law of sin and death. It has affected humanity and all other species in so many ways.

Traditional creationists sometimes criticise science for incompleteness in its theories. They point to flaws like so called missing-link[524] species. At the same time, the scientific models they prefer are small-scale with few predictions. A better creation model will include all histories. Providing a framework for new discovery. Explaining everything from the isotope ratios of Neanderthal baby teeth to the torn-apart and patched-together structure of our galaxy with its destructive black hole[525] core.

Is it vital for creation theories to be scientifically credible? Are not many truths, after all, discerned spiritually? However, the origins debate is more than spiritual; we must consider facts. It affects too many practical and scientific issues to rely only on feelings. Everything in our universe is flawed and has been from its reconstruction. We can trust the science on this question. Nature's defects are universal. God designed this universe's imperfect laws, but they do not reflect his character. There are alternative explanations of creation that are plausible, but those that use a gap in Genesis or long ages of creation, deny God's benevolence. They must think that death and struggle were God's original intention.

Advancing faith and theory

There are a few factors that go into a quality scientific explanation. First, it should expand on previous theories. In the same way Relativity gives similar results to Newton's laws but is more accurate with deeper insights. It might connect areas of science that were previously considered separate. As biology and chemistry were unified by molecular biology or by uniting broader models as this book attempts to do. As it is easy to make up theories that only explain known facts, predictive power is valuable[526]. Second, it can make testable predictions that prompt further research. For example predicting a particle, form of life or leading to insights such as explaining human biology better.

Scientists communicating a theory should not hide relevant information. They need to present fully and accurately any counter examples or objections that critics have made to the idea's correctness. Then, respond in detail and discuss the alternatives. A theories sources should be clearly set out so their quality can be assessed. Are they previous suggestions, computer models, primary sources or broad reviews of research? Does the data include many independent measurements? Strong research shows what standards were followed to avoid bias and contamination of results. Finally, it should be independently reviewed by knowledgeable experts in the field, not associated with the authors. All of these things contribute to scientific reliability.

How does this book compare to the above ideals? Better than previous attempts to interpret science through the lens of religion. I suspect most scientists will find it acceptably factual while disagreeing with the religious implications that I draw. Even the most indirect interference by God in natural history causes discomfort to biologists. They have experienced constant attempts to sneak planning and purpose into scientific explanations over many years. Yet, this is different to my approach. Freedom sits at the heart of God's laws, not blueprints.

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524 The advantage of insisting on complete chains of species is that every time a gap is filled, that leaves two more to point out. Ignoring the fact that the discovery was predicted and of course the gaps are now only half as wide.

525 At the centre of our Milky Way galaxy, sits a supermassive black hole in the direction of the constellation Sagittarius. Astronomers think that these gigantic black holes form the seeds for new galaxies. It has a mass that is 4 million times that of our sun. While fairly quiet at present there are indications that it has been active in the past, consuming surrounding stars and ejecting accelerated particles. Every time our own galaxy swallows one of the orbiting dwarf galaxies it roars to life. Then there is the upcoming collision with Andromeda which will create even larger disruptions.

526 In the 1970s, prominent palaeontologist John Ostro predicted that palaeontologists would discover dinosaurs with feathers based on the similarities between theropod dinosaurs and birds. This prediction has been confirmed. Over 30 species of non-avian dinosaurs are known to have had feathers. Every time palaeontologists go out to look for fossils, they are using knowledge of geological dating methods and models of adaption to predict their location. See for example the discovery of Tiktaalik roseae and similar fossils.

Science is often about finding a missing puzzle piece, but only sometimes. An alternative is to reduce the scope of the search instead. Determining the edges reduces the search space. We can focus on the areas where a solution must exist. When thinking about creation, we can examine flaws in previous explanations. This book assumes that scientific discoveries and the Bible are equally valid. Given both sources, any lasting solution will share many common themes with my own. What about predictive power? The development of the human mind is a starting point. Also a universe that contains real freedom of choice, something scientists and philosophers like to argue about. Both a multiverse and a tendency for life to develop[527] wherever it can, will need to wait for more advanced research and exploration of deep space to confirm. Its seems quite likely, that life will eventually be found beyond our own world. It will be different to Earth-life yet still flawed by a chaotic origin. Such a discovery would confirm my approach.

Attacks on scientific neutrality or suggestions of cover-ups do not disprove the facts already uncovered. That just feeds delusions of conspiracy and persecution. Creationists interpret key human fossils as a new kind of upright-walking ape or a devolved human. There is no agreement on which of the two options to choose. The Bible has no references, and neither option fits a traditional view of Bible history. There can be progress and certainty only by finding a new explanation for these discoveries. If creationism is to be more than preaching to the choir, it must engage with science on a deeper level and trust that Christians can learn without losing their faith. It must be more than an attempt to silence discussion or hide the facts. This knowledge is a key to understanding humanities' pain and its cause, something that science is not set up to investigate, yet it is a vital part of the events of salvation.

Since it is impossible to have a totally naturalistic theory of God creating. Why do we keep trying to invent one? If flood based creationism functions only because of miracles. Then why any natural processes at all. Why not miracles all the way down? For example, a flood with an instant transformation of the whole planet into water then back again to seas and dry continents? That would be a more plausible way of creating, then removing a universal flood, than any natural means. Today's creationism is not trying to shift responsibility for God's actions. Instead they try to deny that God is responsible for the chaos in nature. Rather than accepting that randomness is a part of universal laws.

On the liberal side of Christianity, the usual response to this flawed creationism, is to point to the value of the Bible's principles not its usefulness as history. They think that creationism's focus on the reality of biblical events is simple-minded because God intended Genesis, to be fully mythological.

"*The curious thing about fundamentalism is that I think it's a very, very modern phenomenon. It's a kind of reaction to a scientific rationalism which says, it couldn't have been like that. And the fundamentalist, instead of saying, well what question's being asked here, immediately bounces back and says, oh yes it was, and you then have a sterile stand-off, which doesn't at all get to the level of the mythological and the proper positive sense that you're talking about*" - Archbishop of Canterbury, Dr Rowan Williams in conversation with Philip Pullman in 2004[528].

Unfortunately this response belongs to an organisation that no longer believes in miracles or God acting at all in the real world, even within the Bible. Not that they would come out and say that in a sermon. That is a tragedy, if Genesis is not based on a core of real events then Christianity is nonsense and of no more religious value than any made up historical fiction. On the other hand, conservatives often go too far the other way, believing that the many books of the Bible cannot contain errors, not even small ones. As if they weren't written down in imprecise human languages by writers with imperfect knowledge and a wildly different culture to our own.

527 Specifically the existence of laws biased toward increasing biological and mental complexity.
528 The Dark Materials debate: life, God, the universe, Telegraph, 17 March 2004.

Suffering

As for me, I would seek God, and to God would I commit my cause,
who does great things and unsearchable, marvellous things without number.
- Job 5:8-9

Job is like a lost story from Genesis because it explains the nature and consequences of sin. Because the book of Job was written about the same time, its unknown author lived in the same culture. However, in contrast to Genesis, it is structured like a court case, with an accuser, a judge, witnesses, and a defendant[529]. At a deeper level, it focuses on explaining natural and human evil. Job is also challenging to translate because it's author used many, now lost, words not found in any other ancient books. There are as many ways of translating some phrases as there are interpreters. Just like Genesis, The book of Job intentionally uses God's titles and names to explain his role. El or Elohim a generic name for divine beings is mainly used until we reach God's explanation to Job at the end. This is the same as in Genesis chapter one, and is used in the context of God as a universal creator. While Yahweh[530], God's personal or covenant name, is used exclusively when living creatures[531], including humans are being discussed. This follows from Genesis chapter two[532]. Where it is "*Yahweh 'ĕ-lō-hîm*" that makes mankind and all the other creatures, from the soil, rather than speaking them into existence as the first account implies (see Gen 2:19 vs 1:24).

It is an ancient text, but fragments found in the dead sea scrolls match the source of today's translations. So it must have been treasured and passed down by the Hebrew people. Although some have criticised its prologue as a later addition, it provides context for the rest of the book by outlining the wager and court case set up in heaven. Since Job is faithful in God's eyes, his extraordinary punishments and suffering are truly unjust. Without the introduction, we might think that Job is deluded and agree with his friends that he is being fairly punished for his sins. That would disrupt the central point of the book that there is something wrong with creation itself, that God's design seems to be skewed and broken because even the faithful[533] suffer.

Job's friends blame him for his suffering but also try to justify God. Bildad characterises God as a distant ruler, up in the heavens, ruling through armies of messengers. Job responds in chapter 26, listing all the things God does directly with His own hands within creation, most of them causing uproar but also upholding and stabilising nature. "*He stretches out the north over the void. And hangs the earth on nothing... The pillars of the heavens quake, aghast at his rebuke. By his power, he churned up the sea; by his wisdom, he cut Leviathan to pieces. By his breath, the skies were opened; his hand pierced the escaping serpent. And these are but the outer fringe of his works.*" God is deeply involved in the making and running of the universe, and limits the worst things that chaotic powers do to humans. Job places the blame on God for his suffering but does not stop worshipping. He maintains a solid faith that it is all a horrible mistake, waiting to be corrected. God set up the universe at creation but will someday put an end to suffering.

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529 Job warns his accusers that they should fear the coming judgement in ch19:29. The language used throughout the book makes the idea of a trial or court case very clear.

530 "*The meaning of the personal name of the Israelite God has been variously interpreted. Many scholars believe that the most proper meaning may be: He Brings into Existence Whatever Exists"* (Yahweh Asher-Yahweh) – Encyclopaedia Britannica, topic Yahweh. (retrieved 4/3/2024). Likely some subtle theological meaning is implied by the selection of a particular name but the significance of these names apart from their literal translation has been lost.

531 Job 12 verses 9-11 – Yahweh has in his hand the life and breath of all creatures, including humanity.

532 Without getting into the literary origin theories of Genesis, this highlights the diverse roots of its concepts. Genesis two is localised in the middle East, and full of geographical (rivers) and mining (gold, gems) references. While the first chapter is universal and concerned equally with the heavens, both starry and atmosphere, the seas and our whole planet. They should be seen as intentionally complementary not as separate accounts, it is just that the focus of the writer is shifting to the human aspects of the creation story.

533 The book is not setting Job up as an ideal example of humanity, in his society, slavery and warfare was commonplace.

God's longest speech.

Job is relevant to creation and the laws of nature for many reasons. It includes the actions of 'the accuser' or tempter, the Devil making his first clear appearance as a power of the Earth and bringer of chaos and death. What of God's reply to Job? It must be essential since when He speaks to Job, this is His longest speech in the Old Testament. Such a detailed and poetic response must mean something. What does it include besides talking about nature and knocking down human pride? Yahweh responds to Job and rejects his agenda, re-framing their conflict as one over the universe's design[534] rather than that of the injustice of Job's suffering. As the reader already understands, the arrangement of the world is the cause of Jobs suffering, not his individual guilt.

In God's argument, the world is enormous and varied. It is also wilder, and there is much more of it than Job thinks. Nature lives for itself, and if anything is instrumental to man, if anything serves a purpose other than itself, that is coincidental. Any Jewish reader of the time looking at the details of God's response to Job would pick up the references to Genesis. God's reply is full of the same elements of creation. However, they no longer behave as they did in Eden's paradise. Earthly things are no longer in harmony or fully obedient. Carol Newsom writes[535], "*the key interpretive question for understanding the significance of the divine speeches has to do with the nature of the relationship established in these images between God and symbols of the chaotic*".

Nature is beautifully described with many features, some of which are predictable, such as the form of the Earth and the Sun's morning light and stars. These orderly things are under the control of God. He also commands apparently erratic wild things like the storm, lightning and hail that he prepares for battle and war. Including the storm that Job sees approaching as he disputes with his friends and from which God then appears and addresses Job. The symbol of a divine storm is associated elsewhere with the redemption of the faithful and vengeance against the wicked. For example, "*The Lord is slow to anger but great in power; the Lord will not leave the guilty unpunished. His way is in the whirlwind and the storm, and clouds are the dust of his feet*[536]".

In this part of Job, each creature has its own fierce independent life. There are predators like lions, ravens, hawks and plant eaters like deer, onager, wild ox, and ostrich. These animals all have one thing in common. They have been created wild and free and are beyond human control. Except the horse, which facilitates warfare. Much of what they do is chaotic or dangerous to humans. Pretty much every creature is both. Even the plant eaters are alarming. The horse leaps about like a locust, scares people by snorting, paws at the ground, and cannot stand still. Unlike real horses, it is eager to join in human battles, to fight and kill. The ostrich is thoughtless and cruel to its young. While the deer is a victim that suffers, gives birth in pain and then is abandoned by her young. The falcon defends its fortress nest and haunts the battlefield, its young gorging on blood. The lioness hunts and ambushes its prey. While the young ravens, which are capable of eating almost anything, suffer from hunger and pray to God for food as though the land is experiencing a terrible drought. God accepts their wild natures as he does the right of the accuser to cause Job's suffering.

The main theme of the response is that everything in nature is in a constant struggle and is wild, imperfect, and self-centred. Chaos is part of creation's essential nature. Suffering is unavoidable rather than desired in Job, as it is throughout most of the Bible. Despite the fact that God is above and can overrule, battle and strife of all kinds take centre stage in His explanation. Job suffered because chaos is part of nature and humans belong to the natural world. God says, "I formed Behemoth precisely as I made you. He is stronger than anything mankind can do, and more destructive". Humans are only one small part of nature; and not even the strongest of Gods many creatures. While judgement will come, its timing belongs only to God.

534 Job 38:2 (NASB) - "*Who is this who darkens the divine plan by words without knowledge*"
535 Carol Newsom, Book of Job: a Contest of Moral Imaginations, Oxford University Press, 2003, p243.
536 Nahum 1:3

Chaos and water monsters.

Behemoth and Leviathan are more formidable than Job's human attackers, the warriors from Babylon and Southern Arabia. They are mythic beasts with more strength and independent power than any natural animal. For example: "*Its bones are like tubes of bronze, its legs are like bars of iron", "its eyes look like the light at dawn", "Its breath sets coals on fire, and flames come out of its mouth", "The powerful* (some translations read gods) *fear its terrible looks when it lifts itself up, and draw back in fear as it moves, there is no hope of defeating it, just seeing it overwhelms.*"

The beasts symbolise aspects of nature instead of being real creatures. These verses are an early example of the long Biblical tradition of animals representing countries, or powers. Leviathan, the sea monster, represents the oceans, a key symbol of disorder, as in the waters before creation. These waters are a form of chaos with limits placed on them by the Creator. A creature that rules there is likely to be deeply hostile to order. Behemoth is its counterpart in the rivers. There are explanations elsewhere, Job states that during the creation, God put boundaries on the sea so it would not invade the land. God also set a watch or limit over Leviathan – the monster in the sea[537] in a different part of the book of Job. In chapter 26, he cuts the same beast to pieces, just as he separated the land and waters. So, Leviathan represents primal disorder as experienced in floods and ocean storms.

This monster can also be identified with Job's accuser Lucifer, in that it represents the selfish and wicked elements in nature that God permits. Leviathan is also identified elsewhere as a serpent and as the "Lord of pride", echoing Lucifer's first sin. Both will meet the same fate when God judges, as foretold in Job, in chapter 19. The fallen state of creation is never openly discussed, but it is everywhere throughout the book. The world is flawed. It defies the ideal of a fair world made for humans. At the same time, the suffering in Job is understood through divine goals and eventual justice. Job is full of anguish, but also rich with a true yearning for redemption. Below I've tried to capture some of its internal poetry in modern verse.

I cry violence! But none respond.
Shout help! Justice is far beyond.
Blocked, by an obstacle in my path.
Bound, by wrath and darkness.

Dignity's stripped, my crown torn off.
He attacks, escape's futile.
Hope's a leaf, from a dead tree.
His eyes, an enemy's glare.

Let my cry, be writ in stone.
Carved, inscribed in lead.
Lift it mountain high.
Defy the dust of time!

My heart longs for this.
To cast away anger.
No longer a stranger.
Justice, is His alone.

Bodies may break.
But, in my flesh.

537 Job was most likely written between 800 and 900 years before Jesus. While Isaiah wrote two centuries later, around 700 BCE. Isaiah is the only other book that depicts the Leviathan creature, aside from a minor mention in Psalms and echoes in Revelation. The Leviathan is fully revealed as a symbol of chaos, corruption, and evil by the time of Isaiah. It is called a serpent twice, with all that means, also it lives in the water, signifying disorder that will be judged and destroyed by God, and likely represents Egypt (Isa 26:21-27:1).

Lifted from decay.
I shall, see God.

Healing natures wounds.

Our universe is built on randomness and unleashed raw power. That is demonstrated in biology by organisms that exist only off the misery of others and by extinctions that eliminate entire groups of living species. The consequences of sin have been felt throughout the universe as it has developed over vast periods. Evil and misery have touched many species, not just people.

The choice between God and his enemies could not be made more starkly clear. As death is the key to this universes laws this becomes the focus of salvation. Divine life must be sacrificed to rescue creation. How does God heal the curse of the law of sin and death, this wounded natural order? He pours limitless love, over the origin of all suffering sacrificing his own life. His spirit, flowing through our lives, with power greater than ever before. This connection is thanks to the resurrection, which blew away the curtain, separating our world from the laws of heaven.

The Bible demonstrates the principles on which God's creation operates beyond our island universe. C. S. Lewis also understood this connection between the Cross and natures law, and it shows even in his fictional worlds, as in the quote below.

> "It means" *said Aslan "that though the Witch knew the Deep Magic, there is a magic deeper still which she did not know. Her knowledge goes back only to the dawn of Time. But if she could have looked a little further back she would have read a different incantation. She would have known that when a willing victim who had committed no treachery was killed in a traitors stead, the Table would crack and Death itself would start working backwards."* - C. S. Lewis[538]

This moving story may have quite a bit of truth hidden in it. For those unfamiliar with his writing, Aslan is Jesus. He appears as a mighty, intelligent lion who works the creation of the world of Narnia[539] and again when its universe ends in a final judgement. The deep magic is an analog of the commandments, the laws of death that apply to this particular world, echoed by the 'table of stone' that cracks.

The deepest law is love

Lewis' greater law, which reverses death comes from before creation and beyond the borders of the world. In other books in the series and in the lesser known Space Trilogy, Lewis even clarifies that individual worlds have specific laws and their own thread of time[540], which does not need to match Earth's. For example, the human children who travel to Narnia can become adults there. Yet when they return, they find themselves young again[541], for no time has passed on Earth at all.

538 The Lion, The Witch and the Wardrobe, chapter 15.

539 It is exquisite and echos Milton's Paradise Lost in many places, "*The Lion was pacing to and fro about that empty land and singing his new song. It was softer and more lilting than the song by which he had called up the stars and the sun; a gentle, rippling music. And as he walked and sang the valley grew green with grass. It spread out from the Lion like a pool. It ran up the sides of the little hills like a wave.*"

540 Like the dying ancient world of the white witch with its dark sky and red sun. Which also appears in the chronologically first book in the series. There are strong parallels to certain events in that novel and in Lewis's space novel, Perelandra, which is my daughter Thalia's favourite among Lewis' books.

541 Likely for literary reasons rather than an attempt to reconcile the timeline of different creations?

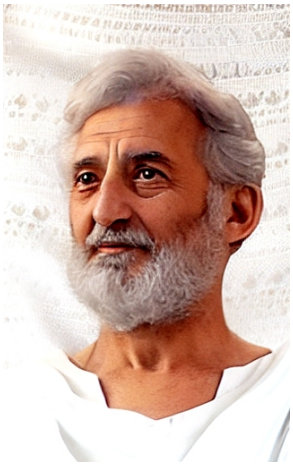
Creation in the New Testament.

"In these last days God has spoken to us in His Son, whom
He appointed heir of all things, through whom also He made the world."
- Heb 1:2 & 10

Jesus at the centre of creation

Genesis is part of the foundation for the role of Jesus in the New Testament. We cannot separate His mission and its origin without doing violence to both. Adam and Eve's choice as our first parents is the reason for the plan of redemption. There cannot be good news without understanding the problem they created, and how evil infected nature. Jesus also emphasised two gifts given to humanity that remained from the creation to the present, marriage and the sabbath.

By Jesus' time, the prophecy of the seed of the first woman (Gen 3:15) was expected to be fulfilled in the time of the Messiah when he would rule the nations[542]. Hellenistic Judaism, and also the Sadducees[543], rejected this. They were opposed to the idea of a supreme God being involved in human history. The supreme being, had not intervened since the time of the Exodus, and did not have any responsibility for judging humanity. They also rejected the later prophetic parts of the Bible. Other groups saw the scriptures differently. They accepted recent writings and prophets like Isaiah, Daniel and The Psalms. Genesis was valued by rural believers, and some literate urban Jews[544]. They wrote paraphrased, and romantic retellings of its stories, examples of which were found with the Dead Sea scrolls. In a Christian interpretation, this Seed of the Woman verse is known as the Proto-Evangelium. It implies Jesus' birth, death and his return, which will crush evil forever. This goal exists at the core of Christian belief, as Jesus is the Lamb chosen to be slain from the world's creation. This understanding is found in verses like Revelation 13:8 and 1st Peter 1:20. Internal conflicts in understanding creation were also set up in early Christianity. They were caused by the same Hellenistic mindset that existed in Jesus' era, among the Jewish religious factions.



However, Greek philosophical ideas did not influence Jesus' view of His Father. He called him by the Aramaic word Abba[545], roughly translated as 'Dear Father'. That would have sounded crazy to his Roman or Greek listeners. Referring to the distant first cause and creator, as your father, is like someone today claiming quadratic equations have adopted them and will someday take them away, to maths land. Further, the New Testament writers edited out non Jewish culture. For example by removing nearby Greek and Roman cities, preferring to present Jesus within a purely Jewish world, rather than as someone with a mission to other cultures. He was not unaffected by the surrounding alien culture, but the house of Israel was his focus.
On the other side of the Jewish faith during this period were believers like Philo of Alexandria. He lived at exactly the same time as Jesus. He created a com-

542 The Fragmentary Targum, Targum Pseudo-Jonathan, and Targum Neofiti are commentaries that translate scripture for the people of their time. They all portray Gen 3:15 as an opposition between the descendants of the woman and the descendants of the serpent, with the woman's descendants striking the serpent's head in keeping the commandments of the law, and failure to do so resulting in the woman's descendants being bit in the heel. The snake's people will not be cured, but the heel (Judah) may be cured in the day of the Messiah king.

543 The Sadducee's were a group that included high priests, aristocratic families, business owners and financiers. They were influenced by Hellenism, maintained cordial ties with the Roman rulers of Palestine, and typically advocated an ultra-traditional temple focused faith.

544 The unlearned rural masses they called the *amme ha-aretz* (people of the land) supported Jesus. They did not always pay the customary tithes or respect the regulations of cleanliness, and neglected the laws of prayer. They were disliked by the erudite Pharisees who applied the law "*Cursed be he who lies with any kind of beast*" to forbid marriage by their own faithful to these uneducated rural people.

545 It is one of only a few terms not translated by the Greek New Testament manuscripts, due to their specific significance. The word Abba is especially crucial since Paul uses it twice when defining what it means to be a Christian. He puts the believer in the same position as Jesus, who speaks directly and lovingly to his father. This represents the most intimate

mentary on Moses' writings that has been well preserved. He also headed a group that petitioned the Emperor on behalf of his fellow Jews, urging the empire to stop its persecution. He was the intellectual forefather of current Christians who think that the lives of Old Testament characters are only symbolic fiction with no basis in actuality. Everything was an allegory for the wise to interpret. So he rejected a recent creation, "*It would be a sign of great simplicity to think that the world was created in six days, or indeed at all in time*"[546]. Plato's beliefs had a tremendous influence on his work[547] as a Hellenistic, Greek-speaking Jew who lived far from Palestine. For example, he added an extra component of God to his commentary, which he called the Logos - 'reason or wisdom', to do the actual creating, as well as new tiers of angels, to address the difficulties of humanity and nature being so remote from a supreme God. He was also intensely interested in numerology and found symbolic numbers throughout the Bible. It was this mixed worldview that the early Christian church adopted, after the centre of Christian leadership shifted from Jerusalem to the heart of the empire in Rome.

What need can there be for a saviour if humankind never fell but only grew in wisdom and skill? If not in Genesis, how did a fall occur? Arguing for a fairly literal interpretation of Genesis is not new. People have been reasoning along these lines for hundreds of years.
Counter arguments exist to Jesus's use of Genesis, pointing out that he uses many stories that he didn't expect people to take literally, like the rich man and Lazarus. But this ignores how he applied existing scriptures, insisting to his followers and others that they had God's authority. He overrode traditions but defended himself when tempted by Satan with scripture, not with his own words.

Early Christians regarded the Old Testament as equivalent to Jesus' statements and assumed Genesis was factual because their religion was based on being an adopted, spiritual descendant of Abraham. The New Testament writers liberally interpreted ancient passages to fit their arguments and strengthen the case for Jesus as the son of David and Messiah but respected it as God's message. Jesus' healing miracles[548] were also seen as powerful evidence that he was God and the source of a fresh creation. A prominent example is the healing of the blind man in John chapter nine. By employing dirt to make a healing salve, Jesus alludes to the creative power and raw material that gave birth to humankind in the first place in Genesis 2:7. The high drama that accompanies the miracle, such as the disciples questioning Jesus about whose guilt caused the man's blindness, and the questions of local sceptics that leads to a comprehensive examination of the cure, emphasises its significance within John's gospel.

Living systems are built to compete and decay. That is evidence that God added later stages to creation. Our genes contain the record of a complex history. This history is demonstrated by the constant struggle against death and even the effects of parasites built into our cells. Chaos threatens the extinction of all species, from bacteria to whole ecologies. Astronomy shows that nature is the same everywhere. Decay is woven into every physical process. It is right to believe that God brought this about. Only ultimate power can alter biology and physics throughout a universe. Alternative explanations are wrong. Science must not cause us to doubt God's goodness. He didn't rebuild a preexisting failed world within a contaminated universe.

The damaging effects of sin are discussed in Genesis three, and they list some of the ways nature changed. However, there are also signs that more extensive alterations must have occurred. After being expelled from Eden, the first humans discover that they live in a universe founded on death.

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of familial ties, which Paul attributes to our adoption by God in Romans 8:14–16 and Galatians 4:6.

546 Allegories of the Sacred Laws (Legum allegoriae), Book I.

547 Concerning God's use of a world of forms and creating a perfect world - "*The Intelligible World within the Divine Mind Compares to a Blueprint within the Architect's Mind. For God, being God, judged in advance that a beautiful copy would never be produced except from a beautiful pattern and that no sense object would be irreproachable that was not modelled after an archetypal and intelligible idea. So when he willed to create this visible world, he first formed the intellectual world, so that he might employ a pattern completely Godlike and incorporeal for the production of the corporeal world. A more recent image of one that was older, which was to comprise as many visible kinds as there were rational ones in the other*". Discussing God changing His mind - "*what can be a greater act of wickedness than to think that the unchangeable God can be changed?*" - Volume III.

548 Drama of the Divine Economy, Paul M Blowers, Oxford Early Christian Studies, P. 261.

Paul, explains the consequences of this event. In Romans 8:20–22, he discusses the future of God's children. They will be transformed on the outside as they already are spiritually when God's kingdom comes in its fullness. But what is the present situation? How did the brokenness of nature come to be, according to Paul? "*For the creation was subjected to futility (incompleteness/sickness/brokenness) against (its) will, but one (God) subjected it. In hope, the creation itself will be set free, from the bondage of decay (or corruption) into the glorious freedom of God's children. For we know, that the whole creation groans and suffers (ódinóin pain as intense as giving birth) together until the present day.*"

The surrounding verses identify that it was God who altered the whole of creation to make it subject to decay. Yet there was hope for eventual freedom from the law of death. So what gives us this freedom? According to verse 24, it is the hope "*in which we were saved*", a hope that "*remains unseen*", because it belongs to the future. The incompleteness and suffering of nature began with the fall, but there is a promise of all being made new. The verse implies that these changes were made unwillingly. Paul is not saying that nature tried to resist its creator. Perhaps it was God who was reluctant, unhappy with causing his magnificent creation to suffer.

A new kingdom within the old.

The kingdom of God is growing within a fallen universe and cannot be understood without that context. Some Christians ignore the older, more inconvenient parts of the Bible. Their spiritual insights are built on traditions equal to or overriding scripture. Others are selective, accepting that the Bible is inspired, but limit its truth to only religious principles without supporting proof. Faithful Christians should avoid either solution. Our view of inspiration accepts scripture as authoritative because it contains God's intentional and personal communication with us. It is not just a record of historical ideas about God. It need not be without error, or it may be hard to interpret in today's context, but it also can't lie about vital events.

The reasons for death and chaos remain unexplained by adding a gap to Genesis or by 'Long Ages' creationism. Based on either view, it cannot have begun due to human choices. According to science, we are a reasonably young species, although our family tree is enormous. As the gap theory also does, these ideas treat the Bible and science as a zero-sum game. For everything accepted in science, there must be something given up from the Bible as history. Both flood-based creationism and evolutionary or long-age creationism fail at this point. Theories of creation must harmonise the Bible with science, not trade off facts against faith. A reconstruction of nature is a better alternative. Since the Bible records the curse, we can be certain that God carried it out. Genesis describes a few of its consequences for humans. While ideas like a gap in Genesis only assist educated Christians a tiny amount.

Something is needed to explain the difference between the present natural laws and the work of a living and loving God. You may believe that humans are too insignificant to affect the universe's fate. Considered on our own, that is true. However, He does not feel that way. In Jesus' eyes, we were a species worth dying for.

Chapter 5 – Deep Space

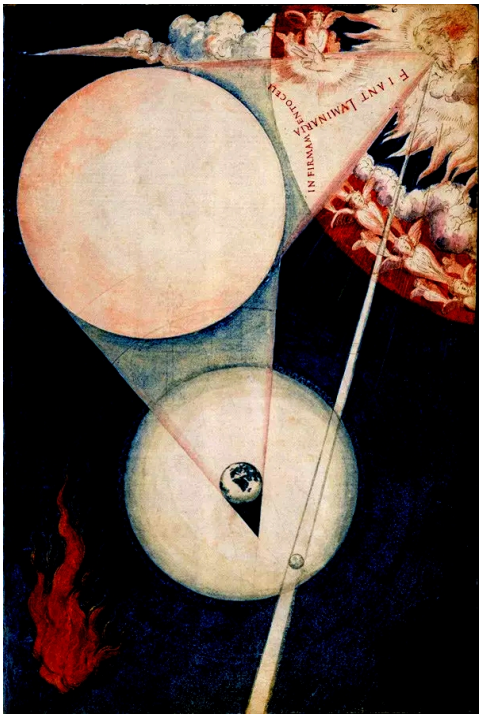
Explaining the Stars

"The dark ages still reign over all humanity, and the depth and persistence of this domination are only now becoming clear. This Dark Ages prison has no steel bars, chains, or locks. Instead, it is locked by misorientation and built of misinformation" - Buckminster Fuller.

Knowledge that overturns established beliefs can be frightening. For religions, this often results in a passionate defence. Unfortunately the counterattack can become more radical and damaging to faith than what it opposes. That is how it has often been with creationism.

Deep space

The delay in light travelling across space means that astronomy studies stars as they existed long ago. When looking across the disk of our galaxy to stars on the opposite edge, for example. Suppose you pointed a massive telescope at the other side. You would see light that was emitted at least 150,000 years ago. The scale of space means that gravity develops galaxies, clusters and superclusters of galaxies at a glacial pace. Changes are exceedingly slow compared to human lifetimes or even those of species. These transformations and collisions between galaxies are essential steps in their development[549]. That is known from our galactic neighbours and by examining our own galaxies shape.



A 1573 painting by Portuguese artist, historian, and philosopher Francisco de Holanda, a student of Michelangelo's depicting the light of creation.

The universe has never been static. So, the record of the past includes the birth and death of stars and galaxy mergers, clusters, and collisions seen in starlight. Stars create elements such as carbon and silicon and heavier elements such as gold. What if we searched for light from the earliest stars? If astronomers are correct, early stars should contain only lighter elements with only a few heavy atoms. That is precisely what has been discovered.

The Spitzer space telescope spent nearly 200 hours studying a narrow area of sky to collect the most distant light. It discovered that the most remote galaxies were made from massive stars mainly composed of hydrogen and helium[550]. These stars had just a sprinkling of heavier elements. They were not the first generation, which was short-lived, but were built from their remains or were a couple of generations old at most. Now that the new James Webb telescope[551] is online, we can collect light from even

549 "*collisions between galaxies have occurred all during their evolution—and these collisions, far from being rare events, were the mechanism by which galaxies developed in the distant past and are the means by which they are changing their structure and appearance even now*" - www.britannica.com/science/galaxy/Evolution-of-galaxies-and-quasars. Our own galaxy preserves evidence of several collisions in which it absorbed nearby smaller galaxies leaving shells of older stars behind as the remains bounced though the common centre of gravity and back again.

550 See The GREATS Hβ+[O III]Luminosity Function and Galaxy Properties at z~8 Walking the Way of JWST, Monthly Notices of the Royal Astronomical Society, stz940, doi.org/10.1093/mnras/stz940

551 Originally planned for 2017, and finally launched late in 2021. The James Webb is a 'civilisation class' science project utilising extremely advanced engineering to study the most distant red shifted light from early stars.

closer to the beginning, maybe back to the cosmic dawn itself. Light that came from the first stars to ignite.

The size of a galaxy influences the quantity of complex atoms it contains. These are any elements heavier than hydrogen and helium. Astronomers have discovered that this balance between size and enriched materials has remained the same for the last twelve billion years, or nearly the whole lifetime of the Universe in nearly every galaxy. However, the youngest galaxies appear different. That is a new discovery of the James Webb[552] Telescope. They don't have the same star to element balance. This is because they haven't gone through the many star creation and explosive death cycles that today's galaxies have. That process enriches the clouds of matter that are the birthplace of stars with carbon, iron and all the other common elements.

As expected, the earliest stars were simpler. "*When we analyzed the light from sixteen of these first galaxies[553], we saw that they had significantly less heavy elements, compared to what you'd expect from their masses and the amount of new stars they were generating*" according to Kasper Elm Heintz, leader of the study and assistant professor at the Cosmic Dawn Centre at the Niels Bohr Institute.

An explanation?

So, how could the universe have existed for only a few thousand years? As some creationists suggest. If that were true, we should only be able to see at most the nearest three to four percent of our local galaxy[554] and none of the other galaxies at all, and there would be no explanation for the rest of astronomy. Starlight's existence is only half the problem since the light contains evidence of changes over vast periods, so they need to explain how that information got there and what it means. Traditional creationism has answered this starlight problem with speculation and distorted physics or assuming an arrangement that creates both stars and evidence of their history, at the same time.

Barry Setterfield[555] came up with one partial solution in 1989. He proposed that the speed of light was infinitely fast at creation and has now slowed down to its present speed[556]. When I first came across that solution, I thought it sounded good. A theory like Setterfield's or something similar seemed essential. It supposes that even the most distant star is only six thousand years old. The solution ignores all the life cycle information in the light itself, as there wouldn't be time for any of that to happen. Yet, as a proposal, it was a reasonable start.

A troubling graph

Having come across the theory in my teens, I was keen to show my support for any serious attempt to resolve the difficulties faced by creationism. I skipped school with my father's agreement[557] and hit up

552 Dilution of chemical enrichment in galaxies 600 Myr after the Big Bang, Heintz, K. E., Brammer G. B., et al. Nature Astronomy, Sep 2023.

553 The researchers examined some of the most distant galaxies ever observed for their study. They found that the chemical abundances in these actively growing galaxies were a quarter of those seen in present galaxies. That demonstrates that early galaxies were still bound to the intergalactic hydrogen and helium gas that filled space and absorbing those pure gases, diluting their heavy element ratios. Although some unusual metals have been found including nickel suggesting some high energy, weird processes were going on in those early galaxies because that element is rare in modern galaxies. This is the cutting edge of research in more ways than one. So expect significant revisions to our understanding of this period of the early universe now that we can observe it directly.

554 Estimates of the width of our galaxy vary but its somewhere from 150,000 to 200,000 light years from edge to edge, here divided by the traditional age of the earth of around six thousand years.

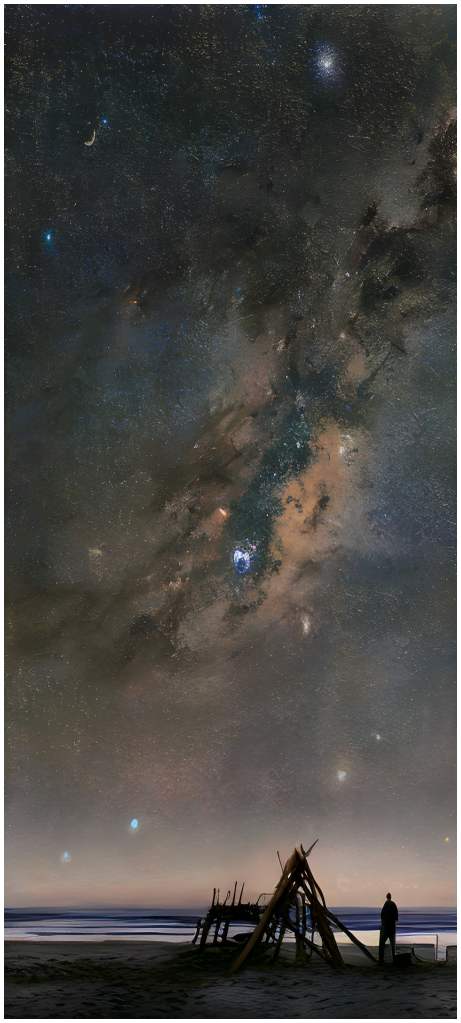
555 He is also an Australian, my pet theory is that Australia, the same as the American mid west, generates creationists and geologists too. This is because its complex, eroded and layered landscape forces you to think about deep time. Either to accept it as a fact or occasionally to emphatically reject the evidence of your own eyes.

556 It has now been abandoned by creationists due to contrary evidence and the theories catastrophic side effects on physical systems like stars, planets and people. Runaway radioactive decay of presently stable atoms, such as carbon, is one obvious problem.

557 That was a few years after announcing to my parents that God definitely existed. I had decided that He was likely present in the extra dimensions of space/time, which seems quite possible; see the many dimensions of M-theory. Space fascinated me for years. To record my ideas, I typed up an ambitious paper for a primary school student and submitted it

the physics and astronomy sections in the Christchurch public library adjacent to the university. I needed somewhere with university-level physics textbooks, preferably older ones. Several books and papers did have the information I was seeking in descriptions of historic science experiments. All the experiments I found had recorded light speed directly or calculated that information as part of other experiments, i.e. astronomical observations. I was looking for supporting evidence in the form of additional data. I expected to find a smooth curve of measurements descending from extremely high in the 1600s[558] to close to the current value in the present.

That is what Setterfield's paper showed in its key graph. Light speed starts with a sharp decline from infinity and then, without explanation, becomes flat and unchanging, stabilised at the present velocity. The dramatic plateauing occurs just as scientists develop incredibly accurate ways of measuring the speed of light in the 1950s and 60s. That was terribly inconvenient if the theory was correct because science just missed out on measuring dramatic changes in a fundamental constant of nature by a few years. Additional data points would be helpful because, for some reason, the graph didn't have too many. I found quite a few extra readings from the experiments after the Michelson-Morley era starting in 1887 and in the decades from 1910 to the 1940s.



It was unclear which readings on my handwritten list were used in the paper, but it didn't matter. I discovered quite a few extra historical observations of the speed of light to add to my extended graph. Many of these were significantly slower, rather than faster than the current speed. That was the opposite of what should have been measured if the light-speed decay hypothesis was true. My own updated graph was an embarrassingly random walk zigzagging wildly from high to low numbers. It then narrowed to a precise figure starting around 1970. Allowing for experimental error, this is just what you would expect if the speed of light is unchanging and always has been. The various imprecise measurements will spread randomly around the real velocity but zoom in on the correct figure as techniques compete and improve. Also, as I learned some years later, the author had selectively omitted or misquoted some lower historical measurements in his source data. However, he did accept all of the higher ones since they fit his preconceived idea. Selectively filtering evidence because you desperately want something to be true is a definite no-no in any research and is scientific fraud. It is not acceptable behaviour for creationists either.

At the time, I did not mind that the theory was obscuring the truth. I assumed there were valid reasons to exclude the measurements I

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to the Christchurch Science Fair as a project. It discussed what we might be able to understand about spacetime, including somewhat randomly Roy Kerr's discoveries about black holes, and how to travel faster than light using negative energy and received a highly commended. I was delighted to later meet Roy Kerr partly because of my project but mainly because Dad knew him. I recall he encouraged me to learn mathematics. So I could put my ideas down as proper equations. He is the physicist who became the first person to solve the field equations of Einstein's general theory of relativity for Black Holes formed with an intrinsic rotation, which also causes local spacetime to rotate around them. He solved the equations in 1963. However, Astronomers only have physical proof for black hole rotation in 2023. Research can take a while to go from theory to proof. His work is fascinating because rotation has wild effects on the inside which might allow movement though the central spacetime of black holes. His most recent work in 2023 shows that in realistic models of black holes there is unlikely to be a central singularity, or area of infinite density which he considers a signal of an incomplete or flawed theory. Do Black Holes have Singularities?, Roy Kerr, Uni Canterbury, Nov 2023, DOI:10.13140 / RG.2.2.34286.38723.

558 My collection of measurements included astronomical observations of, for example, the moons of Jupiter. However a quick online search now turns up most of them.

had discovered, even the fairly recent ones. However, leaving out unwanted data is much too common in conventional creationism. Such shoddy, prejudiced research is embarrassing and offers nothing to support God as creator and the worth of the Bible. This failure prompted me to search for an improved solution[559] to the speed of light problem within the boundaries of a traditional young earth model. Without success then or now, the stars simply do not fit those tiny limits.

There have been alternative explanations of starlight, for example, that it was created already travelling in a long stream of images between distant galaxies and our eyes. That proposal would require God to make up stellar histories, including the formation of clusters and galactic collisions and the expanding universe itself. All explanations of creation do need to be somewhat extra-biblical as there is a lot of science to consider. However, Genesis should not require inventing the imaginary histories that are required for a medieval style creation.

Consider the history of an exploding star to show how this explanation works in practice. In the winter of 1572, a nova was seen by the astronomer Tycho Brahe. It appeared as a dazzling new star that was brighter than Venus[560] for a time. It appeared in empty space where nothing had been visible before, shocking many observers who believed stars to be eternal. Today, the remains of this star is still blossoming out into a growing nebula. According to the light in transit explanation, all the details of events Astronomers observe, are stored in the light made at the moment of creation. So God must have created an invented history for Tycho's supernova stored in that light. The star was still complete and undamaged when God made the images that recorded its death and subsequent decay into fragments. The created light needed to include the motions of planets around their star and changes in the composition of that light as stars experience their usual cycles and random flares. It must show collisions, the formation of planets and their death as black holes or their stars consume them[561], or they collide. Along with supernovae like Tycho's discovery, and other more complex effects, like variable travel times caused by gravitational lensing, from other objects.

At larger scales, galaxies, too, have histories such as NGC4485, which shows the effects of a near collision in the form of many new hot blue stars and their planets. It is also now badly squashed and quite irregular. Where once it was a pretty spiral. This frequent event was invented by God for some unknown reason, according to the light made in transit theory. Why invented? Because the universe did not even exist back then but has only been around for a couple of thousand years. Why did God pretend it had happened? Why add the appearance of destruction and chaos, implying death along with new birth?

In addition to creating a 3D movie of events that had yet to occur at the time of creation, God would need to generate gravitational waves. He would need to add these massive signatures in the fabric of space-time at the proper distance from colliding stars in every direction to match imaginary destructive events. These must be timed to arrive at the exact moment as the light from their collision and the same direction.

According to this explanation, the universe is no more than a shadow play for a human audience. Embedding lies inside light is the same solution that Flat Earthers apply. They too believe the world is a conspiracy built to deceive them. You might as well say the stars are just paint and shiny reflectors on a fake sky. If you find yourself arguing that galactic or stellar histories are illusions created by God. Then, it's time to take a step back and reconsider your ideas.

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559 I recall looking into a galaxy core sized black hole swallowing the newly made Earth at one point, but had too much difficulty getting it back out as anything but spaghetti. The tidal forces in a black hole are insane.

560 www.nasa.gov/audience/forstudents/postsecondary/features/F_Tycho_Nova.html

561 A recent study found that around 8% of stars have consumed, one or more planets, after the formation of their solar system. Enough to alter the composition of the stars material. The early loss of planets due to instabilities in their orbit, is not yet detectable, but is expected to be common. C3PO: towards a complete census of co-moving pairs of stars – High precision stellar parameters for 250 stars, Yong, D., Liu, F. et al, Monthly Notices of the Royal Astronomical Society, Volume 526, Issue 2, December 2023, P2181–2195.

Nature's book is His message, but it's no lie. On the other hand, if you believe that creation did not include the stars, you will need to remove many verses from your Bible. Our sun and solar system circle the centre of our Galaxy and have been impacted by external events along that journey. There is no dividing line that allows us to pick and choose which stars to put in Genesis to make it sound more scientific. Even if we reduce the scope of Genesis that way, it still does not explain the defects in natural law that influence our planet and the entire universe, flaws that had no cause to exist before the fall of humanity. Only creation, placed in a cosmic context, can do that.

We wouldn't require any workarounds if our universe has its own timeline. Instead, we can accept that the light we see travelled across millions, and sometimes billions, of light-years of distance. It was not folded, spindled or mutilated[562] while travelling. It has been speeding towards our eyes for an equal number of years for a given distance. It shows the real history and development of the structure of galaxies, their stars and planets. It is not something faked up[563] by the creator for unknowable reasons of his own. For if we are willing to accept that God fabricated the vast majority of our universe, why not all of history? If that is true then we can't be certain of anything in science or in the Bible. No one is seriously saying God is dishonest. Yet it does show the problem with claiming evidence has been fabricated across the universe.

Infinity and Nature

"I am so in favour of the actual infinite that instead of admitting that Nature abhors it, as is commonly said, I hold that Nature makes frequent use of it everywhere, in order to show more effectively the perfections of its Author" – Georg Cantor

The idea of infinity is a doorway between science and faith. At least, it provides a helpful analogy. However, infinity exists in many different forms. Georg Ferdinand Ludwig Philippe Cantor[564] was the discoverer of the many types of infinity. He arranged the infinities he described into many different mathematical levels. Cantor also built up the mathematics[565], which describes sets of objects and their properties. Music was another interest of his since he was, in his own time, a violinist and performer. He combined fields by exploring the relationship of musical notes to the shape of their vibrations.

He identified the forms of infinity used in many areas of math and physics[566]. These can be arranged so that each type is larger in a provable way than those on the levels below. That may sound absurd, yet it is mathematically correct. Cantor demonstrated that there is an infinite quantity of natural or counting numbers. They make up the first level of infinity. Then, there is a higher infinity of real numbers, which includes all of the decimal numbers between those integers. There is an extra infinity of real numbers

562 Other than adding some red-shift. This was also an annoying thing to happen to punched cards, a simple type of cardboard storage from the early days of computing requiring the programmer to retype their programs from scratch.

563 It avoids the suggestion that conservative Christians are indulging in Last Thursday'ism. The idea that God set up the universe including a built in history. So that everything we remember and know could just as well be fake also. With the universe being created only last Thursday. Because if that was true we wouldn't know any different, since false memories of our lives and choices would also be included.

564 He alone, occupies the set of famous mathematicians with three middle names.

565 Bertrand Russell and Alfred North Whitehead used Cantors foundations to write the Principia Mathematica, a 3 volume treatise released between 1910 and 1913, demonstrating how to construct numbers and other mathematical objects from scratch using only sets and logic. Famously, it takes until page 86 of the second book to prepare the required logic to establish that 1 + 1 = 2, followed with the statement "*The foregoing proposal is occasionally useful*". More recently in 1931 set theory was used to show that mathematics itself is descriptive, being inherently incomplete and expressing concepts, observed in nature or accepted as true but that remain unprovable. See also Gödels incompleteness theorems.

566 For Cantor, infinity came in not two but at least three varieties: the potential infinity of limits, sequences, and series; the transfinite infinity of the infinite cardinal and ordinal numbers; and Absolute Infinity, which transcended mathematics and human comprehension, and which he identified with God.

between each of those first level, natural numbers. Real numbers like 1.5281 which are not neat or exact but found everywhere in nature, make up the second level of infinity. So, he proved that there are multiple sizes of infinite![567]. Each level connects to a geometric shape like a line or a plane, so the infinities can describe the geometry of a space. This process need not end, and mathematicians can move on to describe higher dimensions each larger than the one below. There are endless layers to the infinities that describe the universe.

Cantor's idea's about infinities might seem like they have no relationship to reality. "Pure mathematics is, in its way, the poetry of logical ideas" as Einstein put it. However we can use deep mathematics like Cantors to understand the logic and structure of our physical universe. Scientists solve problems with concepts like multiple levels of infinity, chaos theory, imaginary numbers[568], and spaces of many dimensions. Using these tools, scientific theories offer reliable predictions of natural forces like magnetism and gravity. This reflects nature itself. "*God is a mathematician of a very high order, and He used very advanced mathematics in constructing the universe*"[569]

As a committed believer, Cantor wrote that his mathematics helped him "*better understand the nature of God's works*". His investigation of the world of natural infinities is a profound truth with outcomes that are not yet fully explored. Cantor's mathematical discoveries are taught to young children as Set Theory and support advanced research[570] in physics and the geometry of space. To Christians, they provide a springboard for our thinking about the size of creation. We may have assumed that nature and the laws of the visible world are all that God created. But discover instead that there are many universes, each an element in an even larger multiverse. Yet each creation within can have independent laws and a flow of time.

567 Cantor received the Royal Society's highest distinction, the Sylvester medal, in 1904 and his study of infinity has inspired mathematicians for decades. The influential mathematician Hilbert once declared "*No one shall expel us from the paradise Cantor has created*", see also Cantor's theorem.

568 Imaginary numbers are called this because you can never point them out on a number line, this is because they are in some sense both positive and negative at the same time. While that seems a contradiction it permits mathematics to encode the extra information that exists in more than one dimension. So that an imaginary number can describe points in a plane, three dimensional space or more dimensions than we experience. So they turn up a lot in physics.

569 Physicist Paul A. M. Dirac writing in Scientific American (May 1963). To avoid misrepresenting Dirac's views he is not speaking of a creator but rather nature personified. "*The mathematician plays a game in which he himself invents the rules while the physicist plays a game in which the rules are provided by nature, but as time goes on it becomes increasingly evident that the rules which the mathematician finds interesting are the same as those which nature has chosen*"

570 For example in modern string theory ie The theory of Cantorian spacetime and high energy particle physics, Naschie, M.S., Chaos, Solitons and Fractals, V41, Iss 5, 2009.

The Light of Creation

This circumstance of an expanding universe is irritating
– Albert Einstein, 1929[571].

The universe is filled with static. Stars form because of gravity but generate radio waves due to their planet-sized magnetic fields[572] that also form visible sunspots. Their energy is fed by the stars' rotation. Many kinds of objects in space flash and bellow into the darkness around them. Yet beyond the songs of stars and planets, an older vibration exists. In every direction in the night sky, there is a background fizz of light. It is all that remains of the most intense flare of energy ever emitted. To explain it, we must look back to 1929[573]. At that time Edwin Hubble[574], an astronomer at Caltech, proved that the universe was much larger than anyone had expected[575] and expanding in all directions. From this discovery, two competing explanations developed. The Steady State Theory and the Big Bang[576]. The first allows the universe to create new matter as it expands. Matter just appears from some hidden and rather ghostly source. That permits the universe to look more or less the same as it does today, at least as far as galaxies go. The second treats the universe as a closed system. One that begins with a vast and concentrated supply of energy, which decays into lesser forms. Spreading out as it does. The Big Bang universe is an expanding bubble of space-time, with a few wisps of hydrogen and helium[577] that form the stars. The origins of the Big Bang theory began before Hubble's discovery. A Russian physicist, A. A. Friedmann had used Einstein's general relativity to model an expanding universe. At this time, it was a purely theoretical exercise. No one realised then that our universe was expanding.

Lemaître and the Magisterium[578]

The rate at which the universe expands is known as the Hubble-Lemaître constant. That naming honours Georges Lemaître. In some ways he was the co-discoverer of the Big Bang. He was among the first to model Einstein's theories of space and time across an entire universe. As a physicist, Catholic priest and astronomer, he had a clear perspective on this question. Both Einstein and others[579] had learned that Relativity predicted an expanding universe. But at the time, there was no physical evidence of that. Einstein's solution was to introduce an extra value to the equations[580]. That balanced the universe's expansion with an opposing force. For the moment, a stable universe seemed possible.

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571 As quoted in a New York Times article, Have Astronomers found God, By Robert Jastrow, June 25, 1978.

572 The Sun's average magnetic field strength is only about twice that of the earth, though the field is vastly larger. When it comes to the corona which is part of the sun's extended atmosphere however it can rise as high as 700 times Earth strength in solar flare loops, arxiv.org/pdf/1902.07514.pdf

573 He formally published this in 1929 but had first discussed his discovery in a New York Times article in 1924 and had been presenting it to other astronomers, which is how Lemaître became aware of it.

574 After which the Hubble space telescope is named, a device that has enlarged our understanding of so many things in Astronomy. Delightfully it is still generating new science after 29 years and is expected to continue operating in some form until 2030 or 2040.

575 Called a pioneer of the distant stars, after his unexpected death in 1953 he helped prove that there were endless other galaxies beyond our own, giving us a sense of the real scale of the universe for the first time.

576 Both were poorly named since the Steady State universe was still rapidly expanding. While the Big Bang started tiny and nothing at any time goes bang. The term Big Bang was originally applied as an insult by Hoyle, one its critics but sounds better than Theory of the Primordial Atom. Actually the Big Bang was more of a rapid expansion and cooling. Naming in science is often historical and weird but we are stuck with it.

577 The universe is mostly nothing, with a few puffs of gas as astrophysicists consider it. The rest is just insignificant trace elements like our planet.

578 The magisterium of the Catholic Church is the church's authority or task of giving authentic/authorised interpretation of the word of God, whether that word is in written form or in the form of traditions. It comes in three flavours depending if it is a common belief, decisions made by a council of Bishops or the Pope making a determination.

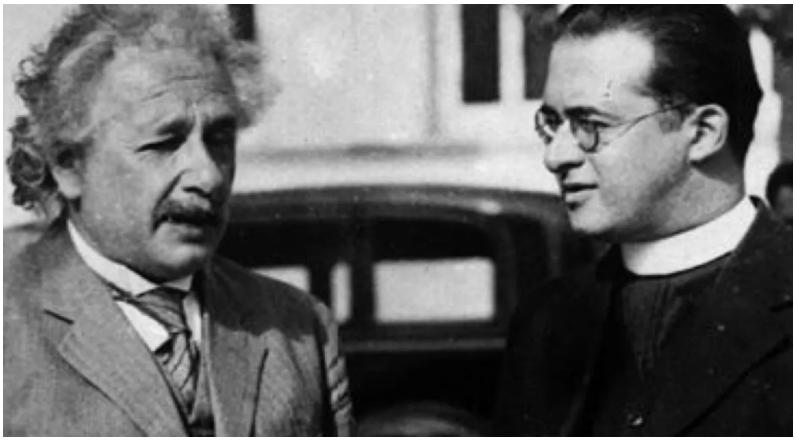
579 The original equations of General Relativity, had a hidden error within them. A divide by zero. When that was corrected it was clear that they predicted an expanding universe rather than a static one.

580 As Einstein later lamented, the cosmological constant that he added, was among his greatest scientific mistakes. Without it his equations predicted an expansion of space/time and implied a BigBang.

In the 1920s, astronomers were unsure whether our galaxy was the only structure in the universe. There was no astronomical distance scale. That might explain why most astronomers assumed a static universe. Lemaître was willing to explore a different option. He had seen the evidence from Erwin Hubble's early observations at Mount Wilson Observatory in California. He published his theory[581] in 1927. He estimated the speed of the expansion using those measurements. They proved that Spacetime was rapidly expanding, carrying along the rest of the physical universe.

Wherever astronomers pointed their telescopes every distant object was part of this rapid expansion. Lemaître understood that an expanding universe must have a tiny beginning. He called this origin point the cosmic atom, from which all matter[582] emerged. Einstein rejected the significance of the new astronomical discoveries for some time. He maintained his belief in a static, unchanging cosmos until 1930, when he travelled halfway across the world from Berlin to Pasadena to see Hubble's evidence in person. He examined Hubble's photographs, looked through his telescopes, and declared himself fully persuaded.

The following photo with Einstein was taken in 1933, after Lemaître's lecture at the California Institute of Technology on cosmic rays. By this time, Einstein was aware of the evidence for an expanding universe and had adjusted the equations of Relativity, to remove the extra balancing term.



Lemaître was determined not to mix faith into his scientific explanations or the reverse. In proposing the Big Bang, he was already suspected of making a religious case for a creator. That was never his intention, but some Christians were using his theory that way. Things came to a head in 1951 when Pope Pius XII proposed that the Big Bang was, philosophically, direct evidence for a creator. In attempting to develop that argument, he cited several scientists. The problem with that was not their discoveries but rather one of authority. One difference between Catholics and Protestants is a claim of an exclusive right to interpret the Bible and tradition. Only the hierarchy of the church has the right, they say, to create an authorised interpretation of scripture. One that, at least in theory, all Catholics should agree with. Using scientific evidence means that there is a second source of truth.

Theologians are delighted that the astronomical evidence leads to a biblical view of Genesis but curiously, astronomers are upset - *New York Times, 1978.*

581 In a Belgium science journal, in French, as a result his theory received scant attention at the time in the US or UK.

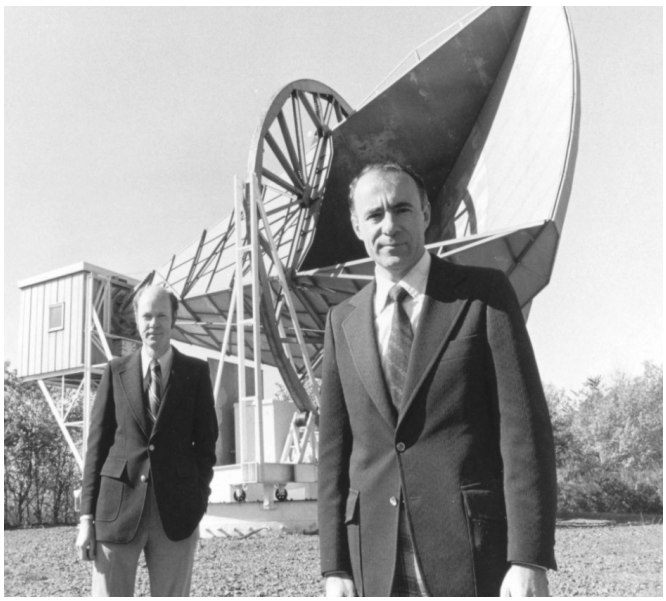
582 There was not at this time an understanding that all the known forces of nature and its laws had their origin at this singularity but they knew it was mysterious and physically different to anything that has existed since.

This trend worried Lemaître who immediately sought a closed but informal meeting[583] with the Pope. No record of that meeting is available, however in an interview in 1964[584] he spoke about this time. "*I am far too respectful of the religious authorities, who know well enough what they have to do. But certainly, I would warn. I have always warned my colleagues, well-meaning spirits, who would like to make an argument on this.. The beginning is not a place where you would touch God, as a hypothesis. I recall Jeans [Sir James Hopwood Jeans] words - 'the finger of God agitating the ether', and that was the beginning of the universe. Well, that's not... That's not a pleasant idea for a religious mind. It's an idea that brings God down into the realm of primary causes*[585]". There was no need for a beginning in the sense of a first moment of time in Lemaître's view. God could quite easily make a universe of endless duration. He is not needed as a first cause at least in a physical sense. Instead, God sustains the existence of everything, past, present and future and the physical beginning that was the Big Bang is no more vital in a religious sense than the present.

Following this discussion, Pope Pius would never again reference scientific findings or scientists in relation to a theological issue. The church's problem was not advocating a compatibility of religion and science, which many on both sides did reject. It wasn't only that the science of the Big Bang was still in its early stages. It was a matter of jurisdiction. The common view of separate spheres of knowledge did not begin with palaeontologist Stephen Jay Gould. It has also been insisted on by the churches. They are deeply worried about losing a monopoly on declaring the meaning of life, and God's actions. Perhaps science and religion are separate magisteriums, as Lemaître believed. Maybe they do not share methods in common and cannot speak to each other's problems. But they must, I think, grow from a shared source of truth.

Cosmic static

With Hubble's discovery of the evidence for an expanding universe, George Gamow extended his model. He became one of its keenest supporters. Ralph A. Alpher was a doctoral student working with Gamow. He was the first to predict that there would be relic radiation left over from the early stages of the Big Bang. This was in 1948 but several years passed and astronomers were unable to confirm that the radiation did exist. Still the model did explain many additional features of the universe and was being refined into a complete explanation. Such gradual refinements are normal in science. As Isaac Newton put it in a letter to Robert Hooke, a fellow scientist - '*if I have seen further, it is by standing on the shoulders of giants*'.



Yet sometimes discoveries are made while searching for something else. The discovery in 1964 of microwave light coming from deep space was made by accident. Robert Wilson and Arno Penzias were looking for microwaves that they thought might be emitted by our own galaxy. They had built a sizeable horn-shaped antenna that would pick up the microwave signal as the centre of the galaxy passed overhead. As they hoped, a clear signal was discovered. Yet they were confused about its source. It was coming from the sky but equally from every direction. At first, they thought it might be the result of atomic testing, the solar wind hitting the upper atmosphere, or just local interference.

583 This article, summarises the current view of this meeting from a Catholic standpoint. See The Pius XII – Lemaître Affair (1951-1952) on Big Bang and Creation by Giuseppe Tanzella-Nitti, Pontifical University of the Holy Cross, Rome.

584 Resurfaced 1964 VRT video interview of Georges Lemaître, Gontcho, S. G., Eluo J. B. K, Gabor P., Journal for the history of astronomy, Jan 2023.

585 To be fair to Lemaître this was in the context of God flicking the universe into existence with his 'finger' as if being the first cause was all that is required and there was no further relationship with nature required. However to say that we cannot meet with God at the origin of the universe was I think premature.

They eliminated every possible local source, replaced parts of the instrument and dealt with the pidgins that had left their droppings inside the horn[586]. Finally, they realised that the radiation really was coming from beyond the solar system and hitting the detector equally from every direction.

It didn't take long for supporters of the Big Bang, to identify this radiation, as the expected leftover microwaves that had been predicted back in 1948[587]. The cosmic microwave background represents a vast discharge of light. How large is it? Assume there was an imaginary battery that could store all the energy that the sun emits in all directions for nearly a billion years. Make each super battery just one cubic centimetre in size. How many of these magic batteries would [588]it take to match the energy, now visible as microwaves in only the area of the universe that we can see? A stack over a thousand kilometres wide, long, and high would be required!
For this discovery, that confirmed the Big Bang, Penzias and Wilson were given the Nobel Prize for Physics in 1978. This, along with related predictions[589] confirmed that it was an excellent model of the origin of the universe and the development of galaxies. Since the steady state model, is unable to reproduce or predict these effects, it is no longer accepted by astronomers.

Many universes expected

A few things remained incomplete about the Big Bang as a theory. The cosmic radiation discovered by Penzias and Wilson showed that the energy of the Big Bang had been evenly spread across space[590]. Simple Big Bang models on the other hand, made a universe that was far too concentrated and lumpy. Something else was needed to explain why this cosmic fossil and the universe itself had only slight concentrations of matter. It was astrophysicist Alan Guth, who in 1980, discovered the equations that allowed for a different kind of expansion, very early in the universe's life[591]. This period of Inflation was caused by processes that operate under the laws of quantum physic rather than relativity. For a period, space and time expanded exponentially at a speed that left it spread out, with only minor bumps of energy that would go on to form clusters of galaxies[592]. Since Einsteins era of science astronomy has focused on reconstructing our universes' history back to its beginning. Measurements in 1992 and 2003 by the space telescopes COBE and WMAP confirm that inflation occurred. Yet this solution came with an unexpected side effect. The forces and laws that drive inflation are powerful and chaotic. Somewhere beyond our universe, these inflationary forces will still be operating. They can generate new regions of the multiverse with different laws from the undivided energy of creation. Inflation is like a sheet of flame that moves ever onwards, expanding fragments of spacetime into new baby universes.

"The hot Big Bang occurred 13.8 billion years ago, but can no longer be identified as the beginning of space and time. Before it, a state of cosmic inflation occurred. Inflation solves a series of problems that

586 They were about to shed light on one of the most profound mysteries of our origins yet were nearly foiled by pidgin droppings. It is great that they did not kill the pidgins. The trap used to capture them is on display at a local museum.
587 That is 'black-body' radiation that was generated by an object that was opaque, non-reflective and at a single temperature. Unlike a star for example that has layers of different temperature, and which is partly transparent. Whatever created the cosmic microwave background radiation met black body conditions. Only the white-hot fog of hydrogen plasma that resulted from the Big Bang could have generated such a vast release of light of the right type. As it decoupled and the universe cleared enough for light to move freely.
588 This is not the energy of the Big Bang itself but just an echo or shock-wave from a period when the universe had cooled enough to become transparent, letting light travel freely. Specifically about 300,000 years after the beginning of our universe. Before that it was simply too dense and hot.
589 The Big Bang not only predicts an expansion but the right kind that matches observed red shifts. It also generates the observed relative quantities of light elements.
590 Also having an Omega parameter that results in space time on the largest scale being completely flat. While magnetic monopoles were also an issue, See www.physicsoftheuniverse.com/topics_bigbang_inflation.html
591 Many books call this a rapid expansion, but it was really slower compared to a conventional Big Bang while still being only microseconds of real time, the scaling factor is the key to what is occurring not how long it took. www.earlyuniverse.org/inflation-does-the-opposite-of-what-it-says-on-the-tin/
592 The space-time of our universe can have an overall gravitational curvature, one that affects its destiny.

otherwise have no explanation within the standard Big Bang framework, plus it's made several new predictions that have since been borne out spectacularly by observation" - Ethan Siegel[593].

In a physical sense, each baby universe is one of God's smallest miracles. Since it begins as a point smaller than an atom. Cosmic inflation provides a straightforward answer to the problem of the stability and shape of universes[594]. Inflation provides a sequence of events causing stable areas to appear in a primal energy field. These areas form a local universe that expands exponentially fast. The new universes can have the energy, and the exact density and distribution of matter, needed to make all of the rest of nature given time. Including today's stars and planets, or make a universe that is totally different. The Big Bang and Inflation together neatly explains our universe's energy and matter. Predicting its scale and consistency wherever we look. The inflationary forces that operated on our universe should still be active in regions distant[595] from our own. In the vastness, beyond the spacetime we know[596].

One additional problem with the Big Bang is the origin of time. That was precisely Augustine of Hippo's issue. What was God doing during the infinite time before making the world? Searching for Aristotle's first cause, scientists did not yet understand what had triggered the Big Bang and what came before. Their assumption was the same as Augustine's. Time was supposed to begin with the first moment of our cosmos. In a similar pattern, early astronomers thought the solar system was the only universe and our sun the only one of its kind. Then their worldview had to grow a lot after the telescope was invented. Modern physicists once assumed that physical reality was just the visible universe. That was a primary scientific principle, set in place by Plato. One universe, one perfect geometric set of laws. However, after scientists realised that inflation could be an endless process, that opened up another possibility. Inflation is eternal or at least indefinite in time, and various physical processes can trigger it. It has been known since the 1990's that our universes current expansion is accelerating and this is due to an inflationary force. The very same force must be accounted for in the universes origin when it's size allowed quantum processes to dominate. Inflation brings into existence many new universes. That solves one aspect of our universe's origin. Other universes are likely different in their laws and probably don't have stars or complex life. It is unknown, just how much of a universe's laws are varied by inflation. That is waiting for a grand unified theory of physics.

Inflation does not resolve the question of the laws themselves. Why do they exist? That is the typical infinite regression challenge for any origin explanation, which also gets applied to God himself. As in, who created God? The concept of eternity is supposed to overcome this problem in theology. However, Science is unconcerned about endless regression problems, since it is quite okay with unknowns, while some explanations may never be uncovered.

There is no clear Earthly analog for whats occurring this early in creation, and even the maths of the models is challenging for astrophysicists. The following might provide a vague sense of these early

593 bigthink.com/starts-with-a-bang/when-cosmic-inflation-occurred. - In principle, what lies beyond the observable Universe will always be invisible to us, yet there are enormous stretches of space beyond that are continually expanding even now. It's very hard to stop the Universe from expanding. As the inflating regions continue to become larger, for every place that freezes it's size, a new, larger region is being established. Even though most locations will see inflation terminate in a fraction of a second, there is enough fresh space being generated so inflation lasts indefinitely.

594 Specifically nearly completely flat. According to the leading slow-roll model of inflation. Since the inflaton field, the field that is responsible for driving inflation, is slowly rolling down, a shallow slope of potential. This results in a longer period of inflation and creates larger baby universes. One of its advantages is that it can be easily incorporated into other theories of physics, such as grand unified theories. This makes it a versatile framework that can be used to address a wide range of questions in cosmology and fundamental physics. Additionally, it makes testable predictions that can be verified through observation. This includes the specific properties of the primordial density fluctuations that seeded the formation of structure in the universe, based on the quantum fluctuations that terminate inflation.

595 There no way in English to describe the size of what is occurring here. It confounds human imagination which after all has trouble visualising even a mere trillion of anything. Like the number of possible games of chess, there just aren't enough exponents.

596 Most models of inflation lead to a multiverse. While "*evidence for inflation will be pushing us in the direction of taking a multiverse seriously*" – according to Alan Guth who originated the concept. www.space.com/25100-multiverse-cosmic-inflation-gravitational-waves.html

moments. Which values, out of all conceivable strengths for primary fields and their matter and energy, will appear in a given universe is likely random[597]. That is, based on the quantum forces at its conception. But they will influence each other, as will energy availability from the primal field. Each new universe represents a nearly instant phase transition, freezing from an inflationary background. When a region transforms, inflation ceases in that location. Then there is a localised Hot Big Bang, as that raw energy, decays into the radiation and later the complex particles of a new universe.

Physicist Andrei Linde of Stanford University has investigated the generation of universes in his chaotic inflationary model. There are several alternative models. Some of them have predictions, that can be tested. So this is part of continuing research and exploration in astrophysics. One example is the last theory created by Steven Hawking, likely the current centuries most well known physicist. He wrote in 2017, about his progress "*We are not down to a single, unique universe, but our findings imply a significant reduction of the multiverse, to a much smaller range of possible universes. This makes the theory more predictive and testable.*"[598]

Each universe is separated from all the others at birth, although they probably can collide[599] during their early history. However, distant universes are born[600], ours really is special. I believe the fine-tuning our universe shows in its laws is God's work. Although as a fallen creation the laws are not optimal, there are combinations that would work better and support richer ecosystems. The eternal inflation process explains in general how universes come about, but the creator's fingerprints are on many aspects of natural law. That is, assuming a fallen and chaotic universe, with living creatures adapting to survive, is what He created in response to sin[601]

597 Random but linked. It is most likely that the rules of nature do not require that a given fundamental constant have an exact value but rather that the constants are balanced when combined into particles and forces. In such a situation, there would be numerous alternative collections of values for these constants, which would be apparent inside each universe. However, due to the underlying symmetry of physics, these all obey deeper fundamental rules.

598 Taming the multiverse: Stephen Hawking's final theory about the big bang – University of Cambridge, 2/5/18

599 See www.earlyuniverse.org/eternal-inflation-and-colliding-universes/

600 There is also speculation that universes inherit their laws because inflation is not a totally randomising process. Black holes for example can trigger additional inflationary processes and they only occur in universes with long lived stars and therefore planets like our own. See for example, dS4 universe emergent from Kerr-AdS5 spacetime: bubble nucleation catalyzed by a black hole, Journal of High Energy Physics, article 107, (2023).

601 If our present universe was intended to be perfect without significant decay, suffering or death then the creator really messed up when implementing it.

Chapter 6 – Biology

A Maverick Biologist.

"The Truth must dazzle gradually – Or every man be blind."
Emily Dickinson[602]

Lynn Margulis (1938-2011) was an American evolutionary biologist. She was a professor of geoscience at the University of Massachusetts at Amherst, a member of the US National Academy of Sciences and a recipient of the National Medal of Science.

Margulis helped explain the early history of life on Earth. Once, the only living organisms were single-celled animals. They were all something like today's bacteria. That is, as scientists understand Earth's history. Groups of cells became successful complex creatures by cooperating. A symbiosis that combined early species was the key to this progress. That process began when two cell types joined. Each contributing to a stronger whole. This explained the origin of complex cells. Her explanation of the origin of early animals and plants was ahead of its time. Complete genetic sequencing was still years away in the 1960's. This concept of symbionts being adopted as new organs was at first considered very controversial. Over a dozen scientific journals rejected her reports. They were first published in 1967 in the Journal of Theoretical Biology.

Symbiosis explains early biology

She was the first to propose that the mitochondria, tiny creatures that inhabit the trillions of cells in every organ of our bodies, were once independent creatures. Then, they were incorporated into our distant ancestors and put to work as a permanent part of the cell. Margulis also predicted that organisms, which are the independent relatives of the mitochondria, would someday be identified. That was confirmed by genetic sequencing[603] of bacteria called Rickettsiae. These bacteria presently live as cellular parasites[604] in a range of animal cells, but do not generate energy for them. Chloroplasts inside plant

602 "*Lynn Margulis worked at the University of Massachusetts Amherst and resided next door to the house where her favourite poet, Emily Dickinson, had lived her life in the mid 19th century... Lynn's courage and grace in the face of considerable opposition was contagious, particularly for junior scientists. Unlike many who gain notoriety, Lynn always had time to interact with students. Many faculty members at the most prestigious universities in the world worked with Lynn at the very onset of their careers. We did not lose a leader. Lynn is and always will be the principal pioneer of our field.*" - S. Foster, J., J. McFall-Ngai, M. Introduction to the special issue in honour of the contributions of Lynn Margulis (1938–2011). Lynn Margulis: a 20th-Century scientist and a visionary of biology. Symbiosis 87, 1–2 (2022).

603 Mitochondria have over time lost most of their genes, with many useful ones being transferred to the cells nucleus, however this transfer has been inconsistent across different animal families and kingdoms. Organelles show signs of a complex origin with components adopted from multiple sources. That is consistent with their vast age, they have evolved since the beginning of complex life. Yet, most of their adaption occurred early in the history of life, close to the split between kingdoms. See Mitochondrial genomes revisited: why do different lineages retain different genes. Butenko, A., Lukeš, J., Speijer, D. et al, BMC Biology 22, 15 (2024).

604 A combination of biochemical, molecular, and cell biological data, along with the discovery of a gene-rich mitochondrial genome in eukaryotic microbes confirms a single endosymbiotic, α-proteobacterial origin. Especially in Jakobid

cells have many sequences in their instructions that are also found in cyanobacteria. Their independent history is clearly seen within their genes.

There are many examples of this style of cooperation in nature. One of these is the symbiotic algae adopted by corals. In a few species, the female coral injects algae into her eggs, but in most cases, they adopt free-floating algae or collect it from the waste of coral-eating animals. So, the algae is only partially integrated into the biology of their coral hosts. It hasn't become an internal symbiote like the mitochondria, even though it has a similar role. These beneficial relationships are essential to life but imperfect. In animals, a failure of symbiosis inside the cell can trigger multiple diseases[605]. Plant cells die if their chloroplasts generate too many active damaging molecules from sunlight. In coral, stress and damage to the algae leads to them being rejected and expelled. Then, the coral dies without a partner to generate its food[606]. So, these invaluable passengers can become the "enemy within" rather than a good servant.

Lynn Margulis questioned orthodox biology. She rejected mutation as the primary driver of evolution[607] in favour of symbiosis. She pushed the importance of genes exchanged between individual creatures. That includes the trading of successful innovations across species boundaries. Such innovations can alter the fate of entire groups of animals. This gene trading has occurred in the history of humanity and our relatives. Humanity carries helpful but also damaging genes from other species, acquired in just a few cross-species relationships. This focus on individual choices was against the accepted biology of her time. That saw creatures as puppets of their genes without any influence on their fate. While genes were moulded by competition rather than coexistence.

Gaia theory and controversy

We filter the world through the net of our assumptions, but now and then, whether by accident or effort, the net loosens, and the seed of a revolution slips through. In the 1970s, Dr Margulis extended the concept of biological symbiosis to all of nature, contributing to the Gaia theory. James Lovelock was another biologist who championed this approach[608]. In a nutshell, the Gaia hypothesis states that all life on Earth has a symbiotic connection with its surroundings. Life maintains the Earth's environment to ensure its own continued existence[609] in complex cycles with everything from the atmosphere and

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Flagellates which have mitochondrial genes that closely resemble a shrunken bacterial genome.

605 Might the strain on mitochondria induced by obesity, chronic stress, ultra-processed food, altered circadian rhythms, or mitochondrial damage caused by numerous environmental pollutants increase a process whose homeostatic purpose is to drive inflammation in a positive way? All of these triggers may result in increased release of mitochondrial components whether reactive oxygen molecules, metabolites, peptides, or nucleic acids, as well as hyper-activation of the sensors meant to cause beneficial inflammation, leading to inflammatory disorders. - A break in mitochondrial endosymbiosis as a basis for inflammatory diseases. Murphy, M. P. et al, Nature 626, 2024.

606 Symbiosis happens at many levels. Efforts to rebuild degraded reefs include mass collection and breeding of heat tolerate coral larvae, which can then be encouraged to settle in damaged areas by playing the sounds of a healthy reef on underwater speakers. These tiny creatures will swim towards the sounds made by territorial fish which in turn protect the coral which provides their home.

607 Although she had a farsighted understanding of the forces of biology, she tended to stick with views even when later disproven, for example insisting that the cilia used by some cells was adopted from bacterial sources because of structural similarity, even when gene sequencing showed it to be unrelated. Her reputation as a scientific maverick also saw her views being quoted out of context by proponents of various pseudosciences, including sadly creationists. Like other scientists that have discovered a whole new field of research – symbiosis, that became her sole working focus.

608 Lovelock developed the Gaia hypothesis while working at NASA in the 1960s. He observed that life has never been a passive passenger on Earth. Rather, it has significantly altered the world, forming new rocks such as limestone, influencing the atmosphere by making oxygen, and driving elemental cycles such as nitrogen, phosphorus, and carbon. This in turn has altered evolution, opening new niches. The result is a selection process that stabilises the environment, but occasionally can become unbalanced. That may lead to runaway changes driving widespread extinction – Scientists finally have an explanation for the Gaia puzzle, Dyke J., Lenton, T., The Conversation, July 3, 2018.

609 Gaia, although named after a goddess, is not the same as a single planet wide organism, and is not divine. "*Lovelock encouraged this metaphor, she claimed, because he thought it would aid the cause of environmentalism, and because it suited his own quasi-spiritual leanings. He says it's an okay metaphor because it's better than the old one. I think it's bad because it's just getting the scientists mad at you, because you're encouraging irrationality.*" - John Horgan, Scientific American Blog, Nov 24, 2011. R.I.P. Lynn Margulis, Biological Rebel.

oceans, to the planet's interior rocks. That is in harmony with Christian thought. Nature preserves elements of unity and struggles to live despite its handicaps. The symbiosis between species and nonliving matter on a massive scale supports life. It resists the drift towards decay that everything experiences. While symbiosis was vital for early lifeforms, her views do not explain the origin of modern species. They were also developed without insights from the new science of molecular biology.

She continued to research and educate in this field for many years. Another focus was writing popular science books like Microcosmos, Symbiotic Planet, along with Mind, Life and Universe – Conversations with Great Scientists of Our Time. Her remarkable insight into the origin of eukaryotic cells was one of the great advances of 20th century science. She was determined to pass on this important quest to understand the origins of life to the next generation. "*Throughout her life, Lynn championed science education, especially in less developed countries. Fluent in Spanish, she was revered by students in Spain and Latin America for her unflagging efforts to help them learn. Generations of American students also benefited from her engaging presence and enthusiastic support. In a very real sense, students and colleagues who were curious about science were all her children*[610]".

Margulis defined her role as a purposeful rebel against received wisdom. That approach is consistent with the spirit of science: constantly challenge your beliefs and other peoples ideas, against the facts. That drive for ever-stronger proof can come at a hefty cost. There are painful headaches caused when a new discovery upends previous neat models. Biology's past is littered with outdated and superseded assumptions. Yet, this complicated science has generated true certainties about nature. It shows how life has transformed over many eras, growing in diversity and endurance. She pointed out that evolution is more than a deadly competition for survival. However, even cooperation and the exchange of genes, come with a price. Gaia is resilient but not forgiving to failures. As Lynn put it 'Gaia is a tough bitch'.

Flaws in the cell

"My cancer is me. The tumours are made of me. They're made of me as surely as my brain and my heart are made of me. It is a civil war with a predetermined winner"
- John Green, The Fault in Our Stars

Both scientists and Christians believe that our world was not always as it is now. Believers look back to a universe free from decay and sin. It was a pure and balanced creation that reflected a loving creator. The explanation given by scientists is more chaotic. At the origin of all energy, space and time were compact, with no stars or planets. Then came the era of the first stars made from pure hydrogen. The matter of Earth was built from the remains of later stars full of complex heavy atoms. That matter was later brought together by the collision of many tiny asteroids[611]. That built up the types of planets we see in specific regions of the solar system today. Still later, life was found only in some deep springs or within the oceans, while the air was poisonous. Living creatures eventually expanded across the planet, but whole eras of history ended in widespread extinction. This story is not without beauty but it's design, if any, is very indirect.

If anything ought to reveal a handmade design, it should be a cell. Living cells are complex arrangements. They can be compared in complexity to modern computers, but their complexity does not prove handmade design. Think about the personal computer. The early years of home computers were the 1970s and 80's. Like early life, the first personal computers came in many competing forms. The first models were tricky to get working and were hand-assembled by the buyer. They quickly standardised and moved into the office, once small printers and spreadsheets were invented. Desktop business PCs

610 Retrospective: Lynn Margulis, 1938–2011, PNAS, Knoll A. H., Jan 20, 2012

611 More accurately called planetesimals. These are smallish bodies of rock that often include ice. They form by addition of many small bodies in the disks of early solar systems before the central star ignites. They keep accumulating and merging until a planetary system is formed. In our Solar System, small asteroids are often leftover planetesimals broken up then reassembled into cosmic rubble piles, which is one reason astronomers take samples of them.

were a new niche. After that there was a lot of money spent by companies on improvements. Businesses wanted them to be reliable. Like steam engines in the early decades of the 1800's, they went from being toys to being everywhere.

Personal computers quickly standardised around one or two models. These were the IBM Personal Computer, and the Apple Two, and a few others. In time, the best-supported computers with the most software outcompeted the rest. Early life was the same, except it ate up its competition or grabbed all available food. At first, cells distributed their instructions all around, floating near locations, where they were needed. But after the rise of the viruses, more on them later, they collected their code in a protected central store. DNA was like the magnetic tape that early computers used to load programs. Like tape, it is slow to find a particular piece of information, deteriorates over time and tends to tangle[612] and break. Still, it was a vast improvement over what went before. That was probably RNA for cells and stacks of cardboard cards with punched holes for computers.

Computers are engineered at great expense. Each generation has improved architecture, appearing in families of processors but eventually throwing away early limitations. Fortunately, they can still run older software even with the latest hardware. Cells developed in a similar way but they couldn't change parts[613] or improve quickly. Each cell required duplicate methods for their processes to allow the same thing. As a result, duplication is widespread in modern cells. Then, environmental pressures will find the best options for each species. Extra pathways allow old solutions to break or be disabled. For example, humans can no longer make vitamin C[614] but still have the machinery to do so. It is just disabled. That is why cells are so redundant and sometimes inefficient. They preserve old ways of surviving as a backup. These older schemes of life are a useful explanation in the context of cancer. However, some things were essential and could not be replaced or duplicated, like the molecules that cells use to store their instructions.

Modern cells are like an early computer with newer parts tacked on. They are stuck with version 1.0 for their storage and power systems while other parts have been upgraded. So how did they do that? How can you run the latest operating system on ancient hardware? It isn't easy, but there were some principles nature applied to take unreliable old cellular hardware and make a mammal instead of a blob of cells or a jellyfish.

Cells discovered how to network and coordinate via chemical signal and physical connection while remaining independent[615]. Species as simple as bacteria can act like societies[616]. For example, they build up resources, for later generations to use. But soon creatures became multicellular with specialised groups of cells for movement, breathing and eating. That allowed for backup plans and defences when under stress. They developed new richer lives in a complex environment.

612 Chromosomes were the solution to this problem, as well as coordinating genes with regulatory elements.

613 An analogy would be trying to change the tires on a moving car. It would be best to add an extra wheel to allow that to happen. Then retract the wheel you want to work on. So you can keep rolling along while things are fixed.

614 We just eat fruit to get our vitamin C, but pay a high price in the form of scurvy if we can't get it. Inuit people living in a fruit free environment used to eat raw whale skin and blubber, reindeer liver, kelp and uncooked seal brains to get sufficient amounts. Although seasonal berries were a tastier option in some locations, and could be preserved.

615 Hints of multiple cells cooperating may be traced back 3 billion years to imprints of what appear to be fossil mats of microorganisms. Some suggest that 2-billion-year-old, coil-shaped fossils of blue-green or green algae, known as Gryppania spiralis, discovered in the United States and Asia, or 2.5-billion-year-old tiny filaments documented in South Africa, are the earliest objective evidence of multicellular life. Other sorts of sophisticated creatures only appear considerably later in the fossil record. Often considered the most basic living animal, sponges may have existed 750 million years ago. Still, many scholars believe the first unambiguous animal fossils were a collection of frond-like animals known as Ediacarans, who lived around 570 million years ago.

616 Bacteria can develop antibiotic resistance through genetic alterations. However, they may protect themselves collectively by forming a biofilm. A thin, slimy film composed of many microorganisms that are less vulnerable to antibiotics.

Many layers of regulation[617] of genes helped work around the problems faced by early creatures. The first technique is having layers of code. These treat the genes as ingredients for more complex recipes that can be adjusted as the environment changes[618]. They reused and duplicated old genes, using them as building blocks. That generated many more kinds of proteins, which carry out the activities of cells. They invented genes that acted as promoters and inhibitors, to accelerate or block some steps, while allowing others to go ahead. Creatures developed ways to switch genes on and off in their life cycles, responding to current needs with internal signals. These include the short instructions called microRNAs, which control when genes become active.

Just like computers, they added error handling. So when things go wrong, and they often do, detectors pick up the mistake. Then something sensible happens to reset the process and continue. For example, managing copying or reading errors. To avoid becoming some other creature's lunch, they added specialist cells to sense and react. In time, some developed a brain, or in the case of Starfish[619], became a walking brain with legs.

Computers have a similar solution with operating systems like Windows, Mac OS and Linux sitting between the hardware, such as displays, memory, storage and the processor and the programs themselves. Programs don't have to know about all that stuff. They talk only to the operating system. The layers of gene regulation are the same. They affect creatures in particular situations. For example, at specific steps when maturing into an adult. They do this by triggering many genes at a time that, in combination, somehow get the job done. The regulatory network doesn't know or care how, so progress is often three steps forward, two steps back.

All of this does sound like design, and in one sense, it is. However, the 'designer' has been many cycles of life and death. Nature doesn't revise. It often gets stuck on currently working solutions and cannot back up[620]. An analogy is turning on a light bulb and then covering it with a little cap, which is removed when light is needed. Rather than simply operating the switch. No sane engineer would plan a system that way. What evolution can do is add extra layers to existing solutions. That can require odd workarounds like growing tissues, then immediately killing off all those new cells. These extras are just relics from some lost era. Once a needed structure, now an unneeded genetic memory. Yet it still gets built and immediately torn down. In order to move on to, the steps for making essential structures.

One example, is the migration of primordial germ cells within a growing baby. They must swim through its blood or gut and through layers of developing organs[621]. The end of their journey is the gonads. These are the ovaries or testes. The organs that will make the eggs or sperm that will someday become the next generation. The germ cells follow the chemical trail emitted by their destination. They need to travel a long way for such tiny scraps of life. This is odd because a wise designer would have generated them in their final location in the body. The vast majority do arrive safely at their destination.

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617 This includes epigenetics which causes reversible changes in the use of regions of DNA. Events in a parents life cause these rapid responses in their own cells and pass them to their children. For example starvation or intense stress. It allows species to prepare the next generation for the kind of stressors they will experience and lets adults adjust as well. This is vital in a world that can shift rapidly from abundance to starvation in a few years. In addition this regulation includes genes that are promoters which trigger the use of particular target gene. To act as a break on generation there are genes that block the activity of promoters switching them off. Also enhancers which increase the rate at which genes are applied. These can be distant from either the gene or its promoter which needs to be nearby. Enhancement happens when the DNA is bent or looped to bring two strands together. That is the role of the transcriptional protein complex. Epigenetic regulation via chromatin is also vital for human brain development in the cerebral cortex which I'll discuss in the context of our ancestors. The complexity of these many interacting regulatory layers creates plenty of opportunities for things to go wrong which is why most disease has a genetic contribution.

618 In IT speak this is similar to virtualising code, along with parallel processing across many host processors.

619 According to research published in Nature, starfish are genetically nearly entirely made up of cells from their heads even through they appear visually to be just arms. That provides insights into how these organisms became such odd evolutionary outliers.

620 A useful analogy is the fitness landscape in which species may not have the optimal solution but movement in any direction exacts a high cost so they are effectively stuck with something that works well enough rather than finding a better solution.

621 There is evidence that the organs concerned adjust their cell walls to allow migrating cell to pass.

This travel assists in eliminating a few percent of the weak and faulty, so it's not entirely useless. If the migration fails badly enough however, the fetus will become an infertile adult. Also the cells that make wrong turns and end up somewhere else in the body can grow into a lump of cancer. That is called an Immature Tetranoma and can grow in the developing baby or make it sick some years later. That is, if the misplaced and isolated cells fail to commit suicide first. Reliable cell death is vital in all living organisms to clean up after many normal processes.

This bizarre trek is just one of many unwanted and dangerous complications imposed on living things by unguided evolution. Unoptimised complexity works well enough most of the time but can be profoundly stupid. Biologists are aware of many examples of this kind throughout the body. As a result, almost all of them disagree with creationism's religious assumptions about a personal designer. There is plenty of complexity visible in nature but no fixed plans.

Does cell biology tell us about the creator or only a fallen creation? Cells are too complex and layered with half working controls, to be reliable in the long term. They are optimised by competition but also prone to failure and death. They have many checks to overcome their frequent faults. The cell is a wild mess of workarounds and controls layered on earlier patches. These adaptions record life's long history and battles. Cells need many backup plans. While failing cells are constantly eliminated before they become defective or cancerous. This inner strength and persistence allow creatures to face life's challenges, but it is costly. Unfortunately, cells are not direct evidence of a creator unless that being is deeply strange. The laws that made life possible are better evidence of God's good intentions.

A universe primed for life.

Most believers accept that this universe's laws promote and generate life. Even those who dislike the Big Bang and reject the existence of deep time agree. They have a problem with other laws. With natural laws like competition, limited food and chaotic genetics guiding species. That leads to a morally neutral world. In which being aggressive and victimising others can be of equal value to cooperation. An unguided free for all that has been magnified by human technology from the hand axe to the hydrogen bomb. Natural law shapes behaviour that has let humanity thrive physically but at the cost of conflict and suffering. As our understanding of God has grown we can see the obvious gap between nature and His moral principles. This is the problem of evil. It appears that God has created a universe with laws that lets evil appear frequently and not be restrained. We are instinctively aware of this down in our bones, from the first pained cry of a child to an elders last breath we sense the wrongness in ourselves and our world. Yet humanity is not the point where the falling angel meets the rising ape. We are more than passive victims of evil. Our ancestors first chose to walk in darkness. We are feral sons and daughters of the Creator grown up under laws that contain nothing of love, justice or mercy[622] and that has affected us deeply. This universe is the ultimate result of Adam and Eve's choice. Though it still contains exquisite beauty.

To see how deep the consequences of human choices go its useful to consider life itself, which shows the tragic defects in natural law. As Adventist church founder Ellen White puts[623] it, nature "*could not now represent goodness only; for evil was everywhere present, marring earth and sea and air with its defiling touch. Where once was written only the character of God, the knowledge of good, was now written also the character of Satan, the knowledge of evil.*"

Cancer is a strong biological illustration of this truth. It is a failure of cell coordination, and in that sense is not a disease at all. Instead it is a defensive state cells fall into when under repeated stress. Though the individual cells survive they undermine the body as a whole through unbalanced growth.

622 Although natures laws do allow those things to exist, at present they don't contain them. With apologies to Terry Pratchett, see Deaths speech in his book, Hogfather: '*Take the universe and grind it down to the finest powder and sieve it through the finest sieve and then show me one atom of justice, one molecule of mercy. And yet... And yet you act as if there is some ideal order in the world, as if there is.. Some rightness in the universe by which it may be judged.*'

623 Child Guidance, page 46.

As Thomas Malthus wrote, "*population when unchecked, increases in geometrical ratio*". That power of rapid growth is the cause of much suffering, in both individuals and species. "The power of population is indefinitely greater than the power in the earth to produce food". If food production cannot keep up with population, then death by starvation, and conflict will result. That turns out to be a natural law of biology. To quickly recover numbers after some disaster or drought, species must expand rapidly or be replaced by those that will. The universal forces of competition ensure there is never enough food or space for all the individuals that might exist. "*Nature has scattered the seeds of life abroad with the most profuse and liberal hand; but has been comparatively sparing in the room and the nourishment necessary to rear them*" as he described his insight. All living things will grow in numbers until they run out of food or until predators or diseases increase to kill them. Living cells must divide so the body can exist and repair damage but they must also die at the right time. Malthus realised that individuals or creatures have no such built-in limits. Only the balance between species prevents a single plant or animal species growing, until it collapses from lack of resources. While only constant vigilance prevents rogue cells from killing their host.

Charles Darwin's major contribution was realising that this tragic lack of resources was the ticking at the heart of nature. Adjusting wild creatures in the same way that Victorian dog, cattle and horse breeders were used to doing. That is, nudging future generations not towards a glossy coat or being relaxed around humans, but towards survival in whatever form and way of life the environment requires. Not always a force for improvement or progress, natural selection can stabilise or lock species into specialised ways of life that eventually doom them. While individual genes can work against[624] the life of the whole organism. It is truly a blind pressure, within what can be a complex landscape of influences. Cancer too is driven by environmental pressures but its exact form is random.

Cancer, like all suffering, is an embodiment of evil. As the book of Job demonstrates, mankind is being besieged from all sides, and our catastrophic position is clear to everybody. If the church does not recognise that the problem with evil is that it rules our current universe, it is denying a lot of natural evidence. Heaven does not exist beyond the orbit of the moon as the ancients believed, it is somewhere else entirely. This is not a holy universe, with a few bits damaged by sin, some of the worst things like death and pain are essential to its functioning. It is this aspect of evolution that Christians find the most troubling, despite the fact that it is an unavoidable consequence of sin. For it must be unavoidable, because if better natural laws could work in a fallen universe, God would have chosen them. As Christopher Marlowe puts it, in the speech of the demon Mephistopheles: "*Why, this is hell, nor am I out of it. Think'st thou that I, who saw the face of God and tasted the eternal joys of heaven, Am not tormented with ten thousand hells, in being deprived of everlasting bliss?*" Torn from God's splendour, our universe is the worst of many creations, but far from the most terrible possible.

Forgetting how to die

Cancer cells have forgotten how to die and how to cling together to cooperate with the rest of the body. Scientists note that the genes that allow cancer cells to switch to this selfish way of life are conserved from the simplest many celled organisms such as sponges and algae. That is the genes used by simple creatures where very little cooperation is needed between cells.

The changes that eventually trigger cancer are not evenly spread, through every gene in the cell. Instead some areas are weaker with a tendency to break. This has been known for some decades. Physically there is a second focus to the damage and that is in one type of organelle. An organelle is a miniature packaged up 'micro-organ' within the cells body, that you may not know very much about. One

624 The human genome is riddled with selfish genetic components that serve no purpose other than to reproduce themselves. The Dox sequence is one example in animals but there are many known. The X-linked Dox gene (Disruptor on the X) initially developed in insects to target a component of the Y chromosome, preventing the development of male Y-bearing sperm. If not suppressed this gene would result in higher Dox-bearing X chromosome transmission frequency as well as a damaging female-biased sex ratio because it would kill all male sperm. Within organisms, tiny evolutionary arms races take place. Selfish genetic components evolve to benefit themselves, while the remainder of the genome evolves suppressors to inhibit them. The selfish genetic components then work to out-compete the suppressor, forcing the suppressing genes to adapt to keep up, and on and on it goes.

of these vital components are called mitochondria. They are the only parts of the cell, to have their own instructions[625], stored in a circular loop, and combine and divide independently. They are like a herd supplying the cell with food. As farmers do, the cell manages them as its needs change. They are mobile and can also shift between cells. They can escape dying or crowded cells to move to a better home. They get involved when stem cells attempt to repair a damaged cell, migrating from their old home along thin tubes. They will replace any damaged or defective mitochondria at their destination. This can save the damaged cell from an early death. They are symbiotic and protected, rather than being slaves. They benefit from a protected life within the cell. Like cows and sheep they are carefully controlled and bred for a task. So they have lost most of their original instructions for an independent life. In plant cells the chloroplasts have the same task of energy generation and are also carefully managed.

Life within life

There are other examples of internal life within living cells. Deep sea tube worms, some protists, and many sap-feeding insects, rely on internal bacteria within their cells to process their meals. Sometimes such creatures have cells, containing internal bacteria, that themselves contain smaller additional bacteria. Each of which provides some critical components for the creature's life. Mealybugs, for example, are sap-sucking insects with nested bacteria that live inside the insects' cells. These bacteria, together with genes added directly to the insect's DNA from a third type of bacterium, enable the insect to survive on its nutritionally poor diet of plant sap. They were once invaders infiltrating the cell, but that was a long time ago. Many of these bacteria, like our own mitochondria, have a shortened set of instructions and are unable to live outside of their hosts. Such alliances may become permanent or change as new bacteria invade, if instead of causing illness, they are trapped and bred to perform useful work[626].

"Beneath our superficial differences we are all of us walking communities of bacteria. The world shimmers, a pointillist landscape made of tiny living beings." — Lynn Margulis

While your DNA is evenly split between your parents, the mitochondria came only from your mother. These useful bugs ancestors can be traced back in the female line only, to the first fully human mother. That woman is known as the mitochondrial Eve[627]. The line of inheritance does not end with her, but goes back to the first female mammal and far beyond to the first complex cells. If you could look inside your cells, you'd find mitochondria everywhere. Some remain stationary, fed by a network of tiny tubes. While others are active. Migrating along favourite paths[628]. Although the host cell provides what they require, their activities are essential to its needs.

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625 Although their DNA is mostly germ-like, it also contains code borrowed from complex cells and viruses so it might be described as a heavily altered bacteria. Its DNA is circular like bacteria but is much smaller than the average bacterial instructions, having lost many functional genes. Among living bacterial families, the α-proteobacteria are the closest identified relatives of mitochondria.

626 Snapshots of a shrinking partner: Genome reduction in Serratia symbiotica, Manzano-Marín, A., Latorre, A., Scientific Reports volume 6, Article number: 32590 (2016). - Ancient endosymbionts that can no longer survive independently have genomes as short as 112 thousand base gene pairs. More recently adopted endosymbionts have bigger genomes, up to the 4.5 million base pair genome of S. glossinidius.

627 The idea of a genetic Eve is well-known from the study of human genetics. It explains how all living people are descended in part from a single lady who lived in Africa between 200,000 and 300,000 years ago. Studies of mitochondrial DNA (mtDNA), a fragment of genetic material contained in human cells, provide evidence. Because only mothers pass it on, it indicates the straightest evolutionary line between a person living today and their most distant female ancestor. However, as with most simple stories, the story of mitochondrial Eve is neither wholly true nor comprehensive. Experts believe that the origin of humanity occurred in Africa, but Eve would have been just one of many human females alive at the time.

628 As well as being anchored at sites where their function is required and being able to divide and recombine, "*Mitochondria move in precise ways along cytoskeletal tracks, often displaying a preference for movement in a particular direction. During certain biological responses, mitochondria and other organelles move to establish a new population distribution, thus demonstrating active regulation of these movements*". Moving mitochondria: establishing distribution of an essential organelle, Frederick R. L, Shaw J. M., Traffic. 2007, Dec;8(12).

They are best known for producing Adenosine TriPhosphate or ATP, an end product of our food after a complex set of chemical reactions within the cell. This messy process generates many units of ATP for each sugar molecule processed. The rest of our digestion is mainly to obtain these sugar molecules. This mechanism within our cells is so necessary and consistent that we use and then recycle an amount of ATP equivalent to 45 kilograms every single day. Although at any time only about one gram of that is ready for cells to use. The energy efficiency of this conversion process is forty percent[629]. Which is similar to the best solar cells or engines that we can make.

Early cells that adopted the bacteria sized mitochondria into their bodies gained a powerful advantage over others[630]. Yet, in addition to supplying energy, mitochondria produce charged chemicals. This process causes damage, and pollutes the surrounding cell. The charged oxygen is corrosive and can rip apart DNA! In normal amounts this waste does not immediately kill the cell, and is useful in small quantities. Because mitochondria host these reactions, they are the most likely part of the cell to suffer genetic damage.[631] That is why they are linked to the origin of many cancers, and are hooked up to the cells internal monitoring system. A number of brain and heart diseases, are caused by mitochondrial problems due to this oxidation damage.

No easy cure.

Cancer cells often have dysfunctional mitochondria, causing them to use more sugar than a normal cell. Initially, cancer cells with damaged mitochondria won't spread or divide at all until they can steal healthy ones from surrounding cells[632]. This is also how some cancers defend against attacking white blood cells by extending tiny tubes to suck up the attackers source of energy[633]. They also use these twisting tentacles to sense their environment, move around and even squeeze into other organs. Healthy cells can also do this and are more mobile than we imagine. Cancer is so difficult to cure precisely because it adapts to its environment and even engineers other body organs to feed it, by for example triggering fatty liver disease. This has led to some desperate measures[634] to try to kill these confused and damaged rebel cells.

The second function of these tiny helpers is to trigger cell death. Cellular life is tightly regulated in our bodies because we are not one creature but many. We are a colony organism. Microscopic life is the basis for every multi-celled zoological species, and regulates our own life and death.

"Life at the surface of the Earth seems to regulate itself in the face of external perturbation, and does so without regard for the individuals and species that compose it. More than 99.99 percent of the species that have ever existed have become extinct, but the planetary patina, with its army of cells, have continued for more than three billion years. ...trillions of communicating, evolving microbes. The visible world is a late-arriving, overgrown portion of the microcosm, and it functions only because of its well-developed connection with the microcosm's activities.[635]"

On the end of each chromosome in a cells instructions is a cap, like the hard plastic tips at the end of shoelaces. This protects them and prevents them from getting tangled. This cap gradually shortens as

629 'The thermodynamic efficiency of ATP synthesis in oxidative phosphorylation', Nath S, Biophysical Chemistry, Volume 219, 2016, P 69-74.

630 The symbiotic theory of mitochondrial and complex cells origin is well confirmed it took place about 1.5 billion years ago and was likely helped by the increase of oxygen levels in the atmosphere known as the great oxidation event.

631 Mitochondrial mtDNA genes are among the most mutated genes in cancer tissue, with 25 of the top 30 most mutated genes being encoded in mtDNA see Respiratory complex and tissue lineage drive recurrent mutations in tumor mtDNA, Gorelick A.N, Kim M., Nature Metabolism, V3, April 2021, p558-570

632 The requirement for mitochondrial respiration in cancer varies with disease stage, Sheehan, C., Muir, A. PLOS, https://doi.org/10.1371/journal.pbio.3001800

633 Intercellular nanotubes mediate mitochondrial trafficking between cancer and immune cells, Saha, T., Dash, C., et al, Nature Nanotechnology volume 17, pages 98–106 (2022). "*The cancer cell sends out these nanotubes, which are almost like tentacles*" - How Cancer Cells Hijack Mitochondria From Immune Cells

634 For example engineering hyperactive T cells with HIV to treat cancer is a real and promising option, although it requires individual gene therapy so isn't easy or cheap.

635 Lynn Margulis, Microcosmos: Four Billion Years of Evolution from Our Microbial Ancestors (1986).

cells divide providing a timer that limits cells from having endless children. Researchers at the Salk Institute of Biological research, have shown that when these telomere caps get too short, they talk to the mitochondria. This communication sets off an inflammatory response from the mitochondria that kills the cell[636] before it can become cancerous. They release chemicals to create multiple breaks in the DNA of their cell when triggered by a variety of other situations such as cancer or infection. This includes when a cell breaks away from its usual surroundings. Without working instructions it will quickly shrink and die. That self-sacrifice needs to occur, or the whole organism will perish.

Because the coding of the cell is scrambled beyond repair as we age, there will never be a medication that will reverse ageing or a vitamin for that matter. The focus of efforts to lengthen life will probably be on the removal of damaged cells and the provision of healthy stem cells that can be encouraged to take the place of damaged ones.

What is more priceless than life itself? Something that causes harm to the individual while greatly advancing the species. It is the key to long-term genetic adaptability, needed to protect creatures from a hostile universe. Mutations serve as both the root of new life, and the source of death.

All living things are flawed.

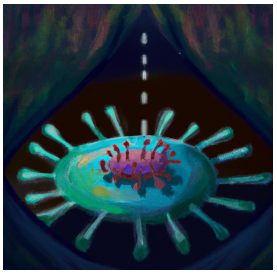
The heart of the Bible is the cross, and to understand the significance of death, we must accept this moment on which all history turns. It is clear that God's desire to help us is frequently thwarted by human decisions but also by deeper flaws in nature. Even his own beloved people rejected Him, they simply could not understand self sacrificing love. "*Many, many times I wanted to help your people. I wanted to gather them together as a hen gathers her chicks under her wings. But you did not let me*"[637]. Human pride resists God, and flaws in our biology undermine our best impulses. Cancer among many other proofs shows how the entire universe, not just humans, is missing[638] the glory and balance found in his other creations. Fortunately, we don't have to stretch to meet God halfway, he bends down to lift us up. Which is far beyond what we deserve.

636 Nassour, J., Aguiar, L.G., Correia, A. et al. Telomere-to-mitochondria signalling by ZBP1 mediates replicative crisis. Nature (2023). https://doi.org/10.1038/s41586-023-05710-8

637 Matt 23:37 ESV.

638 Although it still benefits from his sustaining power. However God does not typically intervene to prevent natural evil.

Going Viral



The virus that causes AIDS is the trickiest pathogen scientists have ever confronted. It mutates furiously, it has decoys to evade the immune system, it attacks the very cells that are trying to fight it, and it quickly hides itself in your genome – Seth Berkley[639]

Retroviruses are among the strangest parasites on Earth. They use a cell's resources and its miniature organs to reproduce. They also disprove the assumptions of traditional creationism. If the cell has a precise design, as usually assumed, then a virus must be equally designed to hijack that cell. Earth's various deadly and disabling viruses do not make sense, if God has engineered animal cells. As pointed out when discussing parasites. They are not the work of any good creator. A retrovirus has the keys to the cell's outer layers. It 'knows' exactly how to translate the code in their bodies into new instructions within their victims while turning off defences. It tricks the cells organs into accepting the code it injects as valid instructions.

Our cell's instructions are stored as DNA (Deoxyribonucleic Acid). While retroviruses use a related molecule called RNA (Ribonucleic Acid). Covid is an example of that virus type, along with the HIV virus that causes AID's. DNA is made from two linked sugar chains winding around each other. That gives it that famous structure that resembles a spiral staircase. In contrast, RNA has a single-strand[640] backbone with encoded chemical letters attached along its length. DNA is more robust and stable than RNA and can reliably store billions of 'letters'. A gene is a stretch of DNA letters, usually several thousand long. It records the steps to manufacture one particular protein a cell may need. To understand the scale of this process, a protein can be anything from one to a couple of molecules, although with numerous atoms in its chain. When not in use, the DNA strands are packaged up. Stored in a few protected chromosome bundles at the centre of the cell.

Our instructions are so lengthy and inefficient that entering every letter would take about fifty years of typing at sixty words per minute. Although our instructions are nowhere near the longest. That record belongs to a plain looking white flower with code more than 50 times longer than humans. If unrolled, the DNA from just one of its cells would be 91 metres long. That is also more than the longest animal genome, which belongs to the Marbled Lungfish. The length varies because some creatures have a lot of random garbage in their code or are better at purging unneeded instructions.

There is evidence that some giant viruses are old and rather like cells. Viruses may have once been a type of early parasitic cell. In time and with competitive pressure, it lost the resources to copy[641] itself. In addition to instructions, retroviruses have a complex shell of proteins. These proteins protect the virus and inject it into the cell. RNA viruses must convert their instructions using the cell's resources. The virus instructs the victim's organs to work in reverse, converting its RNA to DNA. That turns it into code the cell can store, and the virus must then integrate the translated code into the cell's nucleus to reproduce. That is a complex process that the cell tries to resist.

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639 Seth Berkley, at TED2010, talk HIV and flu — the vaccine strategy

640 RNA is singled stranded most of the time, but in some viruses it can be stored as a doubled and linked stretch of code. If cells detect double stranded RNA, that triggers an immune response, since it means a virus has penetrated the cell.

641 The origin and evolution of viruses inferred from fold family structure, Mughal, F. Nasir, A., Caetano-Anollés, G., Archives of Virology, 2020, Vol 165, pages 2177–2191. "*In a previous genome-wide analysis of the evolution of structural domains in proteomes, with domains defined at the fold superfamily level, we found the origins of viruses intertwined with those of ancient cells. Here, we extend these data-driven analyses to the study of fold families confirming the co-evolution of viruses and ancient cells and the genetic ability of viruses to foster molecular innovation. The results support our suggestion that viruses arose by genomic reduction from ancient cells and validate a co-evolutionary 'symbiogenic' model of viral origins*"

Virus infections can kill the affected cell once the virus starts to copy itself. Enough viruses can kill the whole infected creature or damage cells, triggering cancer. Rarely, though, something even stranger takes place. A virus inserts its instructions, but then something in the process fails. Despite being added, the new instructions do not harm the cell. The virus code is retained but is prevented from working. As a result, the cell now has extra code. That is dangerous if the instructions become active again. It can cause the cell to create viral proteins, fragments of RNA or a complete virus in the case of full reactivation. The disabled instructions are permanently added to its nucleus and found in any daughter cell it splits into.

If this occurs, the infection has become endogenous. That means it is built into the cell's internal instructions, which will be copied when it divides. When that infected cell is a newly fertilised egg, these built-in viruses are carried into every cell of the new baby creature as it grows. A young, healthy animal can deal with such instructions. It can store them without becoming diseased. Cells have many defensive processes, and usually, the generation of viral fragments is prevented, and those instructions are blocked or skipped. That is how cells respond to their own instructions[642] being defective. Viruses try to turn off or work around these defences. So there are defences but also counter-attacks by the viruses, which are then resisted by cells. The struggle between cells and viruses has generated countless innovations, as well as losses and stalemates. This long war continues to the present day.

Fossils in our genes

If that creature reproduces, its offspring will carry viral instructions in their cells. After generations, the viral code will become less risky, accumulating nonsensical mutations that break it up. The creatures with viral code may benefit a little. They may gain some immunity to that family of viruses or reuse the spare code to provide a new function. As extra genes without a current role, they can mutate, and generate new proteins. Given enough time, they may even become essential. For example, reused viral genes are used to time some stages of giving birth in humans[643]. The trading of instructions can go both ways. Viruses can adopt code from the creatures they attack to bypass their defences. Yet the virus itself is hardly alive. It is more like a tiny machine. It possesses only one purpose and has no independent life.

Virus DNA that has lost its harmful effects and been adopted into the cells of living things is part of a broader class of genetic components that work independently of other code and can be easily shifted or duplicated. This class of genes are known as transposable elements. They are recognised by both creationist and evolutionary scientists[644] as allowing for greater genetic diversity. Evolution might re-purpose them to regulate other genes[645] or as spare material for new functions as species change. Yet they

642 DNA Methylation is the most common way newly integrated viruses are suppressed. However this protection can easily fail. Methylation appears to influence gene expression by affecting the interactions with DNA of both chromatin proteins and specific transcription factors. Although methylation patterns are stable in somatic cells, the early embryo is characterised by large alterations in DNA modification. Germ cells appear to be able to also recognize virus-specific RNAs and chop them into a distinct class of small RNAs, called sense piRNAs, which usually block the formation of the virus. Studies suggest that this defensive process is identical in species from insects to mammals. See The piRNA Response to Retroviral Invasion of the Koala Genome, Theurkauf et al, Cell, 2019.

643 The placenta goes viral: Retroviruses control gene expression in pregnancy, E.B., Chuong, Plos Biology, 2018 Oct; 16(10) - "*Corticotropin-releasing hormone (CRH) is a protein that can be detected in maternal blood, and its concentration correlates with the timing of birth. In humans and other anthropoid primates, CRH is made by the placenta, whereas in other mammals, it is produced in a specialised region of the brain.*" Our ancestors reused retroviral genes to adjust the timing of this critical protein, controlling when it is released.

644 Thus undermining the belief of some creationists that evolution can not convey any new abilities, because that's exactly what these elements allow creatures to achieve by mutating unused sections of code.

645 This is likely where micro-RNAs come into the story, as these relatively tiny fragments of RNA regulate about 60% of the transformation of human DNA into working proteins with additional control of the genes. They are used mainly by mammals, especially during early development and in many cellular processes including controlling cell death. They are also found in greater numbers in humans than most species, although our nearest relatives have nearly as many. Micro-RNA sequences closely resemble nearby transposable elements, suggesting that they act as a resource from which they can evolve. The existence of microRNA networks and dark sequences does not prove that all DNA is purposefully designed and useful. It shows that long-term chaos and evolution have occurred in mammals and, even more so, in humans. For an overview of this topic and the occasional damage caused by transposable elements, see Transposable Ele-

can also be dangerous. Cells use various methods to disable these elements, preventing them from duplicating because they can also interrupt and damage functional code[646], cause disease and even kill. However, as always in biology, there is a mix of effects depending on whether the focus is on individuals or species. In humans, they are found cluttering our instructions through much of our DNA. These repeated sections[647] serve no current purpose, except for a few tiny areas. Scientists classify approximately one-third of Human DNA as 'transposable repeating elements'. Some of this code is from well-known virus families, while others are degraded, being copies of very ancient infections.

Closely related species likely share the same inserted viral genes. Humanity also carries a range of well-known fossil viruses that we share with our closest relatives. In a recent study in insects, for example, the five largest orders or groupings of species shared 153 common gene insertions that once affected their shared ancestors[648]. These genetic scars fit the known evolutionary tree of the species tested. There is no possibility that this is a coincidence.

It is true, that double-strand[649] DNA breaks are more likely in some regions. Still, for these discoveries to be a coincidence rather than natural evolution, every species must have the same unlikely infection in the fertilised egg of a shared ancestor. In the identical location in the DNA and with the same virus. These infections would have to occur to match the evolutionary tree structure and timing known from other evidence[650]. When all families of species and matching viral sequences are considered, these ancient infections provide solid proof of the converging/shared ancestry of all living things. It rules out simplistic, Kinds models of relatedness between species. Faith is built on truthful foundations. Everyone should accept that the evidence matters. God did not build with flawed genes. The truth is, we share both genes and ancestors.

Damage and responsibility

While viral fossils add diversity, they also create significant health risks. At the same time, they permit major innovations. Active genes that are presently unused can be a rapid reaction force. That can help animals adapt to new environments. For individuals, uncontrolled viral genes weaken and disrupt. Viruses cause suffering and evil. They were not part of the original creation. The damage they do goes beyond suffering the flu or young and old dying from infections or leaving genetic scars. Experiments with mice and rhesus monkeys show that any infection during pregnancy can be a disaster. If a mother's defences are triggered, then that can cause brain damage in her baby. That includes defects in brain structure, decreased volume in areas that perform higher functions, reduced levels of critical neurotransmitters, and behavioural abnormalities linked to schizophrenia. It's well known that events

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ments: Major Players in Shaping Genomic and Evolutionary Patterns, Romano N. C., Fanti L., Cells, 2022 Mar; 11(6).

646 "*repetitive DNA sequences trigger a response that is very similar to the one induced by DNA damage, which we know can lead to cancer*" also they can increase the risk of mutations, and block the healthy replication of DNA. - The mechanism of replication stalling and recovery within repetitive DNA, Casas-Delucchi, C.S., Daza-Martin, M., Nature Communications, v13, article 3953, 2022.

647 However, they give a clear measure of genetic distance since they can usually change without consequence, although uncontrolled duplication is dangerous. Such neutral mutations can be used to calculate the time since species with a common ancestor separated into different populations. If such DNA does not affect fitness, this does not imply that it is actively preserved for future use. It may one day benefit or harm the organism but for now it is just extra history that the cell carries about, and most genes of this type will never become active. For a more detailed discussion, see What We Talk About When We Talk About "Junk DNA", Fagundes, N.J, Bisso-Machodo, R. et al, Genome Biology and Evolution, Volume 14, Issue 5, May 2022.

648 Gene transfer is common in insects. Transferred genes that are shared are common in the most successful and therefore most diverse insect orders. This is expected given their long shared histories. "*Of the 153 distinct horizontal gene transfer events from other species that involved two or more species, 63, 20, 15, 12, and 8 were found in the five largest orders Lepidoptera, Diptera, Hymenoptera, Coleoptera, and Hemiptera, respectively*" - HGT is widespread in insects and contributes to male courtship in lepidopterans, Y. Li, Z. Liu et al, Cell, July 18th, 2022.

649 The twin threads of DNA are robust because it takes a break in both strands before a virus can insert its own code.

650 Neutral mutations cross check the age of a viral insertion. So the timing and sequence and not just the position is significant.

of this kind create disabilities in humans, causing suffering for several generations. That can all be caused[651] by an infection at the wrong time.

Since their only function is reproduction, viruses contribute nothing[652] to infected animals. They attack bacteria and reduce their numbers, but this is a side effect of the war for survival that goes on at all levels of nature, not to help defend humanity. It strengthens the attacks and defences of both sides, but we are just bystanders to their conflict. Did viruses once have a helpful function they have now lost? If God carefully designed them, it seems incredible that he did not know they would become a cause of serious disease, given how common they are. The oceans have around one million viruses per millilitre of water alone. So there are vast number of these things.

There is a difference between permitting predators to exist and carefully designing their fangs and claws. With design comes responsibility for their effects, both immediate and in our own time. The breeder of pets known to be aggressive and cause injuries would be held primarily responsible. That is one aspect of the 'problem of evil'. Handmade creatures come with responsibility for their nature and flaws. Only deep time, self-balancing laws, and a universe that has an open future resolve the question of evil without placing the blame squarely on God. Life is messy and often self-defeating due to it's tangled history, defying human assumptions of design and purpose.

Every complex creature and plant[653] spends significant resources suppressing viral instructions. This suppression has a few failures, in human genes. For example, one kind of transposon in humans, known as the Long Interspersed Nuclear Element, type one, is still actively duplicating itself. Research suggests that if the defences against these jumping genes fail in the brain, as individuals age, then their memory becomes damaged[654].

Viral code is present inside the cells of all animals and in plants[655]. Humans have about five to eight percent of the instructions in our cells known to belong to old viral infections. Some are easy to identify because part of that code still generates known proteins. These proteins form the virus's shell that will protect it and help it penetrate the victim's cells. Humans have a few active genetic parasites. You have about half a million copies of the Line-One[656] virus-like element in each of your cells. Most of these are entirely disabled but around 80 to 100 of them are still working. Their code generates a structure of proteins called ORF2p. This makes additional copies of the virus. It then tries to inject these copies into the stored code of the cell[657] somewhere else in the chromosomes. Fortunately, the cell fights back. Although, every time it's defences fail some extra copies get added. That is why we have so many.

However, that Line-One code, when not well controlled contribute to a number of diseases, inflammation and ageing. Activation of these genes is also the basis for a new test that can detect cancer any-

651 Maternal Immune Activation and Schizophrenia – Evidence for an Immune Priming Disorder, Choudhury Z., Lennox B., Frontiers in Psychiatry, 17 February 2021 - https://doi.org/10.3389/fpsyt.2021.585742

652 Although viruses are key drivers of defensive evolution. For example they are implicated in the origin of multicellular life and in cells suiciding when infected. See Virus-host arms race at the joint origin of multi-cellularity and programmed cell death (2014), Iranzo, J., Lobkovsky, A. E., et al, Cell Cycle. Oct 1; 13(19). However even antiviral defences can also trigger disease.

653 Plants do not have antibodies the same as animals, but have an 'elegant system that can generically recognize invading viruses and transposable elements and marshal the plant's defences against them.' using transgene-mediated virus resistance, co-suppression, virus-induced gene silencing, antisense suppression and transcriptional gene silencing. See 'Gene silencing as an adaptive defense against viruses', Waterhouse, P.M., Wang, M, Lough T. Nature, vol 411, p. 834–842 (2001).

654 Activation of transposable elements during aging and neuronal decline in Drosophila, Nat Neurosci, 2013 May;16(5):529-31

655 Endogenous retroviruses of non-avian/mammalian vertebrates illuminate diversity and deep history of retroviruses - PLoS Pathogens 14(6):e1007072 · June 2018

656 Structure of LINE-1 Reverse Transcriptase illustrates this, https://youtu.be/22JbyHVeCz0

657 The insertion of a different form of this virus like code in the middle of the instruction to grow a tail is the reason the great apes no longer have one. The very same sequence is found in humans. They have been a major force in shaping the structure and function of mammalian genomes although most are so mutated they are just molecular fossils.

where in the body using a blood sample. It works by matching a protein made by LINE-1[658]. That only appears in a very unhealthy cell. One that has lost its internal regulation and no longer controls what it is generating from its genes. You won't find that protein in the bloodstream of any healthy person.

A few instructions from ancient viruses have even been copied and reused in ways essential to our survival. That is impossible to explain using a traditional form of creation. Evolution is not rapid or focused enough for that to take place in a short period. At the same time, other viral instructions contribute to dysfunction and disease. Evidence shows they also contribute to ageing and death as they interfere[659] with cell stability. Some viruses are widespread in humans, for example, the virus that causes chickenpox. Just over half of the world's population has been infected by the Herpes Simplex virus, which can then remain dormant in the brain. The body tolerates these parasites, but age and environmental toxins can reactivate them. That can cause trouble, from the painful rash of shingles to triggering Alzheimer's[660] disease. Traditional creationists must reject all this evidence. They see it as insignificant that instructions for making prehistoric viruses are embedded all over our DNA. They deny the existence of any proof that shared viruses identify particular ancestors.

Most viral code is disabled at critical points to stop it from becoming active. Unfortunately, these instructions are turned off with a method that can accidentally be reversed[661]. If that happens, then viral chaos is released inside the cell. Even when such viruses are reactivated and cause disease, traditional creationists must continue to deny what's happening. It is like a car company adding explosives all over the engine but painting over the detonators so they won't explode. At least not immediately. Deadly viruses found in our genes are strange. Deliberately using a cause of disease and death as part of our bodies contradicts humanity being precisely designed and unrelated to other lifeforms. Yet these genetic scars are also records that reveal life's true history. Nature is full of conflicted biological histories. These infections only make sense as a consequence of sin and deep time.

The cell's first defence against a virus in its code is to prevent it from being generated[662]. It can try to do this by attaching a molecule based on methane to mark that part of the instructions. That preserves the code but prevents it from functioning. Instead, the partial instructions will be ignored or will generate non-functional junk. This process is unreliable. The extra molecule can easily be stripped from the instructions, revealing the dangerous code still underneath. That occurs in cancers, where most of these skip this step labels, are stripped from DNA letters. That can cause fossil viruses to be reactivated, and that failure, contributes to the disease, including the spreading of melanoma around the body in humans[663].

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658 "*ORF1p is a transposable element protein over-expressed in carcinomas and high-risk precursors during carcino-genesis with negligible expression in normal tissues, suggesting ORF1p could be a highly specific cancer biomarker*" - Novel Blood Test May Offer Early Cancer Detection, American Society of Clinical Oncology Post, 2/11/2023.

659 A LINE-1 component to human aging: Do LINE elements exact a longevity cost for evolutionary advantage?, Laurent, G., Hammell, N., McCaffrey, T., Mechanisms of Ageing and Development, V131, iss 5, 2010

660 Potential Involvement of Varicella Zoster Virus in Alzheimer's Disease via Reactivation of Quiescent Herpes Simplex Virus Type 1, Cairns, D.M., Itzhaki, R.F, DOI 10.3233/JAD-220287

661 DNA methylation is a universal epigenetic mechanism that suppresses gene expression in various ways. It is involved in the regulation of the activity of histone modification and gene expression regulation by non-coding RNAs. For example it allows females to turn off genes on their extra X chromosome. Unregulated methylation is linked to many diseases, while epigenetic age is a reliable predictor of lifespan – see Nature, Epigenetic Influences and Disease, Danielle Simmons, 2008.

662 In modern human DNA only a few sequences of viral code are easily able to duplicate themselves to new positions. The most common genetic parasite is LINE1. Its infectious working copies are called hot - LINE1 sites. Around 5000 sites have intact LINE1 code but these are suppressed by other defences. About 17% of human instructions are broken copies of this one virus. In addition another 5 to 6 percent are *LINE*-2 and *LINE*-3 sequences. The L1 molecular sequence has evolved to efficiently target all genomic regions unlike other parasites. These old infection sites are not entirely dead but contribute to human suffering by occasionally being activated. "*Accumulating evidence links L1 activity and the host response to common pathologies including cancer, aging, neurodegeneration, and autoimmunity*".

663 "*Expression of the human endogenous retrovirus (HERV)-K(HML-2) was found elevated in melanomas and it was shown that HERV-K supports the in-vitro transition of melanoma cells from adherent to a more malignant, non-adherent phenotype*" – That is, causing the cancer cells to change behaviour so they spread around the body in the bloodstream. Regulation of human endogenous retrovirus-K expression in melanomas by CpG methylation, Genes Chromosomes & Cancer, Stengel S, Fiebig U, 2010.

In the animal kingdom, there are many examples of infectious viruses being built into creatures' cells and causing disease. Such nearly complete viruses are also found in human DNA in a few populations worldwide. Usually, the immune system of the infected creature maintains control. Until stress or age weakens its defences, then it suffers from the effects of the infection lurking within. That is the situation with Koalas, Sheep and Cats, which all suffer from diseases caused by still active viruses within their cells.

The convention explanation is in trouble here. Such flaws cannot have been added after the fall. That is because we share the exact instructions with other related species at the same points in our cell's instructions. This problem is wider than just human instructions. Creatures share some viral fossils with their closest evolutionary relatives across almost every species with complex cells.

Rhino's & Tapirs

It's worth pausing to think about this more thoroughly. Perissodactyla is a biological group that includes modern horses, rhinos, and tapirs. Their name means 'odd-toed ones', all creatures with three toes or just a single hoof per foot. They have a common ancestor[664], which they share deep in their family tree. This ancestral species appeared in India long ago when it was just a massive island destined to collide someday with Europe. That was not unexpected as islands are known to be one of the engines that generate new species, and several significant families are believed to have evolved there during its slow cross-pacific journey[665].

This ancestor was about the size of a large dog but already had this family's three hoof-tipped toes, that are also found in early horses[666]. It must have had quite a few other advantages apart from tough feet. Its descendants would be very successful. Even, the odd ones like the oversized Paraceratherium, a hornless rhinoceros that measured 4.8 metres tall at the shoulder. This colossal creature has the distinction of being the biggest land mammal known to science. Its descendants and relatives would expand into open woodland and grasslands throughout[667] mainland Asia.

They looked like the sketch, based on fossil relatives that were tapir ancestors but close to the root species for all three families. Their horse descendants would eliminate two more toes evolving via creatures like Hipparion, which had two side toes with miniature hooves and a large central hoof. Today's horses would eventually settle for a single thick hoof on each foot to run on, although as their embryos form,[668] they still have five toe-like points of growth on the end of each leg. That shows the genetic inheritance of five digits from more remote ancestors that they share with humans. In comparison, rhinos have kept their direct ancestor's layout of only three toes.

During the lifetime of this ancestral species, like most mammals, it gathered a few viral fossils. These were passed down to its distant descendants, which included Asian and African rhinos, as well as

664 The species closest to the common ancestor that gave rise to horses, rhinoceros, and tapirs is known as Eohippus, or Hyracotherium, they were a quite delicate creature, only 30–60 cm (1–2 feet) high at the shoulder, but destined to start a major family of life. In their time, India had massive 15 metre long snakes, among the largest ever to live, so they would have been agile and extremely careful.

665 As for example Australia which originated not only gigantic marsupials, but also the Songbird (Passeriformes) family, from which, about half of all today's bird species originate.

666 Hipparion tracks and horses' toes: the evolution of the equid single hoof, Vincelette, A. R., Renders E., et al, Royal Society Open Science, June 2023. See Ancestors of Horses Had Hooved Toes Instead of Single Hoof.

667 An Oligocene giant rhino provides insights into Paraceratherium evolution, Deng, T., Xiaokang, L., Communications Biology, V4, Article 639 (2021).

668 Evidence of five digits in embryonic horses and developmental stabilization of tetrapod digit number, Kavanagh, K. D., Bailey, C. S., Sears, K. E, Royal Society Proceedings Bio Sci, Feb 2020.

horses. These species all share identical viral code in the same regions in their DNA. Yet a rhino and a horse are not the same 'kind' of animal, according to conventional creationists who focus more on appearance than genes. As a result, they interpret this information as proof of shared design. God chooses to copy identical virus-infected instructions into horses, rhinoceroses and tapirs in the same location in their cell's code. For some unknown reason, He then turns that off so it does not make broken virus parts any more, but instead does nothing but take up space!

African rhinos not only carry viruses from an ancestor they share with horses but have also acquired several fossil infections of their own. Along with shared viral code, they carry instructions from rat viruses that jumped species. The rat virus infected one of the current African rhino's ancestral mothers just after she became pregnant, and the infection was built into her single-celled baby. These instructions are not present in Asian Rhinos or horses. These newer viral fossils must have originated after the separation of the Asian and African Rhino species and there are several examples. White and Black African rhinos carry infections in separate regions of their code and from different families of rat viruses.

Major genetic differences[669] and a vast separation in time exist between Horses, Asian Rhinos as well as White and Black African Rhinos, so these species can't interbreed. They carry species-specific genetic fossils from infections but also share viral fossils and a lot of common functional instructions from their ancestor for things like their hooves. That shows shared ancestors, all of which have been part of the long struggle of animals against these parasites.

I'm sure you see where I'm going with this. Traditional creationism must invent differences between viral fossils to explain this evidence. One string of code can be real viral fossils from infections, i.e. the rat virus infections. That compares to the fake virus code God added at creation. That is the shared infections between horses, rhinos, and tapirs. Why? Because they show that species are related to each other in deep time. It proves they are distant family members, and species can change massively given enough time and divide into new species. That is something traditional creationism will never admit. As science learns more about the viral code in species cells and how it is shared and developed, traditionalists will find it ever harder to invent miracles to fix their theory, or they will likely ignore all of it.

Collecting extinct virus code may defend against their living relatives the same as army explosive experts learn. They can learn from bombs with the explosives removed. But it's unlikely that God arranged to assist creatures with this dangerous, unreliable and costly defence against viruses. After all He could have prevented those evil things from infecting any mammalian cells at all with a single change to our code. There is evidence of long-term development of cell defences in all living species. Viruses have also developed different methods to neutralise these defences in an arms race with living cells. When scientists reactivate fossil viruses, they are easily targeted and killed by current cells[670]. They represent a more primitive threat compared to modern viruses like the one that causes AIDs.

If a flood-centred form of creation is true, God must have decided to use virus DNA in the design of all creatures. Using it at precisely the same positions within the code, but only in closely related species, and including identical errors to stop it from working. The alternative that many creatures randomly collected the same viruses at the same positions after separate infections in their babies is ridiculously[671] improbable. It had to have been either design or inheritance. But to avoid admitting that humans share the same ancestors

669 Although the functionally extinct northern white rhino could mate with a southern white rhino, if there were any still alive. According to researchers, morphological and genetic differences suggest the northern white rhinoceros and southern white rhinos have been separated for around a million years, so offspring might not be viable.

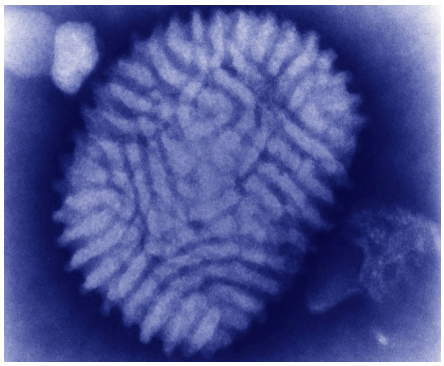
670 Journal of Virology. 2008 Sep;82(17):8762-70, Hypermutation of an ancient human retrovirus by APOBEC3G.

671 Pure probabilities do not apply to evolution because selection strongly skews the odds, but they do apply to where a fragment of virus will lodge in the instructions of the cell. There are known weaker points where DNA breaks tend to

as every other species, young earth creationism would have God make us all in part from dismembered viral killers. Also, they must prove some valuable function for every section of ex-virus DNA that we share. If there are any exceptions, that implies the creator used dangerous fragments of viral code for no reason at all!

For all members of whole families of species to have a set of instructions according to older creationist ideas, it must be essential. Yet many sequences remain inactive in living tissues forever, generating no proteins or RNA and not regulating the expression of other code. Deleting or mutating these sequences does nothing because they are already ignored. Evolution is always in random motion but is stabilised by long-term survival and a consistent environment. Disabled genes have no protection against the constant assaults of nature. That is how some individuals are missing large sections of viral DNA, have duplicated regions or have extensive changes without any effect[672] on their development. Current Creationist ideas also cannot explain why some viral code, when it does accidentally become active, contributes to diseases such as multiple sclerosis, schizophrenia, diabetes, systemic lupus erythematosus, seminoma, and malignant melanomas. Placing faith above reason is all very well, but God certainly did not build nature with such materials. Christians should just accept that all life shares common ancestors that have suffered because of sin.

Myxoma[673], a wild experiment.



Viruses could be designed by God to attack cells. Alternatively they have experienced strong genetic selection over a very long time. There is an arms race between the virus's code and the immunity of its prey. That was seen in one of the first and largest releases of a virus ever undertaken, using the Myxoma virus[674] to control feral rabbits in Australia. First released in 1950, this virus, which is similar to smallpox, was extremely lethal. Over the decades since it had gradually become less deadly, as surviving rabbits developed defences.

In the 1980's, something strange happened. The death rates suddenly increased again. The virus had evolved a new and powerful weapon. It gained the ability to suppress the rabbit's immune system. Rabbits were still dying and in much larger numbers, but not directly from the virus. Instead, their natural immunity was turned down so much that they were dying of sepsis from the common bacteria that every living creature carries. The immune system typically prevents these common species from breeding much, but it was now switched off. That benefited the virus as it could breed in more significant numbers within the dying rabbits that had lost every immune defence. The rabbit's life did not matter to the virus so long as it could spread faster. The same effect has happened with other viruses. For example, West Nile virus spread across North America after first appearing in New York City in 1999. It infects various hosts, including humans, but it is most commonly transmitted through wild birds. Yet as birds have become more resistant, the virus has, in response, become more dangerous, spreading faster and causing more severe symptoms.

Some families of viruses target regions of DNA in their victims that are essential and likely to be used frequently by the cell. That increases the chances that the virus will be generated by the cell. Other families avoid these regions, preferring a long-term 'strategy' of lurking within cells, not making many

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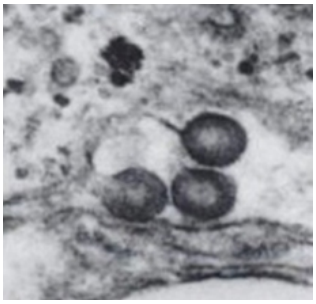
occur and areas that are more strongly defended since disruption kills the infected developing creature. However the probability of the same virus infecting in the same place and being of the same genomic age in two species is already highly unlikely. When we consider just how many times that unlikely event would need to occur to explain the viral fossil evidence for all species it becomes an impossibility, that only intentional 'design' or common descent can explain.

672 Even when vital genes are damaged or missing, living creatures have a lot of different methods to ensure an organism survives despite the constant assaults. That is due to alternative promoters or regulatory patterns that step up to supply needed materials when the usual instructions are damaged or missing. So this point comes with some caveats.

673 Photo is an electron microscope photo of the elaborate outer shell of the Myxoma virus

674 Evidence for Co-evolution of West Nile Virus and House Sparrows in North America, Duggal, N.K, Bosco-Luth, A., Neglected Tropical Diseases, Oct 30, 2014

copies[675] or attracting resistance. While the general area where viruses insert code can be targeted, the exact site is random. The precise insertion point allows us to confirm which fossil viruses have been inherited and which are new to a species. A second source of information is the mutational rate of the code. Once added, the viral code will decay, gathering random changes. These nonsense mutations occur within regions that do not have a function and indicate the general age of the insertion. Most fossil code is from viruses that, long ago, became extinct in the wild.



The black spheres in the photo to the left are Retrovirus particles budding from cells taken from a Rhesus Macaque. You might think the problem is an infection. It is instead an essential function. The cells in the photo are from placental tissue. Mammals must activate local defences when pregnant and keep them active even when no infection is present[676]. That requires reusing virus code to trick the immune system. This protection helps defend Human babies from real threats like the Zika virus.

A female's usual immunity is partly suppressed when she is pregnant. Otherwise, the immune system can and sometimes does attack the baby. That also means mothers are more likely to get sick, which also risks the baby's health. Direct immune responses can be harmful. Because viruses are most deadly when they are already inside a cell, the immune system attacks and kills infected cells. As a result, cells yell 'Virus!' at their peril. Viral sequences are repressed in most tissues to avoid being attacked by the immune system. Yet, it appears that the placenta deliberately creates this situation. How does it strike a balance between the health of the baby and a dangerous immune response?

Instead of risking a violent response, pregnant mammals generate viral fragments. These are copied from some ancient infection. That tricks the immune system into a gentler response. In a designed creature, placenta cells would come with extra defences. That would protect the baby directly. However, living things are not designed. By generating incomplete viral sequences, the immune system is partly activated. It will not escalate to a full attack and kill the 'infected' placental cells. Such bizarre workarounds are common. That is because evolution has no intelligence. It explores solutions randomly. Once a solution works, it is seldom reassessed.

A continuing battle

The amount of fossil viral code varies. It can change even between populations of a species. Koalas in northern Australia have a recently inserted, active virus in their cells. It increases their disease and cancer risk. The virus can completely escape the Koala's genes. It starts multiplying, infecting its carriers directly[677], sometimes killing them. Those in southern Australia and isolated islands are different. They carry almost the same code, but it is mutated at a critical point. The affected Koalas are carriers but develop normally. Viral sequences also contribute to the problems of old age. It is reactivated[678] in older cells, causing inflammation.

To summarise, viral code is found in all animal and plant species. Species share sequences with their closest relatives. Yet some fossil viruses are only found in a few species, and single-species infections

675 Insertion of Retroviral Vectors in NOD/SCID Repopulating Human Peripheral Blood Progenitor Cells Occurs Preferentially in the Vicinity of Transcription Start Regions and in Introns, Molecular Therapy, Vol 10, Issue 5,Nov 2004

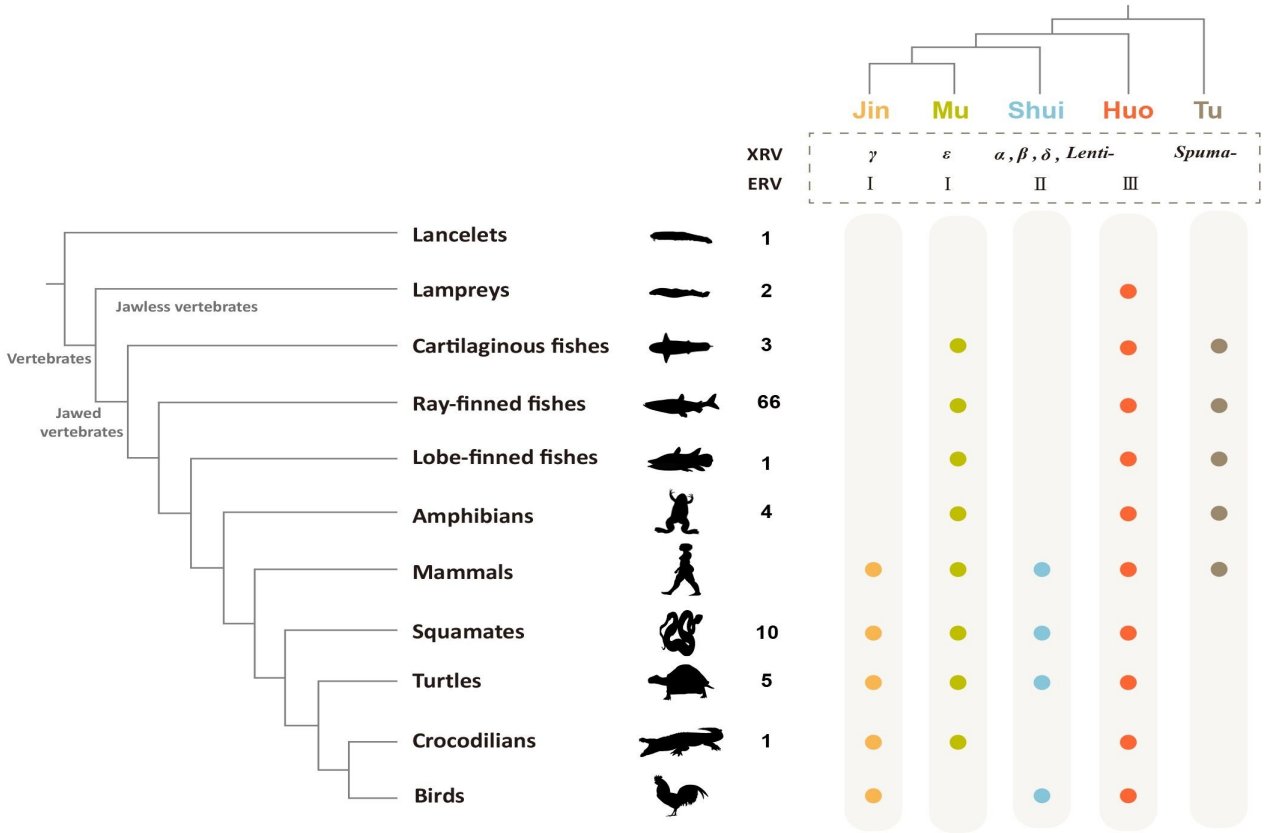
676 SINE RNA of the imprinted miRNA clusters mediates constitutive type III interferon expression and antiviral protection in hemochorial placentas, Wickramage, I., VanWye, J., Klass, M., et al, Cell, Host and Microbe, Vol 31, Iss 7, July 12, 2023. See also Quanta Magazine: During pregnancy, a fake infection protects the fetus.

677 "*It is considered to be a significant threat to the long-term survival of the Koala. KoRV has been implicated in the pathogenesis of two major koala diseases, hematopoietic neoplasia and chlamydiosis, the latter being endemic in the koala population*" - Long-read genome sequence assembly provides insight into ongoing retroviral invasion of koala germline, Hobbs M, King A., Salinas R et al, Scientific Reports, 20 Nov 2017.

678 Inhibition of 'jumping genes' promotes healthy ageing, Nature, 6-Feb-2019, Childs B., Van Deursen, J., www.nature.-com/articles/d41586-018-07553-0

are found in nearly all of them. That shows a common origin for all living things, along with periods of separate development.
Humanity shares several virus sequences with chimps, bonobos, and gorillas. We also have some that are unique[679]. Humans and other species had ancestors who once survived infections. They passed viral genes on to their descendants. This dangerous evidence would not exist without chaos and evil. Viral fossils offer no benefit to living things on a timescale of hundreds or even thousands of years. Only at the scale of deep time can spare genes outweigh the suffering of individuals. This knowledge may be tricky to accept. Yet it can help Christianity move beyond flawed models of the past. Instead of looking for workarounds to this evidence we can just accept that life is ancient, completely chaotic and sometimes harmful to other life because there is no escaping that truth.

In the following diagram, researchers looked for and analysed endogenous retroviruses in the genomes of 92 species comparing them with known records for mammals. They identified more than 8,000 endogenous retroviruses and were able to reconstruct full or partial genomes for about 450 of them[680]. Similar viral integration's are found in species genetically close to humanity. Humans share common ERVs with Chimpanzees, as well as the other members of Hominidae (great apes), the members of Hylobatidae (gibbons), and even members of Cercopitheciodae (the old world monkeys)



679 Many human endogenous retrovirus K (HERV-K) pro-viruses are found only in humans, Current Biology, V9, Issue 16, 1999.
680 Xu X, Zhao H, Gong Z, Han G-Z (2018) Endogenous retroviruses of non-avian/mammalian vertebrates illuminate diversity and deep history of retroviruses. PLoS Pathog 14(6)

Chapter 7 – Humanity

Ancestors

"Issues of origin prove to be these powerful anchors of our understanding.. We are driven to understand the origin of galaxies and stars and planets, we want to know the origin of life, we want to know where intelligence comes from and as we pass through the lineages we want to know where our genus came from. Where our species, has come from and this is a journey that we have vigorously pursued for some time."
- Brian Greene

The Bible is broadly accurate in its events and as it describes people and their lives. Christians must believe that or lose a great deal of our knowledge of salvation and God. Doubting our origin and future leaves us without any message. Providing no guidance for humanity that is unique to Christianity to carry to the world not already found in other religions. The Bible is not without errors in attributing events[681] or cultural bias. At the same time, we can believe in creation and the reality of Adam and Eve with the same certainty that we accept Jesus and Paul. The question is not, did they exist, but when did they appear in human history?

If we step away from a paranoid view of science as the enemy of faith, then all of its discoveries are open for our use. However, we do not get to pick and choose just the truths we prefer. The material that follows is likely to provoke controversy. Bacteria and viruses evolving is a fact. Bugs or flowers changing do not generate conflict, even whales and dinosaurs are known to have significantly altered over generations. Yet consider human ancestors, and you step right into the heart of the conflict. That humanity has roots that include many different species is something a modern theory of creation needs to deal with. How we approach that knowledge is the critical question.

For a long time, the study of prehistory revolved around discoveries around the Mediterranean Sea, the Indus Valley, Mesopotamia, and elsewhere. Especially the towns that gave rise to early human civilisations. That was natural because the ruins of communities leave a wealth of material that archaeologists can study. Another source has always been caves, where humans sheltered and left artefacts. Cave art, artefacts and bones revealed our ancestors. The discovery of other galaxies showed astronomers a larger universe. In the same way, with better dating and precise analysis, archaeologists began to see a deep human history. Their carefully collected knowledge of our ancient relative's lives and genetic links is our shared heritage.

A glimmer of our past

An early insight into our ancestors came in 1925 when Raymond Dart[682] moved from Australia to South Africa and began collecting fossil specimens. These were similar to our species in some ways. They were upright walkers, had human features and many other human qualities. Much evidence of our earliest origin would emerge from then on in Africa. That continent remains the richest source of human-like fossils. At first, this would be a trickle. Such creatures were far from a dominant presence in

681 Occasional, the Bibles writers credited God for politically motivated wars or genocide, or approved of abhorrent practices such as slavery or forced marriages.

682 Raymond Dart, an Australian-born anthropologist and palaeontologist, identified fossils of early human relatives, which led to predictions about human origins. His most famous discovery was the Taung skull, a human-like skull from a prehistoric child.

the landscape. Their fossils, including those from East Africa, were fragmentary and rare. As scientific knowledge grew, we learned where these remarkable creatures lived and how their bodies were preserved. Many more human relatives and trace fossils were located as techniques improved. So scientists understand a lot more about their lives, their diets and the ecosystems that supported them.

Currently, only one genetic type of human exists, our own. However, travel back three hundred thousand years in time, and you would observe at least nine different human species living around our planet. That would be a brief trip into Earth's history. You would pass through[683] just a few of its long-term climate's glacial or warm cycles. Not all creatures had the benefit of being personally formed by the creator like Adam and Eve. The person below is an ancestor of a group of humans. This group knew only the difficulties of our current creation and the consequence of sin. It was not like us mentally but shared something of our own humanity, and like any cousin we share some of it's genes.

The nearly complete fossil known as Little Foot.
If not in a direct relationship to our species
still inexplicable without deep time and human ancestors.

God made the most of the tragic situation of nature by enabling it to adapt and transform for self-preservation. Where required, He gently directed life to reconstruct larger classes modelled on the originals seen in Genesis. These were life patterns, such as flying creatures, fish and mammals. That was all so humanity might have a new home. Yet, present life is a fragment of the dazzling ecosystems that would have developed in the original creation. On our Earth, even the most connected web of life is fragile and can break down due to random extinction. While conflict and suffering is built in.

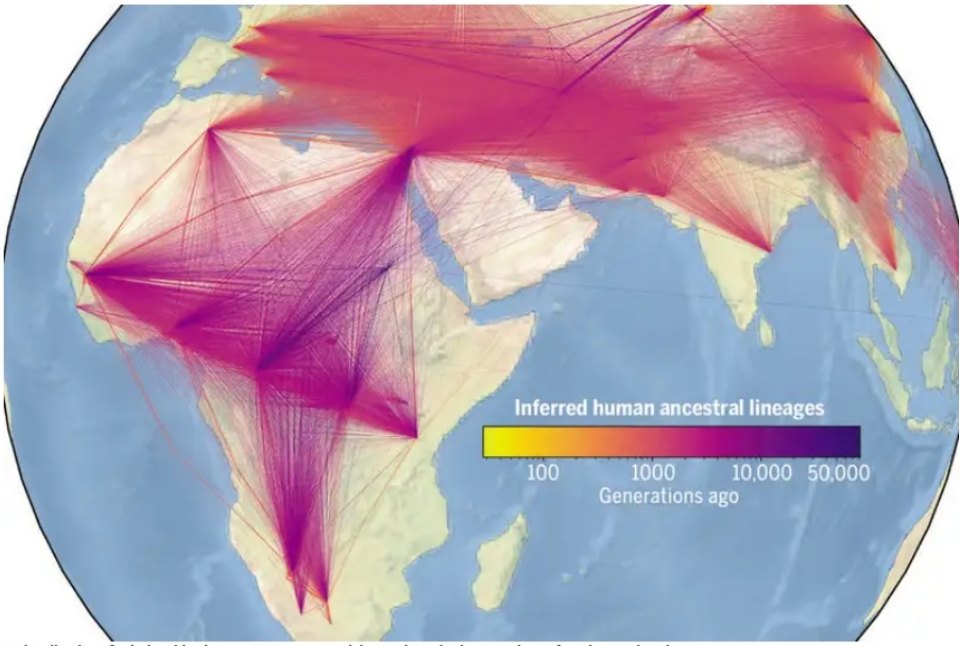
We can discover the effects of this damage to nature in our species' deep history. Looking back, we observe several kinds of humans living on this planet. That's not in any doubt. We have their bones, campsites, and the artefacts they left behind, but more significantly, we have their DNA. While our direct relatives stayed in Africa, these other branches of the family developed adaptions for life in the colder, tougher north. Splitting off to become the genetically distinct Neanderthals and Denisovans and likely other branches in China, the Philippines, and Indonesia.

Christian reasons for human nature without a genuine Adam and Eve living 'in clock time' are all failures. They must have been real individuals, but what is their historical context? When did they live? Was it around the time of the invention of farming and animal domestication? The first human conflict

683 These are Milankovitch cycles, which trigger glaciations and warm periods such as our current geological era, as the Earth's long term orbit shifts.

in the Bible was between the farmer Cain and his brother Able, a specialised animal breeder. From historical studies, we can identify when farming began in the Middle East, and it wasn't at the beginning of our species but much later. Animal domestication was earlier, but not by much for big herd animals. So, the context of Genesis after the fall from chapter four must be sometime after the early Stone Age. Adam's family was more intelligent than average and tended to be leaders of tribes and crafters of tools, metal and even musical instruments, i.e. Tubal-Cain. They are credited with the founding of cities from the time of Cain. If additional time is allowed between Adam and Abraham, then the later Stone Age is reasonable timing for the first historical events of Genesis.
That makes Adam and Eve's genetic contribution a significant factor for modern humanity. The first pair had superior genetics but lacked immunity and skills to cope with the diseases, parasites and predators that made life on Earth troublesome. Their family would gain that immunity as they mixed over generations with the other humans who had lived with those threats for ages. While over time, their distant offspring would lose the long lives that God had granted their parents.

The details and dating of fossil pre-humans discovered by science are significant. Prehuman species are part of the line of our ancestors or they are distant cousins. Their existence proves that Adam and Eve shared this planet with other intelligent beings. Humans united with the ecosystems that had developed here over time. They were shorter with diminished minds, technology and communications. Many more recent fossils were human, but not directly of Adam and Eve's line. Instead, along with all their ancestors, they developed in this remade universe. Advances in human thought began approximately 30,000 to 40,000 years ago. That included complex stone tools, figurative art, and signs of symbolic and religious thinking.



A visualisation of relationships between ancestors and descendants in the genealogy of modern and ancient genomes
Wohns et al. (2022)

Something caused that shift. It was the introduction of a new form of humanity. In the form of the only handmade humans made by the creator. Evidence of this revolution in thinking should emerge from the prehistory of the ancient Middle East. This period was when humanity became morally self-aware. A process that Adam and Eve's genes accelerated. However, their genes took a long time to reach every human worldwide.

Older transitions need to be considered before the beginnings of civilisation. Such as the stone toolkits dating back 2.9 million years, that predate modern humans. These were as essential to our ancestor's survival in the wild as fire. Much later, 1.6 million years ago, Acheulean tools were made by near humans who made 12 to 20 cm long, teardrop-shaped hand axes. These were finely made tools crafted from stone having excellent fracture properties. Hand axes were a significant breakthrough compared to previous stone tools. Still, they may have been partially instinctual[684] and used for social display purposes by prehumans rather than being evidence of individual artistic design. There is little evidence of

684 Their lack of variation with different stone sources or over time, suggests they were genetically primed. That is the ability to create exactly the same kind of stone tool was partly instinctive. So the tools that came from this behaviour were useful for status but not made with artistic considerations or even for practical use. Some examples were perfectly made but far too large to use conveniently as a tool being up to 30 cm in length and 7cm wide, The Acheulean hand-axe: More like a bird's song than a Beatles' tune? Raymond C, Adam J, Krist V, Mark C, 22 January 2016.

symbolic thought in Neanderthal's compared to early Humans. Neanderthal 'art' is just connected or parallel lines scratched into stone or finger marks in once soft materials. Compare that to the emergence of figurative art 35,000 years ago in the form of sculptures, beautifully detailed Aurignacian cave paintings like the one below known as the Horse Panel[685], and a vast array of specialised tools of every kind. Neanderthal's were out of the picture by that period in history, as they disappeared about 40,000 years ago.

Some of our ancestors were great travellers. From stone, shell and bone artefacts, there is proof of trade networks crossing large parts of the globe in every period of history. Yet before modern humans, at every early Stone Age site, there was nothing complex.

Older tools were used once and discarded. They were crudely shaped rocks or stones with usually just one cutting surface. These tools and techniques remained unchanged for many generations. There was no sign of a diversity of learning or exchange between cultures. That is hard to believe if any human groups of the same period knew better. For example, how to make complex hybrid stone tools, work metal and make pottery, glass and even string instruments as Adam's descendants did. Genesis, not coincidentally, claims that the first humans used technology from the copper age that is 3500 to 2300 BC. Such metal working only came with the specialisation that large scale agriculture brought. Throughout the African continent and beyond, trace fossils of human footprints and other animals show that our ancestors were walking the land over aeons[686] of time before that period. As ecosystems changed, they coexisted with, hunted and were preyed on by animals that are now long extinct. As in biology, existing forms of creationism ignore how complex the human story is. There is not enough time in a rapid world history for all that must be explained to happen. When all of this evidence is considered, Adam and Eve's creativity and mental abilities may well have contributed to the rise of modern humanity.

How do the discoveries from Denisova Cave[687] fit a flood-focused explanation? This well-placed cave was occupied for hundreds of thousands of years. The earliest inhabitants had distinctive Neanderthal[688] and Denisovan genetic sequences[689]. This site in the Altai Mountains of Russia is being investigated by University of Wollongong's Professor Zenobia Jacobs and scientists from the Max Planck Institute, among others. It shows evidence of occupation in different eras. The people that lived around the cave were not human but related to our species. They used tools all through the Stone Age. Designs changed as new techniques were discovered or culture shifted. Artefacts from their lives, from simple flakes to

685 A lifelike panel in Chauvet-Pont d'Arc cave, among the best of high Aurignacian period cave art Credit Arnaud Frich, Centre National de Prehistorie.

686 For example, Ichnological and archaeological evidence from Gombore II OAM, Melka Kunture, Ethiopia: An integrated approach to reconstruct local environments and biological presences between 1.2 and 0.85 Ma, Altamura, F. Bennet, M. R., et al, Quaternary Science Reviews, Vol 244, 15 September 2020. Which saw volcanic eruptions followed by repeated recovery of ecosystems and trace fossils including human travellers, over nearly a million years.

687 Denisova cave or the cave of Denis, is named after a hermit who lived in it during the 1700s. Internally it is about as large as a four bedroom modern house but much deeper, and contained many relatively undisturbed layers of discarded materials from previous inhabitants.

688 How Neanderthal DNA Helps Humanity - Quanta Magazine, May 2016, www.quantamagazine.org/how-neanderthal-dna-helps-humanity-20160526

689 Denisovan DNA is implicated in modern Tibetans adaption to high altitudes. This is also the first time pure Denisovan remains have been found in China see 'A late Middle Pleistocene Denisovan mandible from the Tibetan Plateau' - www.nature.com/articles/s41586-019-1139-x

complex artistic designs made from stone or bone have been found. This cave is a rich source of information because it was occupied from 300,000 years ago till recent times. Over 100 optical dating and 50 radiocarbon ages support the history of Denisova Cave. The evidence includes bone fragments of mixed Neanderthal and Denisovan[690] ancestry. There are no living examples of either of these species today. The early occupants of the cave did not include any modern humans, but our ancestors eventual took over the site.

Other closely related species are part of our own human story. Some cross-breeding with modern humans did occur with 3% to 5% of the DNA of Melanesians and Aboriginal Australians and around 6% in Papuans deriving from Denisovans but not being found in any other living humans. The dating, evolving stone technologies and the multiple forms of human DNA found at just this one site would raise questions in the mind of anyone open to the evidence. Aside from that direct evidence there is not enough time in a flood-based explanation for humanity to separate into different species.

Some of the strongest and earliest evidence for using fire comes from Gesher Benot Ya`aqov in Israel[691]. This site is dated to 790,000 years ago, and other discoveries show fire was widely used by our direct ancestors and cousins[692]. Using fire gave our branches of the Tree of Life an advantage and defence ahead of all other species. Yet something was driving our development beyond this beginning. Tool use has been discovered in many species. Only humanity has made it our lifestyle. Creationists of all types see the reflection of an active and inventive God in this human focus. These skills have shaped us in both positive and negative ways. For example, our teeth are an expensive investment in a growing body. As our use of specialised tools and agriculture grew, leading to softer foods, our teeth and jaws shrunk in proportion. We also lost muscle mass compared to our ancestors[693]. While many potent forces were acting on the human brain and body, no one can say which was the most influential on our minds. Scientists have always been comfortable admitting that many unknowns exist in this area. Some uncertainty in our origin is okay. Speculating without evidence leads to fragile explanations. It's a leap from the presence and use of stone and wood tools to being able to say precisely what kind of mind early humans possessed. On the other hand, faith explains why modern human minds are as powerful as they are. That is because moral reasoning requires the highest form of intelligence. It requires an ability to step beyond our personal needs and family and consider all living beings and their connections. Christian belief is that humanity is created in the image[694] of a God, who calls us his children and asks us to respond.

Prehistoric Israel

Support for the origin of modern humans being a mixture of genes comes from Israel. Israel was a crossroads even that long ago. It was a promised land for humanity in an age before cities made of stone or any group larger than a family. Some of our ancestors had crossed the Sinai Peninsula, which was less like a desert then. They had settled in Skhul Cave, on the slopes of Mount Carmel, and in Qafzeh Cave, located in Lower Galilee. When discovered, the lower layers of this cave contained several human bodies, a series of fire hearth's, flint scrapers, and points. There were also animal bones, in-

690 Two well known species that were close relatives.

691 See Evidence of Hominin Control of Fire at Gesher Benot Ya`aqov, Israel, Goren-Inbar, N., Alperson, N., et al, Science, Vol 304, Issue 5671, 2004. - "*The presence of burned seeds, wood, and flint at the Acheulian site of Gesher Benot Ya`aqov in Israel is suggestive of the control of fire by humans nearly 790,000 years ago. The distribution of the site's small burned flint fragments suggests that burning occurred in specific spots, possibly indicating hearth locations. Wood of six taxa was burned at the site, at least three of which are edible—olive, wild barley, and wild grape*". Archaeological data indicates that hominins (prehumans) regularly occupied the lake margin, over more than 100,000 years returning to produce stone tools, process meat, and gather a range of plant food. Remains of the latter preserved due to the waterlogged environment.

692 The record of fire use by Neanderthals is somewhat mixed. Hand-axe wear suggests our hominid cousins might have struck flint against pyrite to create sparks for fires. Some of their settlements were above the arctic circle in extremely cold areas, so would likely only have been viable with access to fire.

693 Earliest known Oldowan artefacts at >2.58 Ma from Ledi-Geraru, Ethiopia, highlight early technological diversity Braun, D.R., Aldeias, V., Archer W. et al, PNAS June 11, 2019 116 (24) 11712

694 The BioLogos foundation has a good summary of how this is still compatible with current biology. Search for How could humans have evolved and still be in the image of God (BioLogos)

cluding gazelle, horse, fallow deer, wild ox, and rhinoceros, and a collection of sea shells, some of these drilled for necklaces, as well as lumps of red ochre, and decorated flakes of rock. The skeletons were distinctly human. They had no brow ridges like Neanderthals, although there were hints of genetic mixing with those people. This group represents the first known appearance of humans with modern bodies and skills outside Africa. They were already accomplished tool users but were taking this ability to new heights. During this period, humanity made its first progress towards a sense of the spiritual and a relationship with our creator[695].

Modern humans are great travellers who like to spread our genes as widely as possible. That is demonstrated by the fact that 91 percent of the original arrangements found in our DNA are scattered among individuals and only 9 percent can be identified as belonging to particular continents[696]. As science has recorded, we share genes from small groups of ancestors at more than one point in history. One of these groups led an exodus from northern Africa through the Middle East and went on to colonise the rest of the world. That is what the best and most up-to-date genetic evidence shows.

The decoding of human DNA has led to breakthroughs in understanding our ancestors. Like most other creatures, modern humanity developed from a complex tangle of related species. They shared some of our abilities and flaws. Genes were swapped between related species, Neanderthal, Denisovan and unnamed others. All of which later died out, ending up as just footnotes to our history. Other subspecies, like Homo naledi, were left behind. They were a remainder from earlier times, not benefiting from the mental advances modern humans enjoy. When we examine prehistoric humans' skills, psychological and physical, we can see how God gradually nudged each one towards what he needed them to be. Each blossomed as that age's highest expression of mental abilities until that torch was passed to their descendants. Finally, their physical and mental abilities combined with Adam and Eve's specific genes to form modern humanity as God intended.

We can look back beyond the revolution in thinking that Adam and Eve introduced. Focusing on the broader picture and ignoring arbitrary lines dividing species is helpful when we consider early humans. The near humans of the deep past were different to modern humanity. All of them were reasoning creatures. All of them used various kinds of tools[697]. They would have had complex minds beyond other living creatures. Only some would have had a culture and language to explain the universe to their children. From the perspective of faith, that period was our species' babyhood. Like a baby, early humans would have had a limited comprehension of life. So, their responsibility would have been equally limited. A human without oral culture or the mental ability to make reasoned decisions carries no deeper guilt than an animal[698]. Responsibility grows with knowledge and power. An angel can sin in ways that would be impossible to humans and even beyond our understanding. Our ancestors could not avoid unintentional evil. Only God is without flaw,[699] but this was the mindless natural evil of parasitic wasps and erupting volcanoes.

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695 This was a failed attempt to settle the Middle East. Its not clear what happened to these early explorers, the record shows their occupation was short and was replaced by Neanderthal type humans for many years afterwards. It would be left to future migrations to expand to every continent across the planet but this occurred at a much later period. However there were ongoing contacts. Homo Sapient genes were exchanged with Neanderthal ones on at least three occasions. Research shows repeated gene flows. That began 250,000 to 200,000 years ago, and altered the genomes and biology of both modern humans and Neanderthals. Likely Neanderthals carried about 2.5 to 3.7% of modern human genes. Liming Li et al. 2024. Recurrent gene flow between Neanderthals and modern humans over the past 200,000 years. Science 385 (6705); doi: 10.1126/science.adi1768. Such widely separated contacts are impossible in a traditional constrained timeline of only a few thousand years.

696 Serre, D., Paabo S., Evidence for Gradients of Human Genetic Diversity Within and Among Continents, Genome Research. 2004. 14, p1679-1685

697 The hand muscles of Australopithecus sediba have activation patterns consistent with a similar suite of habitual manual activities as in humans. In contrast, the earlier Australopithecus afarensis and Australopithecus africanus display a mosaic pattern that combines indications of both humanlike and apelike manipulation of hand tools. If daily tool use and upright walking is human then Australopithecus sediba fossils from about 1.977 million years ago qualify, making them a close branch on the vast tree of our earthly relatives or candidates for direct ancestors.

698 Nor should we look down on them, but one link in a tower of being established by the creator, rising above us to powers unimaginable. "*Let this great truth be present night and day; But most be present, if we preach or pray. Look round our world; behold the chain of love. Combining all below and all above*" - Alexander Pope.

The human brain

We knew human relatives first from their skulls. They are a large and well-protected part of the human body. Skulls were always likely to defy the odds and become a fossil. Starting in the 1850s with our cousins, the Neanderthals, humanity realised that we, too, had an extended family and that our history was deep. A recently discovered fossil skull, an ancestor of the Australopithecine family that includes the famous 'Lucy', is a fine example. It fills in our knowledge of the human fossil record from 3.6 to 3.9 million years. It was found in 2016 by a herder looking after his flock of goats in northern Ethiopia. It is one of the best preserved of its type and age.

Regarding our origins, the primary use of a skull is that science can learn about the brain it once protected. The human brain is one of the most delicate and demanding organs ever. It functions most of the time to make sense of the world. Until suddenly it doesn't, mental illness can be particularly cruel. It afflicts us all, directly or through the suffering of friends and family. Some people are born with much reduced intellects, but everyone with a modern brain is far more intelligent than an Australopithecus. The human brain has many specialised areas, some proportionally larger than other species. 'Paleoneurobiology' studies the development of these brain structures over geological time. The inside of fossil skulls do not preserve brain tissue beyond an imprint on the inside of the skull. They do show overall development when considered against age and body weight. For example, Lucy's species, the Australopithecus, was slow to mature, showing that their babies would have had an extended childhood, allowing time for extra cultural learning. Just as modern human children experience[700].

What changed between earlier forms of humanity and ourselves? To answer that question, it might be useful to review brain anatomy. Each area of the brain tends to be specialised for specific tasks. In simpler creatures, this layout even includes a single neuron dedicated to one task, found in every creature in precisely the same place. The structure of regions of the brain varies according to their role. Language areas, for example, are highly variable in structure. They have complex connections between neurons. That is, compared to essential areas like motor centres. Areas that control movement and internal processes like digestion need to be efficient. Early scientists identified the expansion of our neocortex[701] as an obvious difference from other mammals. Still, there were subtle changes throughout the brain, including changes to chemistry and organisation.

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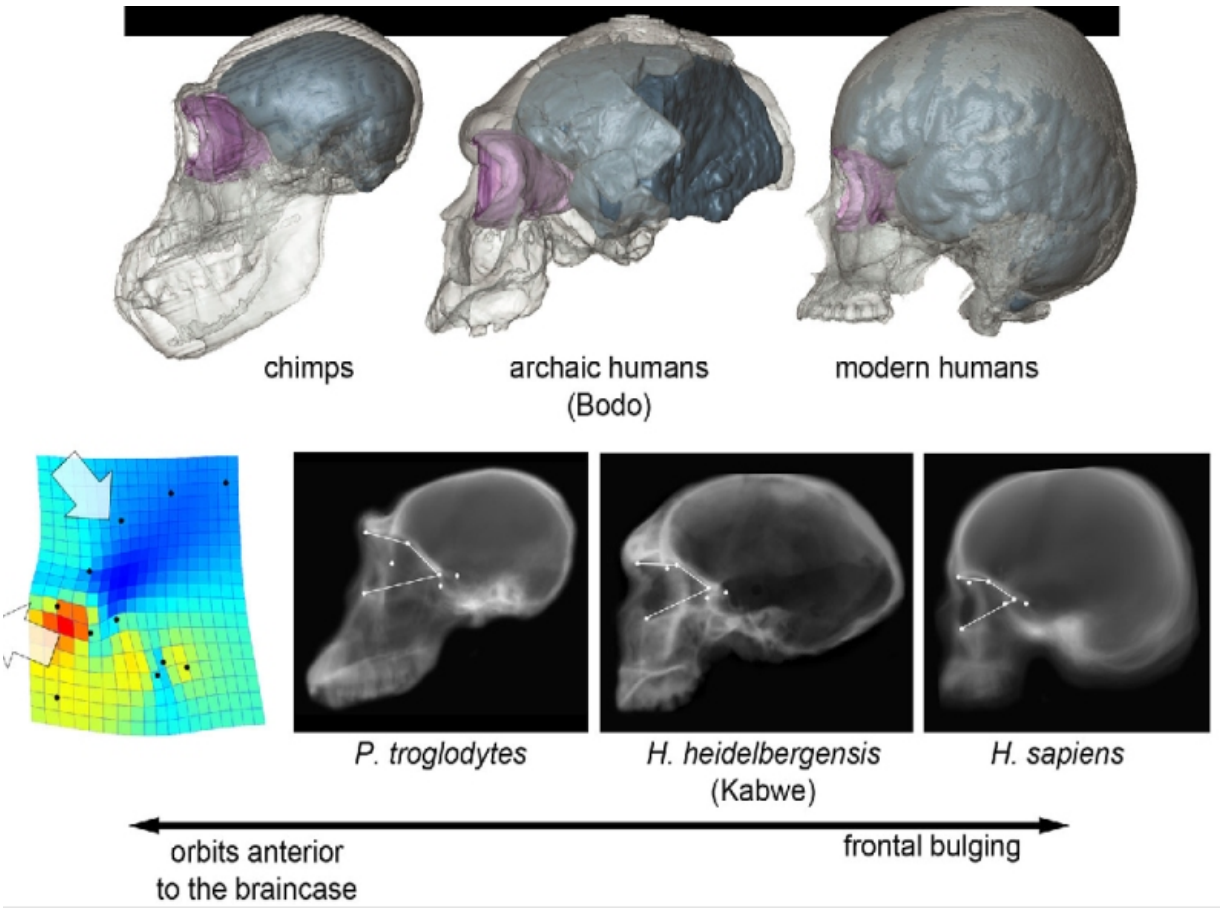
699 Luke 18:19 – Not even the stars are infinitely hot, they just seem that way on a human scale. So too good and evil. Compared to God everything in this universe is tarnished and faded. Even things which bear no responsibility for their nature carry the effects of sin.

700 Australopithecus afarensis endocasts suggest ape-like brain organization and prolonged brain growth, Gunz, P., Neubauer S., Falk, D. et al, Science Advances, Vol 6, Issue 14, 2020. Lucy's species had an ape-like brain, but its extended growth suggests that infants may have had a long dependence on caregivers. Professor Tanya Smith from Griffith University's Australian Research Centre for Human Evolution co-led an international team in determining that the oldest known baby in the hominid fossil record was 2.4 years old when it died."*We established this by counting the tiny time-lines preserved in its teeth, which is the only accurate technique for ageing young fossil individuals*"

701 The neocortex is a part of the brain of mammals. It is the top layer of the cerebral hemispheres, 2-4 mm thick, and made up of six layers. The neocortex is part of the cerebral cortex. It is involved in higher functions such as sensory perception, generation of motor commands, spatial reasoning, conscious thought, and in humans, language. The neocortex consists of grey matter surrounding the deeper white matter of the cerebrum. While the neocortex is smooth in rats and some other small mammals, it has deep grooves (sulci) and wrinkles (gyri) in primates and several other mammals. These folds serve to increase the area of the neocortex considerably. In humans it accounts for about 76% of the brain's volume. - www.sciencedaily.com/terms/neocortex.htm



The structural changes can be seen in the previous illustration, but deeper differences between ancient and modern humans are still being uncovered[702].

What even a quick glance at the brains in the image will show you is that modern humans have undergone expansion in several areas. Now as most people are aware size is not a reliable indication of function when comparing different species. Birds for example have extremely compact neurons in their skulls because every gram of weight counts for flyers. Their neurons are so efficient that birds outperform for their size on many tests of intelligence.

Among large mammals all of which share similar neurons, humans are an exception. We have brains that are six times larger than expected for a mammal of human size, and triple the size of an Australopithecus. All of this comes with a large cost in extra energy consumed. Which is why other closely related species have not taken the same path as us and increased their brain's processing power over time. "*On their typical diets of raw foods, great apes can't afford to fuel more neurons than they already have. To do so, they would need to spend an implausible amount of time on foraging and feeding. An ape can't develop a brain the same size as a human's, while still eating like an ape*[703]". The solution that allowed for bigger brains in our ancestors was a wider range of foods and also cooking. Both required more complex societies to sustain the needed techologies.

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702 From Language, Paleoneurology, and the Fronto-Parietal System, Emiliano Bruner, Front. Hum. Neurosci. 2017

703 "*To afford a brain that's about two percent of its body weight (as in your head and mine), a primate that fed for 8 hours a day (like a gorilla) couldn't be heavier than 42 kilograms, or have more than 49 billion neurons. If it fed for 7 hours a day (like a chimp or orangutan), it couldn't be heavier than 26 kilograms or have more than 32 billion neurons. To pull off a human-like brain-to-body ratio, primates would have to sacrifice both mass and neurons. The largest great apes cannot afford both a large body and a larger number of neurons.*" - Metabolic constraint imposes trade off between body size and number of brain neurons in human evolution. Karina Fonseca-Azevedo and Suzana Herculano-Houzel, PNAS November 6, 2012 109 (45) 18571-18576

The skull of Australopithecus Amanuensis as it was found. Note its small size and flat fore-brain[704].

Cooking food greatly increased the nutrients available in both root vegetables and also meat[705]. Harmful bacteria are killed while plant foods with defensive toxins are made safe to eat. This is known as the cooking hypothesis, and was first developed by primatologist Richard Wrangham in 1999. It helped explain how early hominids like Australopithecus might be related to modern Homo sapiens with our much larger, more expensive to operate brains[706]. Traces at sites where Neanderthals and early humans cooked meals show they collected and processed in multiple stages a wide variety of wild grains, nuts, herbs and roots, along with large wild animals. Quite a bit of effort went into improving the taste of food, which must have been a special focus for them just as it is for modern humans. "*Our ancient ancestors ate a varied diet depending on where they lived, and this likely included a wide range of plants*" [707]. Yet cooking, like everything else in this universe, has a drawback. It damages the DNA in foods. Cells have been shown to take up damaged DNA molecules from both plant and animal foods, and higher temperature cooking especially of meat causes more proportionally more damage[708].

704 Discovered in 2015, Image: Yohannes Haile-Selassie, Cleveland Museum of Natural History – Australopithecus Anamensis is the earliest species of this genus to have been found. This is the same genus/family as the famous Lucy fossil. Fossils attributed to Anamensis have also been recovered from sediments dating to between 3.8 and 4.2 million years at the sites of Kanapoi and Allia Bay in northern Kenya.

705 However, there is a cost since it is hypothesised that cells pick up faulty DNA from meat, which is more damaged by high-temperature cooking, this is likely hazardous to cellular health.

706 How much more expensive? Brain cells use about 22 time more energy to run than muscle tissue. The adult brain in Homo sapiens requires 20% of daily energy intake, although it makes up only 2% of the body mass. The energy is primarily used by its 90 billion neurons for signalling processes and resting potentials. The number of synapses per neuron increases with brain size, with humans having the greatest number of synapse connections. Blood flow also increased steeply during the last 3 million years of human evolution, shown by a six-fold increase in total cerebral blood flow rate. Neuron number in living primates scales linearly with brain mass, suggesting that the number of neurons likely doubled during hominin evolution. - From Fossils to Mind, de Sousa A, Beaudet, A et al, Comm Biology, 2023.

707 *"Plant material found at the Shanidar Cave in northern Iraq, most famous for a Neanderthal burial and Franchthi Cave in Greece revealed prehistoric cooking by Neanderthals and early modern humans was complex, involving several steps. Wild nuts, peas, vetch, a legume which had edible seed pods, and grasses were often combined with pulses like beans or lentils, the most commonly identified ingredient, and at times, wild mustard. To make the plants more palatable, pulses, which have a naturally bitter taste, were soaked, coarsely ground or pounded with stones to remove their husk*" - Cooking in caves: Palaeolithic carbonised plant food remains from Franchthi and Shanidar

708 Possible Genetic Risks from Heat-Damaged DNA in Food, Jun, Y., Kant, M., Coskun E., American Chemical Society, Central Science, Jun 2023.

With closely related species, an increase in particular areas provides evidence of expanding abilities. For example, most creationists recognise that the Heidelbergenis[709] skull, seen earlier in this section is human, although of an unusual type. Brain surface area is the key to boosting intelligence. You can fit many more cells in complex networks over a folded surface than a flat one. The human cortex is only fifteen percent thicker than in macaque monkeys but has more than ten times the surface area. It also has many more connections between the neurons, both on a local level and links between specialised areas.

There is evidence that compared to chimpanzees, humans have less standardisation in our brain cells[710] than other mammals. In addition, the organisation of cells in the top layer of our brains is known to be significantly different from that of Neanderthals[711]. Neanderthal genes emphasised brain networks devoted to visual and spatial abilities ideal for hunting or gathering rather than social interactions. Our brains are more flexible in structure and organisation and take much longer to mature. That is a mixed blessing, for adaptability adds to our cultural richness. While slower maturity improves creativity and depth of understanding. However, this comes at an increased risk of mental illness if development goes badly.

Language is the key

For intelligence, as it is usually measured, a key area is the supra-marginal gyrus on the left side of the brain. That is the receptive language centre of the brain in almost every human. There are clear links between the surface area of this part of the brain and conventional measures of intelligence. The link is strong, which means there's almost perfect genetic overlap between IQ and surface area in that region. That is reasonable since the development of spoken language was an essential human breakthrough.

The development of an enhanced language ability does not stand alone. Yet, it was critical because it allowed humans to deal with an increase in the size of their societies. Connected people are safer, can share access to food and other resources, and are better informed than more isolated humans. This enhancement to human intellect and society was also essential to enable humans to understand and preserve a knowledge of God.

Humanities history has not been either straight or easy. Yet the build-up of physical abilities[712] and mental depth over many generations has helped. Especially the gifts of deeper spirituality and self-awareness that may have come from Adam and Eve's genes. These factors have enabled us to push on with our lives in a universe that we know is deeply flawed.

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709 Homo heidelbergensis (Heidelberg Man) is an extinct, potentially distinct species of the genus Homo. They were likely a daughter lineage of Homo erectus. Fossils of Homo heidelbergensis have been found at several locations, including Arago Cave in France, Sima de los Huesos in Spain, Bodo in Ethiopia, Broken Hill in Zambia, and Dali in China. Averaging 1,206 cubic centimetres in capacity, the brains of these mid-Quaternary hominins are significantly larger than Homo erectus of the same ages. Homo heidelbergensis most likely originated in western Eurasia or Africa and then migrated throughout the Old World. Archaeology reveals that compared to previous populations, they had refined stone technologies, built simple dwellings and likely used fire. In time they became the ancestors of both the Neanderthals in Europe and the early humans in Africa that would begin our own lineage.

710 Human brain cells are really diverse, often with extensive genetic variation from their originating stem cells. See Mosaic copy number variation in human neurons, M.J. McConnell et al., Science, 342: 632-637, 2013. These are implicated in many disorders including childhood schizophrenia and are found in all modern human brains.

711 Archealization of human brain organoids, Muotri, A.R, Neuropsychopharmacology, vol47, pp 401–402 (2022), '*We have selected NOVA1 because this gene is activated during neural development and influences the expression and splicing of hundreds of downstream genes, increasing the chances to alter neurodevelopment.. the early maturation of cortical neurons carrying the archaic NOVA1 mimics the behaviour of chimpanzee-derived cortical neurons*'. Several of these differences also mirror neuronal development in the brains of children with severe autism.

712 There have also been many neutral changes over the generations. Modern people's faces are smaller and have shallower bumps and hollows than their ancestors. According to studies, this change accelerated when hunter-gatherers became agriculturalists some 12,000 years ago and began eating softer foods, most likely due to decreased strain on the skull.

Adam and Eve

"Archaic humans like Homo erectus spread like many other mammals in the Old World. They never came to Madagascar, never to Australia. Neither did Neanderthals. It's only fully modern humans who start this thing of venturing out on the ocean where you don't see land. Part of that is technology, of course; you have to have ships to do it. But there is also, I like to think or say, some madness there. You know? How many people must have sailed out and vanished on the Pacific before you found Easter Island? I mean, it's ridiculous. And why do you do that? Is it for the glory? For immortality? For curiosity? And now we go to Mars. We never stop." — Elizabeth Kolbert[713]

It is possible to imagine a world where every living human originated from just two people. Yet, it would not be one operating with this universe's biological laws. As sinless beings, Adam and Eve were practically a different species at the time of the first events of creation. After sin, God remade them to be a new kind of humanity. The genetic evidence is clear. We descend from a chain of species affected by sin and disease. We are part of a line of life with many side connections. Most of the genes we retain[714] from breeding with near human species are now part of our immune system, defences against a hostile universe. Our family of life has survived and branched out for an extremely long time. There is no archaeological evidence of humans without the same fallen and disease-prone heritage we have, even though thousands of sets of ancient genes from burial sites in the Middle East and worldwide have been collected. Adam and Eve's genes must have been altered by God, not just to make having children painful but to unite them with a fallen natural world. This remade world included other humans with the knowledge and genes to help them survive.

Marrying brothers and sisters, then grand-kids with each other in a fallen state doesn't work. That would have concentrated any flaws or disabilities. These turn up in every generation spontaneously. Every new baby has between 45 and 60[715] completely new mutations. They can increase during a person's lifetime. In addition, older parents create a greater risk of disability in their children. We know from the Bible that Adam and Eve's descendants lived very long lives. Breaks in a cell's instructions are due to DNA's mechanical properties and would have been the same then as now[716]. So disease-causing mutations would have spread swiftly in this small group of relatives. The whole population would be affected by severe inherited diseases within a few generations. That is if they weren't in contact with a bigger society. As an example, some late Neanderthal groups show extreme inbreeding, like the most inbred pet animals today. That made their whole species vulnerable and contributed to their disappearance.

God planned, not just for them but for all who would come later. He altered Adam and Eve's genetic instructions and made many other changes to natural laws as part of the curse. The suffering that women experience giving birth is a direct consequence of our oversized human brains. That follows from genes we do not share with other mammals. Human babies are born helpless and premature compared to other creatures. Even though they are delivered right on the edge of survival. Unlike most other mammals, those big skulls need to compress[717] to fit through a human pelvis that is optimised for run-

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713 Quote from The Sixth Extinction: An Unnatural History

714 Geneticists call these introgressions, see academic.oup.com/mbe/article/34/2/296/2633371. Much of the useful code adopted from these relatives is immunity focused. Polygenic Patterns of Adaptive Introgression in Modern Humans Are Mainly Shaped by Response to Pathogens, Gouy, A., Excoffier, L., Mol. Biology and Evol, Vol 37, Iss5, 2020.

715 De novo mutations, genetic mosaicism and human disease, Mohiuddin M, et al, Frontiers in Genetics, Sep 2022.

716 There is no evidence of early humans using some more stable form of DNA structure for their instructions, the current arrangement is fundamental to all life on Earth. The greatest diversity in human instructions comes from groups that have been independent the longest, that is various African indigenous groups. There was inbreeding going on in early societies that causes disease but not brother-sister marriages which any sensible society bans.

717 "*When a baby is born in a head-first position, pressure on the head in the birth canal may mould the head into an oblong shape. Spaces between the bones allow the baby's head to change shape. Depending on the amount and length of pressure, the skull bones may even overlap*". - see Newborn head moulding, medline plus, national library of medicine.

ning. The position of a baby as it is about to be born is also critical. Anything other than the head coming out first can result in injury to the neck and back of the child, and this is more likely in premature infants. That is not accidental. It is the direct result of human intelligence, shared equally by men and women. The pain of childbirth and its risk of death is the price of living in a fallen universe.

Potential Biblical evidence

There is a possible record of the consequences of this change in the 'Sons of God' marrying the 'Daughters of Men' in Genesis 6:1-4. "*When human beings began to increase in number on the earth and daughters were born to them, the sons of God saw that the daughters of humanity were beautiful, and they married any of them they chose.*" (NIV) While some writers have supposed that these Sons of God are angels, the unions between them are ordinary enough. They also result in human children, if ones that grow up to be powerful and accomplished. See Genesis 6:2 which reads "they took them wives", so not likely a temporary fling with supernatural beings. The Bible's text at this point is a family history listing the outstanding male descendants of Adam and Eve in the line leading to Noah. These men are famous mainly for the great ages[718] they lived to, and also their delay in having children compared to modern humans. For example Noah was 500 years old before having his three sons. Maybe because humans of Adam's line had an extended childhood to go with a long life. The writer recounts how the offspring of these marriages were heroes of antiquity[719]. Its clear the author of Genesis believed these marriages, and the children that came from them to be vital knowledge. Their genealogy is given almost equal importance and focus to the story of the fall itself. It seems possible that the 'Sons of God' were the direct descendants of Adam and Eve while the daughters were the native residents of the remade Earth. Even after the flood, Noah's descendants lived for hundreds of years for many generations. Highlighting the special inheritance their family has from Adam and Eve.

According to biological research that traces Y chromosome diversity in the human male line of descent there are two bottlenecks in non African humans. The first of these occurs 47 to 52 thousand years ago. This result fits with the wave of modern humans that spread across Europe[720] and the Pacific from out of Africa and the middle East and rapidly expanded across the world[721]. Then a second bottleneck around 10 thousand years ago[722]. This was connected with both the beginnings of agriculture around the Fertile Crescent and rapid climate change at the beginning of the present geological era. It is possible, based on the cultural background of mixed hunting farming seen in Genesis to be the time in history in which our first parents left Eden and entered our present universe. Before this time large scale farming was unknown in the archaeological record. Assuming that their genes were not required for human mental progress. It could not be much later than that time, as by then, the first cities were already being founded. The site of Jericho before it grew into a city was a popular camping ground for Natufian hunter-gatherer groups at this time in history, as seen in the microlith tools they left behind and it was

718 The lists of descendants in Genesis is somewhat like other ancestral lists such as the Sumerian king list in which the first two kings Alulim and Alajar ruled for 28,800 and 36,000 years respectively, before moving to more recent kings. That was intended to show both that they began beings descended from as gods, far more gifted than regular humans. If there is a core of truth here it may exist in the distinction between regular humanity and a unique line of humans blessed with knowledge and long life by the gods. If the Sumerian histories and Genesis itself is accepted as historical it was this uniquely blessed group that helped establish early civilisations in the middle east.

719 Nothing negative is included in the Bible about this group of people, only the much later giants in Joshua are portrayed as evil as they are fated to violently but unsuccessfully resist the incoming Jews.

720 Modern humans reached northern Europe by 45,000 years ago. That was long before the extinction of Neanderthals in southwestern Europe. However they were small and mobile groups of pioneer Homo sapiens, staying for only short periods. Homo sapiens were sporadically occupying some sites from as early as 47,500 years ago. Stone artefacts that were thought to be produced by Neanderthals were, in fact, part of the early Homo sapiens toolkit. They were also entering northern China at around the same time, Initial Upper Palaeolithic material culture by 45,000 years ago at Shiyu in northern China. Yang, S. X., Zhang, J. F., Yue, J.P. et al., Nat Ecol Evol (2024).

721 There were also migrations back to Africa from the middle east by early modern humans. Prehistoric African populations had about 0.3% DNA traceable to interbreeding with Neanderthals, while it was once believed they had none. This compares to other modern groups that have 2-3%. Many of these genes add useful innovations, i.e. cellular resistance to ultraviolet light – Africans, too, carry Neanderthal genetic legacy, Michael Price, Science 31 Jan 2020, Vol. 367, Issue 6477, pp. 497.

722 A recent bottleneck of Y chromosome diversity coincides with a global change in culture, Karmin, M, Saag L., et al, Genome Research, March, 2015.

not long after this that permanent houses appeared. The Earth is at this time coming our of a period of glaciation, with melt-water pulses causing massive sea level rises, this would also have created significant flooding events world-wide on a scale not seen before or since by modern humans. Its worth pointing out that the judgement of the flood is directly focused on punishing Adam's corrupt descendants. If there were other humans around in distant regions they would not have been specifically included.
The writer also uses an uncommon word Nephilim often translated giant in describing these descendants. This also fits because it is suggested in other sources that Adam and Eve were tall[723]. If their offspring kept their height they would have towered over the ordinary humans. While if everyone were descended from Adam and Eve then they would have been of more or less the same physical build. Which makes identifying some people as being giants especially odd.

As you examine the record of life spans in the previous verses, you can see that some factor is decreasing their lives. There is a steady decline through the generations until they reach the current average for humans. Immediately after the point when these 'Sons of God' had children with the 'Daughters of Men', it is noted that their maximum age from then on, was limited to 120 years. This consequence did not apply to the faithful descendants who did not intermarry. See Genesis 11 from verse 10, where Abraham's ancestors are listed, all with extended lives. That is only one possible explanation of the text, and the reference might refer purely to the people's faith and ethnic group. However, that does not explain why this group of mixed descendants were described in such an unusual way.

As with any historical writing, we must be careful not to assign meaning without supporting evidence of the writer's intentions. For these verses, that is difficult since this is the only reference in the Bible to this mysterious group of people. Also, that particular word is used elsewhere in only a few places.

Further along in the Bible story, Cain, the firstborn of Adam and Eve complains to God about the judgement upon him: "*Today you are driving me from the land.. I will be a restless wanderer on the earth, and whoever finds me will kill me."* Which brings up the issue of who exactly he was afraid of. Given that at that time, only four people have been recorded as existing. There could not have been more than a handful of people on the whole planet if they were Eve's children, grandchildren etc. All of them were close relatives living in a limited area. Becoming a stranger to anyone seems unlikely if that's all there was to humanity. So it's reasonable that other people existed back then, which he did need to worry about. It seems likely that just as Jesus united the divine and the earthly, Adam's descendants had a blend of unique creation and adaption to this planet in their genes.

Studying prehistoric skies

Is there eyewitness proof for the Earth's ages? People who were present and witnessed a different aspect of nature. Many extinct animals, such as Aurochs and cave bears, are shown in European cave paintings, as are others that still survive, such as Rhinos. Other paintings from Australia and South America demonstrate how different ecosystems were in the past compared to today. In Europe, during the Stone Age, humans didn't yet have writing, but they recorded the life cycle of animals they knew with paintings of their lives and dots counting their birthing cycle in Luna months[724]. As they were mainly of animals that were seldom used for food, these images might be connected instead with fertility or power. Given how difficult certain caves were for people at the time to access, and how many paintings there are, they had to be incredibly significant to their culture or religion and over an extremely long time[725]. At the same time, other animals were sharing space with early humans and bene-

723 "*Adam is said to have been more than twice the height of men now living upon the earth; Eve was a little shorter, with her head coming just a little above Adam's shoulders*". - EGW, 3SG p34. Its not clear if she is asserting this is true or merely repeating a common idea. Good health usually leads to taller offspring so maybe this simply magnifies this principle backward.

724 This was a recent breakthrough in understanding European cave paintings. It demonstrated the existence of a 20 thousand year old dot based notational system connected with an unmistakable animal subject that counts biological events such as the animals birthing cycle, allowing scientists to comprehend a Palaeolithic notational system for the first time.

fiting from our company. In Europe, this included first foxes scavenging human leftovers, then wolves and ravens, followed sometime later by the domestic animals we know.

Archaeo-astronomy is the study of ancient cultures' understanding of the sky. There are prehistoric images and symbols of the sky. The oldest of these are different to today since the present constellations we see are temporary, changing over thousands of years. They alter due to long-term changes in the Earth's tilt and the movement of their stars. The sun's direction at the summer solstice will also gradually swap with the winter solstice every 12,850 years. This movement is believed to be recorded in a number of prehistoric artefacts and ancient religious structures. More recent astronomical events, such as supernovae, were also recorded as bright new stars.

Those things are but a few of the ways in which humankind has recorded our journey through time. As well as the remains of our stone tools, wood and bone artefacts, fire pits and later pottery. Many prehistoric structures are linked to the seasons and aligned with the sunrise positions on the solstices. These reflect the gradual changes in the precession[726] of the seasons. This type of star record was also made as long ago as 40,000 years, with animals possibly representing constellations in the famous painted caves at Lascaux in central France[727]. That art was made in reaction to the sheer beauty of nature or perhaps expressing natural religious impulses. Yet, it provides unbiased evidence that humans were living on earth long ago while the ever-so-gradual drift of stars overhead marked the ages. Not that cave-centred life was all amusing art and bouncing through the snow chasing[728] mammoths. Like handprints on cave walls our DNA records the scars and repairs made along our journey through the ages. In particular the effects of viruses and the damage they have carved into our genes.

The conflict between science and religion has been painful and ongoing for some time. "*Extinguished theologians lie about the cradle of every science, as the strangled snakes beside that of Hercules; and history records that whenever science and orthodoxy have been fairly opposed, the latter has been forced to retire from the lists, bleeding and crushed if not annihilated; scotched, if not slain*"[729] according to Thomas Huxley.

As John McLarty points out in an Adventist Today[730] article the fundamentals – the Adventist church's creed requires belief in a 'recent' creation of among other things the heavens and the Earth. This might, without context place Adventism squarely among the cults that are science or even reality deniers. He puts it this way "*Creeds are themselves ideological fossils, not living organisms. They are frozen snapshots of the convictions of a majority at the time the vote was taken.. If we grant our creed superior au-*

725 Jenolan Caves, and Caves House on the other side of the Blue Mountains from Sydney, remains one of my favourite locations to visit and stay. If you have the opportunity to join one of their rarer cave trips, it is well worth the effort and squeezing through low areas. The caverns inspire and leave an impression of chaotic beauty, even though scientific knowledge from decorations like stalagmites, stalactites, rimstone, dogtooth spar, and cave pearls that charts their development is also advancing rapidly. Walking though the entrance cave and looking up I've seen the remains of the underground rivers that created these deposits running across the roof. Knowing the caves once grew at the roots of mountains, as high as the Himalayas, which are now just hills in a decayed landscape that I can walk beneath, gives a solemn yet wonderful sense of deep time.

726 A gravity-induced, slow change in the orientation of an astronomical body's rotational axis, in this case the gradual shift in the orientation of Earth's axis of rotation – see precession of the equinoxes

727 This is disputed by some experts on prehistoric culture, who interpret them as stories or images of magic related to hunting, but there is no doubt they are extremely old and record a number of creatures who are now extinct.

728 Neanderthals went in for colossal prey. Based on isotope studies, mammoths were a big part of their diet and stone age modern humans were also keen hunters of big animals. They wiped out mega-fauna worldwide. The result was whole continents with deficient ecosystems. Their crowning species decapitated. Ecologists are still counting the cost of this reckless slaughter. Farming was in part a response to these damaged and incomplete ecologies. On other hand, the lack of man-eating species, aside from Africa ecosystems that grew along with humanity, is a comfort among the wreckage. If a creature kills humans today it's either microscopic or does so by accident.

729 Darwiniana – Essays (1896), p52. Thomas Henry Huxley was half admiringly called Darwin's bulldog because he was such a pugnacious defender of the science of evolution.

730 Adventist Today is not an official church publication, it's devoted to explorations of SDA theology and culture with an emphasis on things of interest to the more liberal, left wing side of the church, i.e supporting women as ministers, critically examining theology that is a bit of a hack etc.

thority to both the Bible and science, if our creedal convictions cannot be corrected by either the text or the rocks, we have abandoned the quest for truth." Creeds are stupid because we are human, we simply can't know everything about the supernatural. We should also be open to truth that God has not yet revealed. Once created a creed doesn't secure the future of an organisation it fossilises it. From then on it becomes impossible to have a sensible conversation about the evidence because "*It is difficult to get a man to understand something; when his salary depends upon his not understanding it.*"[731]

While God might have used many alternative forms of creation, the evidence suggests that he selected a completely reconstructed universe. To understand the biology and physics seen in nature we must reject a 19th century, mechanical view of the universe as a finely tuned system with few flaws. Delicate and unchanging biological designs would be unsuitable for life on Earth due to their inability to adjust to natural disorder, which is everywhere. As environmental conditions change, the most specialised creatures become extinct. Instead of being purposeful, most events in nature are generated by laws rather than by an intelligent source, such as God, the devil, or even humans. It is these patterns in our genes, and biology that science is focused on. Therefore most events can be explained with confidence, while for the remainder we can look to what God has revealed.

731 Quoting Upton Sinclair, or alternatively don't expect a plastic surgeon to compliment you on your youthful face.

Other Minds

"Our descent from progenitors of anthropoid primates, then further back of all mammals is firmly established by the sort of approaches I have described... Biological evolution does not belong to the category of creation, but to the category of history. Creation includes all histories. We seek to understand the providence of God in biological history in precisely the same way as we seek to understand the providence of God in the history of the Jews" - Graeme Finlay[732]

Everyone loves a neatly constructed tale. The poor farm boy overcomes adversity and rises to heroism and acclaim. Androcles showing mercy to a wild beast and in turn being saved from execution. What we have more trouble with is moral ambiguity, the warrior king who unites his people but commits genocide. The democrat who champions freedom but keeps slaves. The science of human origins once seemed simple. Yet there were greater differences in human ancestors than science expected. What does their existence mean for conservative Christians?

Our family tree?[733]

Nature is great at finding ways of living that are functional most of the time, but with no obvious goal to its tinkering. At least without outside help guiding it towards a destination. Animal breeders by contrast shape animals to an intentional goal. Breeders adjust animal's body shape, their coat and other abilities. This human interference makes domestic animals weaker than their wild cousins, as there is no purifying selection and they suffer from genetic diseases. The changes go deeper than their appearance and being calm around humans or friendly. Modern dogs for example have a special muscle in the corner of their eyes that wolves lack. It is useful to help them communicate expressively with humans[734]. Use of this tiny muscle has a strong influence on how likeable we consider a dog to be. The parallels between animal breeds and the pressures of wild nature are useful in understanding how nature can transform and even thrive in a dangerous universe. That is independent of God's role in shaping nature and something that all modern varieties of creationism accept as true, to some degree.

Within an ecosystem a specialised creature can capture a particular role or niche just for themselves. Any competition for resources is easier if there are only a few others in your category. Yet being specialised also comes with risks. For example living in a limited area[735] or being too dependent on other species. As humanity has discovered the death of an ecosystem can begin with the extinction of some

732 Evolution and Eschatology: Genetic Science and the Goodness of God, 2021, ISBN: 9781666704594.

733 Seth Furlow, 2 Oct 2017 via twitter.com/Furlow_teach/status/914894640498790400

734 Sad puppy eyes are cute, the muscle dogs use for that, the levator anguli oculi medialis is missing in a few wolf like breeds. Dogs will even use it more often if they see a human looking at them. It's not a unique adaption for emoting to humans however as wild coyotes also use it to express their emotions.

735 Such as the Wollemi Pine, which was "*discovered as a small grove of seedlings and mature trees only 200 kilometres west of Sydney in the Wollemi National Park. Since then, two other small groves have been discovered. The pines are growing on moist ledges in a deep rainforest gorge surrounded by rugged mountains and undisturbed forest. Their exact location is a closely kept secret*" because they are the only place this species still exists in the wild. See www.wollemipine.com for more info.

unimportant looking creature or plant[736]. Its removal leading to a chain of others until sooner or later mighty predators are starving.

Our specialisation is that of the mind. Even species that are open to many kinds of food and lifestyle need something extra to stay ahead of the pack. Science of course does not understand why early man ended up significantly more intelligent than other mammals. There have been lots of suggestions. Some have suggested that high intelligence is attractive, and therefore one factor was sexual selection. This may have helped give us our present language abilities and intellects. As Robert Heinlein put it '*Language is the plumage of Man*[737]' comparing the wooing ability of, for example poetry with the flashy colours of a male bird.

Coexisting with hominids

Where did non-humans appear in the events of creation? If we want to understand the reality of deep time then we must study both humans and prehuman species. Many of which are now well known. An example are the Dinaledi[738], scientific name Homo naledi. They were a species that lived at the same time as our own form of humanity in Africa, up to around 280,000 years ago in an area that is now close to today's city of Johannesburg[739]. The discovery of this species shows how hard scientists are willing to work to reveal truths about our world. With a team of short and flexible scientists worming their way into the depths of Rising Star cave. They were at increased risk of injury[740], as the cave was too narrow in places for safety equipment. The Dinaledi fossils once excavated were of a primitive, though in some ways human-like species.

They had quite small brains almost the same size as chimpanzees, and a number of ancient skeletal features like the Australopithecines. In particular their fingers bones were permanently curved and their shoulders were positioned for climbing and hanging from trees. Their pelvic bones flared outward and are shorter than in humans. They also had some features that were quite similar to modern humans.

The Dinaledi had long slender legs like our own and walked upright with similar muscles to ours. Their palms, wrists and thumbs were like ours and their feet bones were close to modern humans except for

736 "*Crucial information about the overall health or resilience of an ecosystem may be lurking in data about supposedly inconsequential species. In fact, the presence or absence of some of the rarest species may be giving us clues as to how near an ecosystem is to a potential collapse*" - Early warning of critical transitions in biodiversity from compositional disorder, Doncaster, C.P., Chavez V.A. et al, Ecology, Aug 6 2016.

737 From his book Time Enough for Love, 1973, p 322 – This merely reflects conventional scientific ideas in which the development of plumage, courtship dances, song and other so-called secondary sexual characteristics follow from females' choices of mates, creating a positive feedback mechanism over generations.

738 Dinaledi is one proposal for their common name which I am going to use, it is also the Sesotho and Tswana word for stars. This name is appropriate because the fossils were found in the Rising Star Cave, which is located near the Cradle of Humankind World Heritage Site in South Africa.

739 The fossils have a well established age limit of 236,000 to 335,000 years. Researchers led by Paul Dirks of James Cook University in Australia determined the age of the original remains using a combination of techniques. They also "*combined optically stimulated luminescence dating of sediments with U-Th and palaeomagnetic analyses of flowstone to establish that all sediments containing Homo naledi fossils can be allocated to a single stratigraphic entity*" They were able to date the fossils using electron spin resonance (ESR) dating, which examines the ions trapped in tooth enamel, and uranium–thorium dating, which measures the radioactive decay of uranium. Independent dating by different laboratories ensured the consistency of results - The age of Homo naledi and associated sediments in the Rising Star Cave, South Africa, Dirks, P.H, Roberts, E., et al, eLife Sciences, 6, May 2017.

740 One 25cm wide tunnel in the caves is now called 'the Berger Box' after Lee Berger dislocated a shoulder trying to squeeze through it in 2014.

their curved toes. The shape of their skulls was modern but less than half the size of our own. Their brain was small, with a mix of modern and primitive features[741]. You might think that doesn't matter but modern human children grow their brains to 80% of adult size by age 3 and 90 to 95 percent by 6 years old, they need a close to adult sized brain to navigate our complex world. Human brains are also efficient in their connections, putting more energy into thought not wiring. However, Dinaledi brain structure is actively being investigated. So we will learn more about this in the future. Unfortunately, so far none of their DNA has been recovered.

They were well adapted for making tools based on their hands, wrists and especially their opposable thumbs. Quite a lot of dental chipping and wear on skulls suggest damage from food coated with gritty particles. This likely came from eating unwashed roots and vegetables. There's also strong evidence that their bodies were intentionally carried into the cave and decayed in place. This suggests something like a funeral or at least careful disposal of bodies.

There are some areas of the outer cave complex, downhill from the entrance that contained material moved by water. That is natural for any unsealed cave. However the majority of Dinaledi bones remained untouched and together. This was especially true in the dug graves where tiny infant bones that would be easily separated by any natural processes remained intact. These infants could not have entered the cave on their own and died there they were barely old enough to sit up and look around. There is no sign of predators killing, then moving bodies to feed on later such as broken skulls or bite marks. Some quite intact bodies were found very far from the entrance, up to 70 metres away. They were located beyond winding tiny passages and in several locations. That rules out their bones being collected by flooding or lions. These were intentional burials in an excavated grave in several cases. They seem to have been healthy, with strong well developed bodies suggesting that they were a dominant local species. Yet they were also small and light by modern human standards reaching about 140cm tall and 45kg with many unusual physical features along with that small brain[742].

What is extraordinary about them, considering they were so different in many ways is that they most likely used fire[743]. It seems likely that fire and simple stone tools were common in all branches of early humanity. Like modern humans they probably used fire for cooking and for light to enter the caves where their dead were found. But there's no way they're some kind of modern humans; their anatomy, particularly their brain structure and skulls, was completely unlike our own. If they did use fire for lighting and heat, it would not have been unusual. Our direct ancestors and other relatives had done so for a long time. Regular use of fire by hominids for light, warmth, and of course cooking was common hundreds of thousands of years ago. There is evidence for early use, at one million[744] years ago. Clear evidence of regular use of fire, and preparation of animals for cooking comes from caves in Israel dat-

741 "*Hominin skeletal material from the Dinaledi Chamber, South Africa, represents the species Homo naledi. This fossil assemblage represents at least 15 individuals, both adults and juveniles across all stages of development. .. The cranial, dental, and post cranial remains of H. Naledi exhibit a mosaic of derived, human-like traits combined with primitive traits shared with Australopithecus and other stem hominids.*" - Endocast morphology of Homo naledi from the Dinaledi Chamber, South Africa - Holloway, R.L, Hurst, S,D. Garvin, H.M et al, PNAS May 29, 2018, Vol 115 (22). Their feet, fingers and toes were very curved, more so than most other Hominids. That strongly suggests a life in the trees. While their pelvis bones were more tilted so they would have been excellent walkers, better in fact than modern humans of a similar height. Yet their brains were tiny, barely the size of an orange.

742 "*H. naledi shares cranial characters with species across the genus Homo, including Homo habilis, Homo rudolfensis, Homo erectus, and Middle Pleistocene Homo. These include aspects of cranial form, facial morphology, and mandibular anatomy. However, the skull of H. naledi is readily distinguishable from existing species of Homo*" The skull of Homo naledi, J. Human Evol, vol 104, p100-123

743 See https://www.sciencenews.org/article/homo-naledi-fire-hominid-cave-human-evolution. "*Researchers have found remnants of small fireplaces and sooty wall and ceiling smudges in passages and chambers throughout South Africa's Rising Star cave complex*". "*Signs of fire use are everywhere in this cave system,*" said Berger, of the University of the Witwatersrand, Johannesburg. The Dinaledi presumably lit the fires in the caves since no other hominids relics have turned up there".

744 "*micromorphological and Fourier transform infrared microspectroscopy (mFTIR) analyses of intact sediments at the site of Wonderwerk Cave, Northern Cape province, South Africa, provide unambiguous evidence—in the form of burned bone and ashed plant remains—that burning took place in the cave during the early Acheulean occupation, approximately 1.0 Ma*" - https://www.pnas.org/doi/abs/10.1073/pnas.1117620109

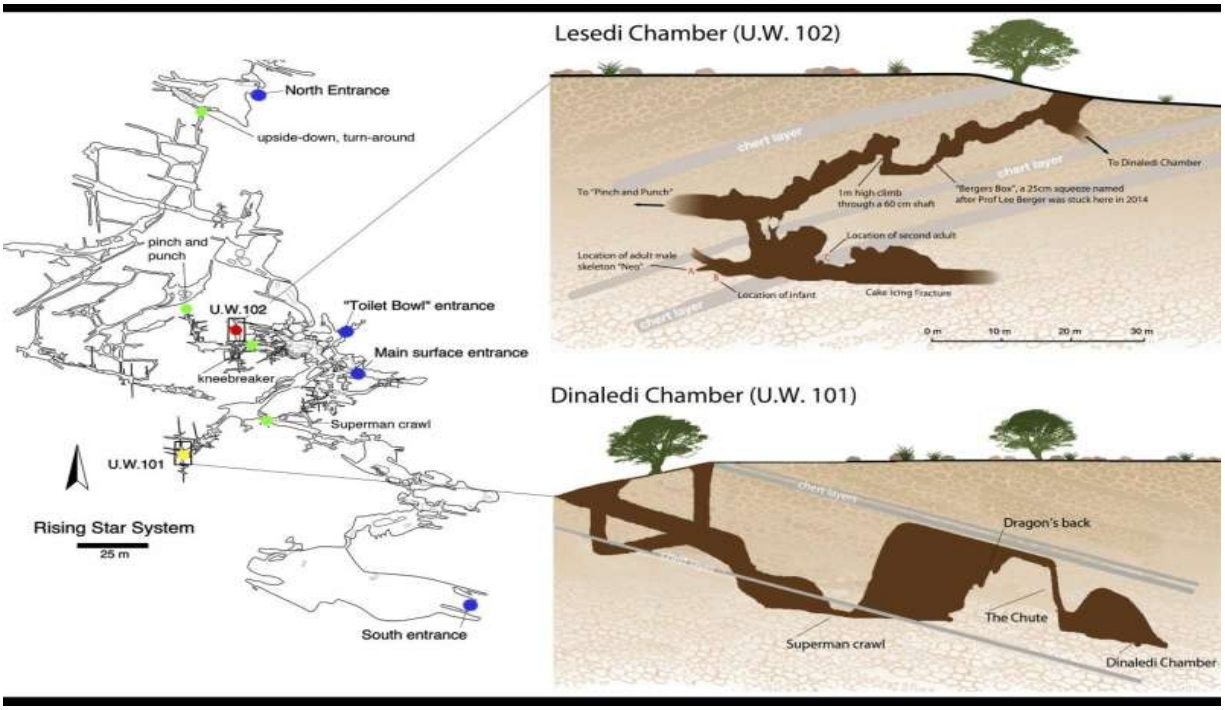
ing back 350,000 years ago, such as the repeated use of a single fire hearth in Qesem Cave over many centuries. We should not be surprised by their planning and social skills. All the close branches of our family tree were skilled thinkers, compared to other animals.

This skull and facial reconstruction is from an individual Dinaledi dubbed "Neo", the Sesotho word for gift. His nearly complete remains were found in an adjoining cave in 2017. His skull is part of the most complete known skeleton for any individual of his species. He was likely older than 30 years at his time of death. Insets show a typical human skull superimposed over a Dinaledi skull. The previous page shows Professor Lee Berger holding a model of one of the skulls for scale.

How can a conservative form of creationism explain this? Is God expected to create many sinful or animal-like human species after, or maybe before making Adam and Eve? Based on a flood focused viewpoint, if they are human they would need to be devolved in many ways but there is no sign of inbreeding or deformed individuals, they were healthy[745]. They were simply their own species of human like creatures.

The other common reaction has been to classify all pre-human species as unusually human looking, unexpectedly bright, tool using, upright walking apes. God made many strange beings, traditionalists tend to say. That he made quite a few species that look like early humans and they appear in the fossil record with apparently older dating is just a coincidence. With a completely traditional interpretation of Genesis its not possible, that they were human, or related in any way to humans.

745 Although one individual did have signs of a non aggressive cancer, while the ages of bodies suggest high infant mortality, not unexpected as weather can get as cold as 3 degrees during the winter near the caves.



Yet the Dinaledi couldn't just be human looking apes, animals couldn't light their way through a cave with fire, carry it with them though tight spaces, work in groups to dig grave pits in the Lesedi chamber, or carry bodies long distances. They also placed bodies together in a grave, positioning the bodies in a knees up fetal position. As seen on the next page and decorated the cave walls in the vicinity of the graves, with patterns of lines scored deeply into the hard rock with stone tools. See the map of the Rising Star cave system and cross section, highlighting key discovery areas[746].

The marking in the previous photos were discovered on surfaces at a height that would have been accessible and visible to the Dinaledi. They were made on rocks that look to have been prepared and smoothed out. The apparent symbols include deeply carved cross-hatching's and other geometric forms layered over older patterns. These are similar to later human and neanderthal cave art. It appears that the lines were created by continuously running a pointed or sharp object through the grooves in the rock. These kinds of marks are recognised as an early method of expressing ideas and are accepted as a historic milestone in mental evolution, even if they have not yet been dated to the era of the graves.

Traditionalists could just admit they have no clue, how the Dinaledi could possibly fit into Genesis, or they could reject the science and claim these discoveries are fake. Invented to test the faith of conser-

746 The Rising Star cave system. Image credit: Marina Elliott, Wits University.

vatives or make up some other story with hidden human involvement to reject the facts. I'd suggest following the evidence rather than making up answers to suit just a single Biblical interpretation. The remains of other species like the Dinaledi show that our species of humanity is united with all life on Earth and shaped by its wild flows.

Many bones of this species have been recovered from three locations deep within the cave system representing about 18 people in the primary cave and several in nearby caves and about 2000 fossils in total ranging from complete skulls to small pieces of bone[747]. In the primary location only hominid bones were found, but no animal bones highlighting the intentional nature of the burials. The careful removal of fossils from the cave was exceedingly difficult and the material recovered so far has been mainly those fossils already exposed on the cave floor with some burials elsewhere removed intact. Some areas are reserved for future excavations that will certainly recover even more evidence. This is likely to include the tools used in marking the cave walls with what may be Dinaledi 'artwork'[748].

Regardless of where this species falls into the pattern of human history, its presence challenges humankind's uniqueness and orthodox creationism. Especially given their tiny brains and unusual mix of human and prehuman features[749]. Discoveries of cousin species in Indonesia and elsewhere contribute additional weight to this issue[750]. Even if certain features of these finds are not validated, such as if the wall markings are dated older than the burial sites, it would not solve the fundamental question. Which traditional creationism cannot explain.

Life is not a tree

It was once thought by both creationists and evolutionists that species were separate and distinct. Creationists at first thought that they were totally unchanging. That they had been created individually by God with an appearance and abilities that were fixed forever. The traditionalists have now transferred this rule to broad categories of creatures. A given species may adapt or change randomly, sometimes with extreme alterations, but stay within a broad 'kind'. This makes sense if you don't have much time for nature to adapt in. As for example, in the 1656 years between creation and the flood based on the traditional timelines. Membership in these groups is based on appearance rather than genes[751]. Changes such as crocodiles adapting their teeth to switch from eating meat to a vegetarian diet[752] for example is fine, as traditional creationists see it. A vegetarian crocodile looks much like a meat eater, just with flat-

747 There are for example no signs of predators feeding on the bodies, no other species remains have been found as at other sites where bones have been washed into a cave, and the bodies were intact when deposited. The cave itself is horribly difficult to access. The "Chute" is the only access point into the Dinaledi Chamber today, a vertical descent of 12 meters, with jagged edges and a minimum squeeze width of 18 cm. Hominid material is separated by up to 30 meters within the overall Dinaledi Chamber area which would certainly not be the case if it had been washed into its present location from the shaft.

748 Which at this time remains undated although the difficulties even today's humans have in accessing these locations and the lack of any human stone tools suggest the Dinaledi as the most likely creators rather than early humans.

749 Their cranial structure is more similar to those found in the genus Homo than to Australopithecines, although with some primitive features. Their middle-ear bones resembled those of chimpanzees, gorillas, and Paranthropus robustus. Hip mechanics and the flared shape of the pelvis are similar to Australopithecines, while legs, feet and ankles are within the range of our own genus Homo. The thumb, wrist, and palm bones are modern while the finger bones are curved, as in Australopithecines, possibly an adaption for climbing. In the major chamber their bodies must have been carried or dragged a considerable distance underground then buried. The 'graves' would be consistent with a caching behaviour rather than burial as we practice it today were it not for the surrounding art. If the timing of the rock art found can definitely be linked it would suggest complex emotions or culture surrounding death and the dead. At the time the Dinaledi lived our direct ancestors were not yet burying their own dead. Then there is the possibility of grave goods with at least one individual buried what appears to be a stone tool.

750 The enigmatic Homo floresiensis and Homo luzonensis.

751 This is not always sensible for example Australian Sugar Gliders and North American Flying Squirrels are not the same 'kind' even though they closely resemble each other in looks and behaviour. Instead their genes tell the real story of their ancestry.

752 Repeated Evolution of Herbivorous Crocodyliforms during the Age of Dinosaurs, Melstrom, K., Irmis. R. B., Current Biology Report, June 27, 2019 - "Results suggest that herbivory independently evolved a minimum of three times, and possibly six times. This study indicates that herbivorous crocodyliforms were more common than previously thought and were present throughout the Mesozoic and on most continents."

ter grinding teeth. A land creature adapting to living full time in water[753] would likely not be accepted, because it will end up looking different to its ancestors[754].

Once scientists saw evolution as a straightforward transfer of genes. Species descended in straight lines from their ancestors in a tree structure. Beginning with the first form of earthly life. This came with a related idea that evolution was moving upward. Although there was in reality no evidence of greater complexity only increasingly varied forms. The idea of all species progressing upwards was also adopted by racists to justify the rule of the 'intellectually and morally superior races' of humanity over the rest. Crossbreeding or the trading of genes between species was believed to be uncommon or even harmful. It did not contribute anything useful to the advance of a species[755] because such mixed creatures were often unable to have offspring of their own.

The first cracks in this view started in 1928, well before the discovery of DNA. Frederick Griffith was a bacteriologist working at the British Ministry of Health's Pathological Laboratory in the 1920's. His main focus was understanding the spread across the country and progress in patients of the several different kinds of bacterial pneumonia. Some species were dangerous because they were talented at avoiding the human immune system, while others caused only mild disease. From many years of experiments he knew that sufficient heat could kill any live bacteria in the samples. But he wondered if the remains of the worst species would have any effect on other less damaging forms. What effects would it have on their growth and development? What made one species effective at hiding from the immune system and others vulnerable to it. He was able to show that adding the completely dead remains of one species to a bacterial culture of another species could transform their behaviour and even their shape under the microscope. The abilities of the dangerous bacteria were being transferred to some of the ordinary ones. Today we understand that it was DNA they were reusing from the remains of their dead relatives. Bacteria have the ability to easily adopt useful genes from their environment. Anything that helps them survive will then spread though their populations in the usual way.

Once DNA could rapidly be sequenced from 1977 on it was discovered that 'horizontal' transfer of genes occurs in other species than bacteria. Usually genes pass down vertically from parent to child, or parent species to descendants. A less common kind of transfer are genes picked up by direct adoption of a section of DNA as bacteria do, or though infection by a virus. In this kind of transfer the source is always a different species. Cross breeding also allows genes to pass between related species and is the most common way in which this occurs. All this, is just interspecies symbiosis, first promoted by Dr Lynn Margulis. Just as animals herd together for safely, species have an ability to adjust to challenges by trading useful genes. Parasites too collect genes from their hosts to control their behaviour.

Because fossilisation is a rare process, usually requiring silty water to slow decay, the graphs showing the relationships of species started off pretty straight and direct. You may recall neat trees of ancestors beginning with a shambling great ape, just down from the trees, though various cave men with flattened skulls[756] and ending with modern technological men. This has turned out to be almost entirely wrong. Walking upright has been in our lineage for an extremely long time, long before any variety of human existed[757]. While real mental and cultural progress is a new thing on this timescale. There is a sense of direction and purpose in such tidy family trees, with each species making way for the next. Before the discovery of Homo floresiensis, many experts in human evolution believed that just one species of human had developed throughout time, with a few regional variations like the Neanderthals.

753 Basilosaurus, for example had extensive aquatic adaptions but retained almost useless vestigial back legs.

754 What is acceptable as adaption or rejected as macro-evolution among creationists, varies depending on who you ask.

755 This view has been partly reversed see for example – Interspecies Hybrids Play a Vital Role in Evolution, Quanta Magazine, August 24, 2017

756 This is accurate, humanity's bulging forehead, flat face, pointed chin and nose are both new adaptions. The chin is newest, in fact even neanderthals didn't have this feature. They did have other distinct features like large noses and overhanging brow ridges to make up for that though.

757 A new Miocene ape and locomotion in the ancestor of great apes and humans, Böhme, M., Spassov, N., Fuss, J. *et al. Nature* (2019). - Danuvius guggenmosi is a fossil ape found in Bavaria. Dated to 12 million years old it had a similar spine to humans, and although tree dwelling was equipped for walking upright just like us.

Now we know that biology is a lot messier. Species such as Homo naledi and Australopithecus anamensis for example coexisted with other advanced variants of humanity for many thousands of years. The usual concept in which one species continues until it is swiftly replaced by another one is not true in most cases. Every species is a fuzzy cloud which shares space, genetic and physical with its close relations often for long periods of time. Sometimes parts gets left behind, while the rest of a species moves on to better, or at least different, genes. Modern humanity has limited diversity[758]. As a species we are no longer genetically varied[759] compared to other branches of life. That might be because the specific breakthroughs that made us human occurred in only a few individuals. I believe that two of these individuals were the historic Adam and Eve, who were real human beings, and not figurative symbols. I am not suggesting however that everything that makes us human comes from them, just some key mental adaptions. Another possible reason, is near extinction events in our deep past or social factors that reduced our ancestors diversity[760].

Our origin extends beyond the beginning of this universe. The inflationary Big Bang is a well-established model that explains the universe's origins, scale, and many other features. In addition, it predicts the existence of many other universes aside from our own. Humanity shares a connection with life's deep history here on Earth that we must not ignore. The suffering of past generations of life should not be forgotten. These extinctions and conflicts reflect the brokenness in nature. As God's plans are completed, creation will be restored, and that suffering will be given meaning.

758 Neanderthals were only 30% as diverse as modern humans, probably due to smaller populations and high mortality.

759 "*The genetic difference between individual humans today is minuscule – about 0.1%, on average – study of the same aspects of the chimpanzee genome indicates a difference of about 1.2%. The bonobo (Pan paniscus), which is the close cousin of chimpanzees (Pan troglodytes), differs from humans to the same degree*". - Article: What does it mean to be human, genetic evidence, Smithsonian, Jan 2024. Modern biology has no place for the idea of different founding human populations ie races, instead there is continuous genetic variation by region. There is no evidence of the biblical explanation of extreme incest following the flood.

760 Current evidence supports decline of diversity with distance from Africa, that is Africa has the most human genetic diversity, followed by the middle east. There were bottlenecks in diversity in the Late Pleistocene at approximately 50 thousand years ago as humanity expanded out of Africa and earlier bottleneck at 140,000 years likely due to the onset of an ice age.

A Christian Cosmology

"We are like a judge confronted by a defendant who declines to answer, and we must determine the truth from the circumstantial evidence"
- Alfred Wegener[761]

The case for compatibility

It is certain that no one other than God has the power to change the basic laws of nature. Natures laws are universal and affect everything. The laws of our universe include deeply rooted randomness and chaos which cannot help but create suffering. These flaws exist in natural law, because our universe was remade for human beings that had separated themselves from God.

Nature is corrupted and unrestrained because God has decided to withdraw much of his power and control over its chaos. To remain fully revealed would have destroyed humanity, for Gods presence destroys all evil. God does not remote control his creations, but opens the future for all living things to try and grow. God limits suffering by giving nature the ability to adapt and create temporary balance. Nature struggles, and because of this gift for adaption it can still be beautiful. Yet because creatures are the product of unleashed chaos often nature will become cruel. This is not some original perfection that decayed over time but a compromise from the beginning due to the existence of sin[762]. Our origin is different to all other living creatures, being made by a divine hand, through Adam and Eve and earthly though other threads of humanity. We are made in Gods image yet grew up as a species within this universe's laws. Our bodies and minds are flawed but still struggle towards the light, all the time sensing that we are lost. This is how the Bible describes our condition, our world and the whole of creation before the events of the cross.

It is expected that not everything in a theory will be totally confirmed. That is a good thing, predictions make for stronger science. At the current time there may be no obvious way to confirm or disprove some points. Lots of theories begin along these lines, presenting some ideas that at the time science could not confirm. While the central ideas of my proposal, God creating multiple independent universes[763] and rebuilding our universe after the fall, lacks direct scientific evidence at present. Still it explains the facts of science with greater success than any other Bible focused theory. It also represents the best alternative for those who wish to respect the intent of the Bible's writers. There are solid biblical requirements for such events, and creationists can propose them to resolve many scientific issues. It is essential to revisit traditions when they have become a barrier to newcomers and a source of conflict internally. This includes traditional static and predetermined ideas about nature. Our faith in a creator who walks with us, may appear strange to people outside of Christianity. They will see accepting science as proof that we are truth seekers. A group willing to consider ideas from beyond its own religious circles.

Avoiding fragile assumptions

One principle in science goes back to Aristotle, who wrote, "*Other things being equal, we should prefer a theory which derives from fewer postulates or hypotheses*". That idea is also known as Occam's

761 Alfred Wegener proposed a theory of continental drift based on the boundaries of land forms and matched fossils which resulted in the modern theory of plate tectonics.

762 This is seen in model form in the Old Testament, the goat receives the ultimate consequences of sin and represents its originator.

763 Including the universe of Heaven, the city of God as described in Revelation.

Razor because it was used so frequently by William of Ockham (1285-1349) in cutting away too complex scientific and philosophical explanations of his own time. When different theories compete to explain nature, we choose the simplest or the one that uses known attributes of nature rather than unknown ones. One requirement for using this principle to compare theories is they must be equal. They must explain the same set of facts. That rules out theories that cover a gap in their explanation by asserting God's unknown motives. Consider the impact craters that are common across the solar system. Saying God made it that way, is only giving up and admitting our ignorance. While accepting that planets have a complex history of impacts applies an existing property of nature to explain these discoveries.

Flood-focused theories must be detailed and complex to explain nature, and don't do a good job even then. Simpler theories tend to win out against complex ones. Cosmic Creation explains the flaws in this universe with a change to its deep laws. That wins out against a pile of separate small changes, all based on miracles. God had no reason to make most of the changes to physics, biology and chemistry that traditional Platonic creationism requires to work. Also it doesn't predict anything much so its foundations are very shaky.

To suggest that God created planets with the appearance of being old and damaged uses a conspiracy theory to fill a gap in our knowledge. Such theories are not equal or alternative explanations to scientific ones. Also, a God of the gaps of this kind is one whose work is forever shrinking as knowledge expands. If two theories are equal, the one that uses a simple principle is always better because it applies to more situations. For example, flood-based models cannot explain the history of material originating on other planets, the existence of asteroids, or the development of other solar systems. Reworking our ideas about the Fall to include the reconstruction of our whole universe is a big concept. But it passes the test of Ockham's razor because it fits together the existing truths of creation.

Human nature is tricky, and it's hard to predict our decisions, as psychologists have discovered to their annoyance. At best, psychology can describe what is likely based on character and a person's past actions. A prediction might also take into account their motivations and ethics. Given science's limitations in understanding humans, how much harder it is to understand the actions of our creator. One who is better and more holy than the 'best angels' of human nature. However, we can be certain of one thing. What has been revealed by God of his character rules out faking the past. Including the history of distant stars and galaxies. Also, the fossil evidence that shows the development of ecosystems, predators and parasites[764]. God tempts no one to sin or doubt, and he does not conceal his creative power.

If Adam and Eve were reintroduced to a rebuilt universe, there should be evidence in the historical record. There should be a clear and unexpected intellectual leap present in the history of early humanity[765], such as that found between the early and late Stone Age. Historically, several breakthroughs match this event. A distinct genetic signal still existing in human DNA is also possible. If such a signal existed, it would be in the instructions regulating the development of the fore-brain and in adaptions that indicate a deeper spiritual understanding of the universe. The discovery of life subject to death elsewhere in our universe would also confirm the theory[766]. If we find extra-terrestrial lifeforms, which could be pretty common[767], then that discovery is supporting proof. It seems unlikely that we will discover other intelligent life soon, although bacteria or ant-sized life is entirely possible.

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764 All of which are consistent with the law of sin and death as described by Paul.

765 About 60,000 years ago (give or take), something unique happened in Africa – a sea change in human behaviour. Tools became much more finely crafted. They were made of varied materials including bone, which allowed the development of deadlier weapons. Group hunting methods became more efficient. Art also made an appearance—clear evidence that our ancestors were capable of abstract, contemplative thought. Overall, it really isn't hyperbole to talk about a 'great leap forward' in mental abilities, to use anthropologist Jared Diamond's term

766 Finding intelligent life could result in a reevaluation of the whole nature of sin and salvation. Assuming they are as imperfect as ourselves.

767 There are certainly planets with large amounts of oxygen around other stars for example, see Alexandra E. Doyle, Edward D. Young, et al. Oxygen fugacities of extra-solar rocks: Evidence for an Earth-like geochemistry of exoplanets. Science, 18 Oct 2019, Vol. 366, Issue 6463, pp. 356-359. On the other hand some planets atmospheres are likely too toxic for complex life as we know it see A Limited Habitable Zone for Complex Life – Schwieterman, E.W, Reinhard C.T, et al, June 10th, 2019. The Astrophysical Journal, Volume 878, Number 1

Action based on evidence

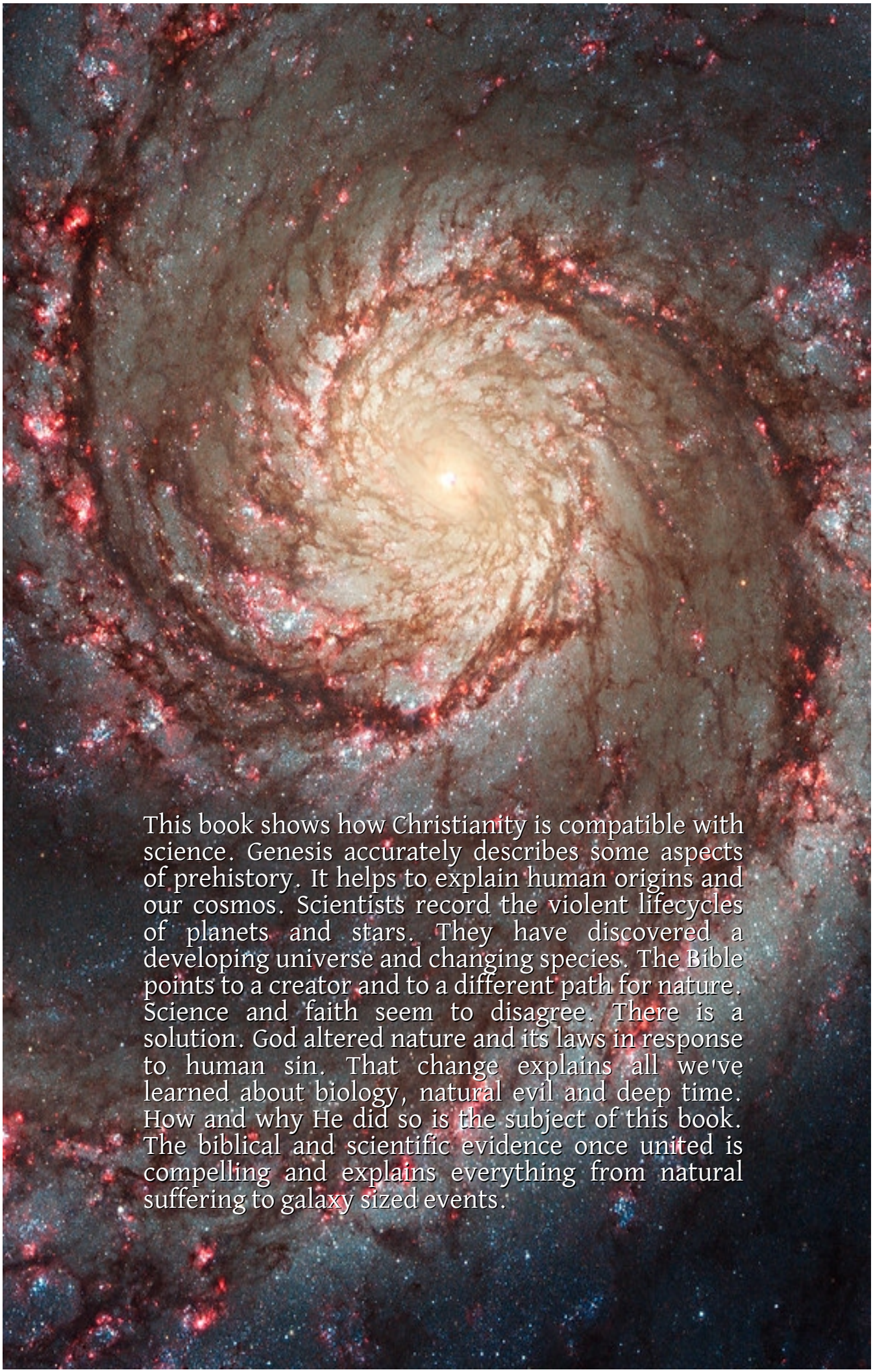
Humanity has been moving toward a crossroads for generations. We are unwittingly causing great harm to nature and each other. That is due in part to misunderstanding our origins. In contrast, Christianity connects us to worlds beyond this damaged universe so that we might be a light to all.

Everything in our world is subject to death and decay. It has been this way since the time of the fall. Scientists confirm this. It is due to the role of entropy in our universe. A cosmic theory of creation protects Christians from opposing newly discovered truths about our world. Science is an honest investigation of God's creation. We should respect that goal. Some may find this book too speculative. They may think it depends too much on incomplete knowledge from science and ideas that the Bible covers lightly. To them, I offer this challenge. Propose a theory that more accurately explains creation, especially genetics and our chaotic universe. One that gives humanity better knowledge of ourselves as our power and peril grows. Although sceptics imagine science and the Bible to be separate, they are twin paths to self-understanding.

A cosmic viewpoint helps us see our place in time and our duty to God's creation. The living Earth is not any perfect garden, but it does belong to Him. Human beings are among the last survivors of our genetic family tree. Our species is united with nature and we share genes with our nearest relatives. We have been shaped by conflict and evolution. Humanity has become the planet's apex predator. We were genocidal to our own nearest relatives and a significant cause of extinction to a long list of other mammals and birds. Yet the Bible opens communication between our guilty, blood-covered species and the maker of universes. We can pray to Him and receive a response. That is the most extraordinary thing in this universe or any other. The work of the spirit heals humanities deep mental flaws. Science helps us understand the origin of our nature, but it is God who offers the solution. Adam and Eve's choice is the key to suffering in our universe. Yet we can be reborn into the life that God desires for us, complete and without spiritual pain. That is the great treasure that Jesus describes. Every human needs this, even when they have never sensed God's presence.

Science offers the knowledge to protect nature's potential and our own physical and mental health. Protecting the poor and creatures who cannot speak for themselves should be one goal shared by every Christian. Can we continue to reject much of science, or will we abandon the idea of a historically accurate Bible and all that means? Does the quality of the evidence about creation matter, and how can we judge this? These are issues worth considering. Our answers will shape how educated people think about creation, a vital element of the Christian faith.

- Justin Fitzgibbon



This book shows how Christianity is compatible with science. Genesis accurately describes some aspects of prehistory. It helps to explain human origins and our cosmos. Scientists record the violent lifecycles of planets and stars. They have discovered a developing universe and changing species. The Bible points to a creator and to a different path for nature. Science and faith seem to disagree. There is a solution. God altered nature and its laws in response to human sin. That change explains all we've learned about biology, natural evil and deep time. How and why He did so is the subject of this book. The biblical and scientific evidence once united is compelling and explains everything from natural suffering to galaxy sized events.