Religion has influenced the development of science over the past two millennia. *The Truth about Science and Religion* tells the story of their interaction. The book examines the origin of the universe, evolutionary processes, Christian beliefs, the history of science, what being human really means, and what science and religion have to say about these ideas.

*The Truth about Science and Religion* is designed to help explore personal views on science and religion, offering questions for discussion at the end of each chapter. The book provides the historical and scientific background and the philosophical insight needed to think through issues of science and religion and their influences on personal beliefs. Metaphors, analogies, and comparisons are used to simplify complex topics so that any reader can engage with the key concepts. Unlike other books in this field, *The Truth about Science and Religion* follows a chronological scheme, treating increasingly personal topics as the book moves through cosmology, evolution, the life of Jesus, and the lives of several great scientists to regain a unified view of science and religion in today's world.

**FRASER FLEMING** is Professor of Chemistry and Head of the Department of Chemistry at Drexel University, Philadelphia. He has published over 80 research articles in chemistry and is a leading expert in the chemistry of nitriles. Fraser Fleming has taught courses in science and religion.

“Chock full of ideas, explanations, stories, and thought-stirring questions, Dr. Fleming’s book will lead readers to reflect deeply about their own faith and their grasp of science. The discussion questions and bibliography alone make this perhaps the 'go-to' book on Christianity and Science for today. Highly recommended.”

—*Terry Morrison*, Emeritus Director of Faculty Ministry, InterVarsity Christian Fellowship

“Competent scientist and true believer, Professor Fleming asserts that 'science and religion are intertwined like DNA.' . . . Fleming presents abstruse matters in a clear and accessible manner. This work merits wide distribution among students and faculty and all people truly searching for answers to the mysteries of the universe and humankind.”

—*Father James Chukwuma Okoye, CSSP*, Director of the Center for Spiritan Studies, Duquesne University

“In the modern West, the relationship of science and faith has tended to be one of either hostile antagonism or uneasy coexistence. Fraser Fleming argues persuasively for a third way: mutual cooperation. With an irreligious spirit and in accessible terms, Fleming reviews the role of Christian faith in the development of science, particularly cosmology and human development, and finds throughout a consistent invitation from God to a relationship of love with him and others.”

—*Dennett Buettner*, Pastor, Church of the Savior, Ambridge, Pennsylvania

“Fleming delves right into the most vexing questions in the Christianity/science debate, but he isn’t throwing bombs—he’s asking deep questions. It is refreshing to see a topic that can be so contentious discussed so reasonably and thoroughly.”

—*Brenton DeBoef*, Professor of Chemistry, University of Rhode Island
The Truth about Science and Religion
The Truth about

SCIENCE & RELIGION

From the Big Bang to Neuroscience

FRASER FLEMING

WIPF & STOCK · Eugene, Oregon
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“Science and religion are intertwined like DNA,” begins Fraser Fleming in his Introduction to this book. While that statement seems counter-intuitive, it expresses a point of view that is both necessary and important for a correct understanding of the relationship of science and religion. For more than a century, science and religion have been thought to be in conflict, offering alternative and mutually exclusive accounts of the creation of the universe. Traditional religious narratives, like those in Genesis, have come to be considered primitive attempts of pre-scientific writers to account for the mysteries of the world around them by employing supernatural tales. Only with the rise of modern science, in this widely held view, did an accurate understanding of nature become possible. As science provided rational explanations for what had previously been thought to be God’s handiwork, nature lost its mystery and religious explanations retreated into the world of the irrational. In fact, that view is a myth, based on what historians of science term Whiggism. The Whig interpretation views the past through the lens of the present and sees history as moving progressively toward the ideas and institutions of our later, more enlightened, age. Whiggish historians have sometimes distorted the past to affirm the values of the present by dividing historical figures and movements into the friends and enemies of progress.

Even more influential has been the conflict thesis, which has been for the past century the predominant view of the relationship of science and religion. It has wedded a triumphalist picture of modern science, which it views as a factually-based liberating and progressive force, with a dismissal of religion, which it sees as faith-based and regressive. The conflict thesis continues to be widely accepted; indeed, it has become
the dominant narrative among both scientists and layman. But, as recent scholarship has demonstrated, it too is a myth. Throughout the past two millennia the relationship of science and religion has exhibited a multiplicity of approaches, reflecting both local conditions and particular historical circumstances. The relationship between religion and the sciences is neither a monolithic nor a static one. Both have changed over the centuries and they reflect the diverse circumstances of time and place. The popular view that the march of science is one of inexorable progress and that the controversies between religion and science were disputes in which (to quote Alfred North Whitehead) “religion was always wrong, and . . . science was always right” is based on a mistaken view of the history of scientific progress, which was as uneven as theological progress.¹

Far from being in conflict, science and religion have often been allies and considered by their proponents to be complementary. Many leading scientists have been devout believers who studied nature (in the words of Johannes Kepler) “to think God’s thoughts after him.” Controversies between science and religion have tended to arise when long-accepted scientific theories were being challenged by new ones, as in the substitution of a heliocentric solar system for a geocentric universe in astronomy or in the adoption of evolutionary biology in place of a static view of biological development. Defenders of traditional scientific views have sometimes appealed to biblical texts for support against novel theories. Indeed biblical interpretation remains the crux of many disputes today between some (but by no means all) religious believers and those in the scientific community whose views they challenge. At most times in the history of Western civilization such disputes were minimal and the scientific enterprise enjoyed relatively harmonious relations with Christian thought.

In this volume Fraser Fleming casts his net broadly, while focusing on the creation of the universe and the descent of the human race. He begins by exploring the Big Bang and its implications for everything that follows. In tracing those implications philosophical and theological questions arise. What is time? When did it begin? Is the universe eternal or created? The result of chance or design? Is the universe teleological, finely tuned with the human race seemingly in mind? Chapter 2 discusses the origins of life on Earth and its religious implications. How does one harmonize the creation narrative of Genesis with what we know of

¹ Ferngren, Science and Religion.
prebiotic evolution? Is evolution divinely guided or the result of chance? The discussion in chapter 3 focuses on the beginning of living organisms and the multitude of theological questions that raises that are not easily answered. Whence came death, suffering, and the extinction of species, for instance? In chapter 4 we come to the development of humanity and to another set of difficult questions. How did humans cultivate religious sensibilities? How did they develop a moral and a spiritual sense? How did moral evil first enter human society? How should we interpret the Genesis narrative of the fall of the human race and its influence for human history?

In the first four chapters Professor Fleming addresses scientific issues. In so doing he follows the traditional pattern of Christian theologians who have spoken of God’s Two Books, nature and the Bible. The first book is that of general revelation. In Christian theology revelation is God's disclosing himself and his will to his creatures. In general revelation God reveals himself through nature. An appreciation of the natural world as God’s creation has always been a central theme in Christian theology. But he also raises the questions that trouble many religious believers. Has science left any place for God in the modern evolutionary view of creation, especially in dealing with the origins of the human race? While providing an impressive and up-to-date summary of current scientific views, he demonstrates that natural science does not explain everything. For all its achievements, science does not provide ultimate answers to questions regarding the meaning of the universe or of life itself. And so he proceeds in chapter 5 to describe special revelation, the term that theologians use to speak of how God reveals himself in prayer, miracles, prophecy, and Scripture, which fill the gaps in general revelation.

Chapter 6 deals with the history of science and its interaction with religion from the Babylonians to the mid-twentieth century. Fleming’s account is brief but provides the reader with the perspective that (as historians like to think) is necessary to understanding how we got to where we are today. In particular it demonstrates that the pioneers of modern science were not narrowly scientific in their approach, but were often men of faith who were deeply concerned with the religious implications of their scientific discoveries. And few fields of modern science have made more progress and require a religious perspective more than the neurosciences. Hence, in chapter 7 he examines the mind, the soul, and the spiritual and mystical experiences that are at the core of religious views of the world. In chapter 8, Fleming brings the various strands that
he has so far dealt with together in a discussion of the way in which he believes science and religion provide a comprehensive understanding of the world around us, a world that contains both material and spiritual components. Finally, in an Epilogue (chapter 9), he provides a personal point of view. He writes both as a practicing research scientist in Chemistry and as a Christian believer who is widely read in the literature that addresses the intersection of sciences with theology. He draws on both his own experience in science and his reflections in his journey of faith.

By means of a simple analogy, Sir William Bragg (1862–1942), a Nobel laureate, likened the relation of science and religion “to the cooperation of the thumb and the fingers.” They are, he said, functionally and spatially opposite, but it is by means of their opposition that they are able to grasp a wide variety of objects. I find that analogy helpful. Science and religion are not adversaries. They do not offer alternative and competing views of nature. But they are different. When each fills the role that is intended for it, they enhance one another. On the other hand, when science attempts to make religious statements, or religion to make scientific statements, they impinge on one another’s domain and thereby invite conflict. During the last two millennia they have far more often been in harmony than in conflict, each doing what the other could not do. In their fruitful opposition they have provided a comprehensive view of nature, and so enlarged the human mind and exalted the human spirit. The means by which they continue to accomplish that task is the subject of this book.

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Almost three decades ago I began reading books on science and religion to understand how both ways of knowing might coexist. With a little understanding and, I confess, much hubris I began giving presentations, then a series of classes at churches, that ultimately led to co-teaching several classes on science, religion, and society with my friend and colleague Bruce Beaver. The notes I had collected ultimately formed the basis for the current book.

I began the book in collaboration with a dear friend and colleague, David Somers. The basic chronological structure developed over many hours of discussion on how to approach a book on science and religion in a form that would transcend an academic collection of ideas. As the early chapters were written Dave’s focus on relevance helped keep the science in step with religion. I am also indebted to Dave in sharing his neuroscience expertise, which was enormously helpful in writing chapter 7 on mind, brain, and soul.

Over the course of writing this book I have been fortunate, blessed, to have had much advice, critical evaluation, and editorial help. My daughter, Catherine Fleming, who is working on her Ph.D. in English literature, has been my fiercest and finest critic and editor. Although I have referred to her as the Editorial Dark Lord of the North, I am extremely grateful for her refining many versions of the text. She deftly helped focus the drafts around common themes and ensured that each chapter had a central thesis. Her talent for developing ideas is much appreciated in crafting the sections into their final form.

The Reverend Dennett Beuttner, as a former lawyer and now an Anglican priest, has forced me to make sure my arguments are sound
while helping me stay true to orthodox religious tenants. Dennett has a knack for straightening nuances and for viewing all sides of an argument that has influenced my thinking and helped correct at least some of the ideas I first put into print. Terry Morrison’s intellectual mentoring in science and faith is deeply appreciated, as is his friendship and wisdom over many years. Rachel Luckenbill has taught me the vagaries of English grammar, though I still fall prey to loose commas! Bruce Johnson’s keen intellectual insight and fine writing skills have helped tremendously in simplifying tricky concepts while staying true to the meaning I wanted to convey. I am particularly grateful to Gary Ferngren for his friendship and wisdom during my early intellectual development and for penning a thoughtful forward to the book. I am most appreciative of significant effort provided by several others who read drafts and provided valuable feedback; Catalina Achim, Alec Cleland, Iain Coldham, Brenton DeBoe, the CAFE group, Fr. James Okoye, and Howard van Cleave.

I have had the great fortune to teach a study abroad course on science and religion which used early drafts of the book. I am most appreciative of the students in these classes who have provided feedback and helped make the concepts relevant. Lastly, I thank my family for indulging many hours of writing, watching videos on science and religion, and visiting museums, exhibits, and religious sites. While I am deeply indebted to the many people who have donated their time to help craft the final manuscript, ultimately I assume full responsibility for errors in the printed version.

“To God be the glory, great things He hath done”

Traditional hymn, lyrics by Fanny Crosby 1875, first published in 1875 in Lowry and Doane’s song collection, “Brightest and Best.”
Science and religion are intertwined like DNA. Science and religion provide two perspectives on reality that speak to life’s most fundamental issues: purpose, meaning, and morality. “The Truth About Science and Religion” examines pressing issues at the intersection of science and religion by following the chronological unfolding of the universe. At the heart of many of these issues lies the central question of what being human means.

Science has become a powerful force that influences the way people think about religious issues. Extraordinary advances in science over the last two centuries have revolutionized physics, chemistry, and biology. More recently, evolutionary biology, genetics, and neuroscience have pushed the conventional boundaries of experiments with living systems. Several scientific discoveries have challenged historic theological positions through a greater understanding of reality on the one hand and through the development of techniques capable of manipulating the creation of living systems on the other. Addressing the religious ramifications of these scientific advances requires a clear understanding of both the main scientific ideas and the implications of these ideas for classical theology.

Each chapter begins by delving into the science fundamental to discussion between the scientific and religious ideas. In some chapters a rather brief introduction is all that is necessary whereas other chapters, such as the discussion of Big Bang cosmology, requires greater introduction. The style is to fairly evaluate the major themes as objectively as possible. Ideas from science that challenge conventional religious dogma are examined with the same level of criticism as religious implications.
of scientific discoveries. Although some author bias is inevitable, with the author having stated Christian convictions (see the epilogue), the intention is to provide a balanced presentation rather than presenting a compelling case for specific Christian beliefs or a scientific position.

Beginning with the Big Bang, the book examines the religious implications inherent in cosmology and evolution. Despite a widespread perception that science and religion are antagonists, history shows that science's development was often motivated by religious belief. Although religious motives are usually absent from recent scientific pursuits, the discoveries often raise valuable questions that impinge on religious belief. Does the vanishingly small chance of a Big Bang point to the absence or presence of God? Does natural selection render God redundant or is the exploration of biological forms under divine guidance? Following the evolution of modern Homo sapiens and the differences between humans and their hominoid predecessors, the book explores the religious dimension by focusing on good, evil, and morality. How these religious issues relate to science is examined through consideration of the life of Jesus Christ. Christ's life and teaching raises questions central to understanding prayer, miracles, and the resurrection in light of modern science.

Historically, modern scientific discovery blossomed in Europe in Christian cultures that were undergoing tremendous religious change. Many early scientists held strong Christian convictions, viewing scientific study as a way to a true understanding of the world and an insight into God's character. Following the lives of several major scientists, Copernicus, Kepler, Galileo, Newton, Darwin, and Einstein, provides a brief history of science to show the influence of personal religious convictions, positive and negative, on scientific discovery. For Kepler, religious convictions provided the motivation for astronomical discovery, whereas deeper scientific study into biological evolution led Darwin from the priesthood to agnosticism.

New findings, particularly from physics and biology, are revealing a much stranger world than expected. The sun does not rise, man is genetically almost indistinguishable from advanced primates, and time and space are not what they seem. Advances in neuroscience reveal insight into human identity, causing a reappraisal of not only what being human means but personhood—the state of being a person with human characteristics and feelings. Understanding what or who controls the mental traffic in the brain impinges directly on fundamental issues of
self-awareness, free will, and what happens at death. Science and religion are not only intertwined but provide mutually beneficial ways of knowing.

The Truth about Science and Religion provides a tour of how the world came to be and a framework for approaching existential questions. The book is intended to stimulate personal reflection more than providing an intellectual exercise, furnishing knowledge for personal reflection that in turn challenges core beliefs and provokes changes in behavior. Each chapter concludes with an overview that leads into a series of discussion questions for personal reflection or through a group dialogue of the religious or spiritual topics. The hope is that engagement with the ideas will facilitate individuals in developing a holistic religious and scientific mental framework for understanding of the world.
1. Is There Purpose to Life?
Implications from the Big Bang

People long for understanding and meaning. Where did the world come from? What existed before there was a beginning? Is there a purpose to life? Does God exist? All attest to people's fascination with one of life's challenging questions: what, if anything, brought the world into existence? An intense explosion with precise timing and unimaginable force initiates a remarkable series of events that ultimately delivers earth: the blue planet, where butterflies dance between flowers and orcas breach seemingly for sheer delight. What a strange and beautiful world this is.

Two basic philosophical approaches have vied to explain the world's origin; either the universe always existed or the universe had a beginning. Each approach has both scientific and religious implications. These philosophies have influenced science, but science cannot provide philosophical or religious proofs. Science provides a powerful method for investigating and revealing reality with which philosophy must wrestle. Although science and philosophy may seem esoteric, distant, and impersonal, at the root of these approaches are core beliefs that influence, or should influence, every person's drive to live a life where actions are consistent with beliefs. Among the most significant of these questions is whether the world is designed and, if so, why? Alternatively, if the world is the result of chance, then how is purpose instantiated into each person's life?
THE BIG BANG AND THE BIBLE

Big Bang theory states that the universe began from a very dense, very hot “singularity.” Elementary energetic particles called photons burst forth and spread out into the universe radiating energy. Cooling coalesced the photons into several larger atomic particles, quarks and gluons, that further coalesced into the three-quark structures: protons and neutrons. Over the following fifteen or so minutes, protons, neutrons, and electrons fused into the two most prevalent atomic species in the universe; hydrogen and helium. The entire sequence required less than an hour, indicating the remarkable ability of the universe’s early beginnings for self-organization and development. Physicists describe the extreme choreography of the Big Bang as being seemingly programmed into the very fabric of the universe. Physicist Fred Hoyle famously ruminated that “a superintellect has monkeyed with physics.”

Many different pieces of evidence support the Big Bang theory. First, in the 1920s Edwin Hubble made the astounding observation that the galaxies were rapidly moving away from the center of the universe. If the universe is expanding then the natural conclusion is that sometime in the past the universe existed in a very compact form.

Scientists predicted that the enormous energy dissipating from the Big Bang would cause an afterglow in just the same way that a fire retains hot coals many hours after the last flames die. As sometimes happens in science, two groups simultaneously made the same discovery, Arno Penzias and Robert Wilson at Bell labs and Robert Dicke at Princeton; in this case finding the signature of the Big Bang as background microwave radiation. In a twist of fate, the scientists at Bell labs, while trying to develop better communication systems, found a constant background noise that could not be eradicated from their receivers. Inadvertently they had discovered the background radiation bathing the universe.

The rapid expansion of the Big Bang created an intense fireball with much of the radiation being emitted as light. God’s first creative act in the Bible’s opening chapter is the creation of light. Coincidence or correlation?

In the beginning God created the heavens and the earth. Now the earth was formless and empty, darkness was over the surface of the deep, and the Spirit of God was hovering over the waters. And God said, “Let there be light,” and there was light. God saw

that the light was good, and He separated the light from the
darkness. God called the light “day,” and the darkness he called
“night.” And there was evening, and there was morning—the
first day.²

The grand opening lines of Genesis declare that God created the
world, although without any explanation how. Believers try to harmo-
nize the Big Bang with the Bible’s famous description of God creating the
world in seven days. Abundant scientific evidence for an old earth forces
believers to revisit their interpretation that Genesis is literally describing
seven twenty-four-hour periods. Some people concerned with maintain-
ing the Bible’s truthfulness have favored a close, literal reading of the text.
For example, each “day” corresponds to millions of years. Others, who
stress science as providing an equally truthful tool for understanding cre-
ation, see the first chapter of Genesis as having a poetic form not suited
to a literal interpretation.

In fact, this is nothing new. Theologians since the third century have
identified problems with a literal interpretation, such as there being an
end to the first day without a sun or earth. A non-literal interpretation of
“day” overcomes the otherwise problematic issue of God’s work schedule.
If God created light instantaneously, what did he do for the rest of the
day? The focus in Genesis, it is suggested, is not how God made the world,
but that God made the world as the stage for the drama of life.

In the 1920s Edwin Hubble’s telescopic images demonstrated that
the universe was continuously expanding. Prominent among the pro-
ponents of this idea was the Catholic priest and physicist, Georges Le-
maître, who saw no problem harmonizing God and cosmological theory.
Galaxies moving apart at the speed of light means that, playing the tape
backward, there was a beginning from which all creation came. The space
between galaxies is stretching with space continuing to grow, but exactly
what is the universe expanding into? Like the question of what happened
before the universe existed, this particular question is better suited to
philosophical answers than scientific ones.

Harmonizing scriptures with new scientific discoveries is a continu-
ous process. In a sense, the resilience of Genesis to reinterpretation as sci-
ence advances shows either God’s providence or people’s stubborn belief
in God. Harmonizing the truths of science and religion is ultimately only
valuable if the result is a richer, purposeful, and more consistent life.

². Gen 1:1–5
A FINELY-TUNED UNIVERSE

Whether experiencing nature’s web in a pristine mountain glade or peering at the wonders of a working cell, evidence of an intricately functional universe is everywhere. The beautiful and elegant descriptions used of nature are exactly those used by cosmologists to describe the equations for the expansion of the universe. Equally surprising is that the mathematical equations that describe the universe’s development are few and simple, the kind of equations whose discovery earns Nobel prizes.

Scientists commonly speak of equations having beauty despite the fact that no definition of beauty exists in science. Collectively, scientists agree on what constitutes a beautiful equation, an ingenious chemical reaction, or an elegant design because as humans, people see beauty in the world—the delicate lines in a face, intense colors of sunset, and the wonder of seeing a child being born. Scientists are as passionate as artists but operate within a discipline that strives for complete objectivity. Science is inherently focused on explanations of how the world works, but scientists, as people, are much more interested in understanding the meaning of the results. Einstein’s conclusion to his first paper on general relativity captures this personal essence: “Scarcely anyone who fully understands this theory can escape from its magic.”

The universe not only has a beautiful mathematical structure but the equations and values are very finely tuned. Just four basic forces affected the first particles during the initial stages of the Big Bang: gravity, electromagnetism, the strong nuclear force, and the weak nuclear force. The balance between these forces is extremely precise in two ways: first the physical constants of the universe have very specific values, and second, the initial “boundary” conditions for the universe are tightly specified. Boundary conditions refer to the starting or developing nature of the universe, such as the delicate poise between expansion and collapse, and the fluctuations that form galaxies without forming black holes. Cosmologists like to say that the universe seems quite finely balanced between the outward energy of expansion and the inward pull of gravitation. Like shooting hoops, the force and trajectory must work together.

Fine tuning is nicely illustrated in the life of a star. Stars get their energy by burning hydrogen to form helium. When all the hydrogen is consumed, the core of the star pulls together under extreme gravity to form beryllium. Beryllium is a toxic element lacking the right bonding

properties for most living organisms but is very efficiently converted to carbon (~100 percent), because there is just the right relationship between the electromagnetic and nuclear forces of beryllium and carbon. The energy for the conversion of beryllium into carbon is very closely matched so that if the conversion were only 4 percent higher or 0.5 percent lower, virtually no carbon would form. Carbon, once formed, can be consumed through a carbon-helium collision whose energy is similarly highly controlled; a deviation of only half a percent would lead all the carbon to be converted to oxygen. Carbon is slowly converted to oxygen, gradually enough to allow carbon to build up, but at a rate sufficient to produce oxygen for life. A series of delicately poised transformations provides a way for carbon to be produced from stars to provide “the building block for life.”

If the value of the gravitational constant was slightly larger, then the stars’ lifetimes would be much shorter with much less time for planets, and life, to evolve. Alternatively, weak gravity would mean that the stars could not generate enough heat to grow and explode to liberate the heavy atoms needed for life. How finely balanced is the force of gravity? Estimates for the allowable variation are in the range of 1 part in 100,000,000,000,000 (one hundred thousand billion).

Another example of fine tuning is the attractive force between two large masses. If this were just a little stronger, the force between the earth and the sun would be too strong and cause them to collapse into one body. If the force was just a little less, the world would spin off away from the sun. In either case the earth would not be properly warmed by the sun, and life would be unable to evolve. Owen Gingrinch, Harvard astronomer and historian of science, interprets this as follows: “Had the universe exploded with somewhat greater energy, it would have thinned down too fast for the formation of galaxies and stars. . . . Had the energy been somewhat less, gravity would have quickly got the upper hand and pulled the universe back together again in a premature Big Crunch. Like the Little Bear’s Porridge, this universe is just right.”

Particle physicists at the supercollider in Switzerland recently found the elusive so-called “God particle.” Perhaps the most surprising thing about this discovery is that finding the God particle was not actually surprising. Theorists predicted the existence of a particle accounting for

4. Gingerich, God’s Universe, 30.
5. Overbye, “Physicists Find Elusive Particle Seen as Key to Universe,” A1.
the attraction between different mass units almost fifty years beforehand. What was surprising is the precise mass of the Higgs boson and the associated Higgs field. If the Higgs field was slightly stronger atoms would start to shrink and neutrons would decay leading ultimately to hydrogen as the only stable element. The ramifications of finding the Higgs boson and the Higgs field will keep particle physicists occupied for many years, but as quantum physics probes ever deeper into the structure of the atom, the fine tuning continues to be an integral part of the universe’s structure.

The influence of philosophical ideals and scientific theory is ironically captured in the work of one of the leading physicists Fred Hoyle. Hoyle preferred to believe in the universe’s eternal existence—a steady state universe—because he held strongly atheistic beliefs. Hoyle showed that the light elements, particularly hydrogen, helium, and deuterium, could be formed from nuclear reactions early in the universe’s existence. The intense temperatures permit nuclear fusion through particle collisions at high speeds to form the first elements of the periodic table, hydrogen and helium. Ironically, Hoyle’s calculations showed that the exact amount of existing helium was best accommodated by Big Bang cosmology rather than his own favored theory of the universe’s eternal existence. Hoyle’s conclusion: “There is a coherent plan to the universe, though I don’t know what it’s a plan for.”

The mathematical form and values of the universal equations are not the only examples that cause scientists to say that the universe is finely tuned. The density of the universe is also strictly specified to a precision between $10^{-56}$ and $10^{-60}$, the equivalent of hitting a bull’s eye at a target twenty billion years light years away on the opposite side of the universe. Hoyle, an atheist, was so stunned by the coincidences that he wrote: “If this were a purely scientific question and not one that touched on the religious problem, I do not believe that any scientist who examined the evidence would fail to draw the inference that the laws of nuclear physics have been deliberately designed with regard to the consequences they produce inside the stars . . .”

Evolutionary biologist Richard Dawkins views the fine tuning of the universe differently. His book *The Blind Watchmaker* is subtitled “How the Evidence of Evolution Reveals a Universe without Design.”

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rejects the idea that fine tuning is suggestive of a coherent plan, claiming that is instead how he would expect an evolving universe to be. The key issue is the interpretation of fine tuning in the universe; is this best explained as design imparted by God, or do godless naturalistic processes provide a better explanation for this seeming design?

COSMIC RECYCLING

Stars burn hydrogen and helium at their cores but eventually run out of fuel and burn out. Toward the end of a giant red star’s life, the intense heat and pressure fuses hydrogen and helium to produce the heavier elements—carbon, oxygen, magnesium, silicon, iron, and sulfur—that comprise more than 96 percent of earth’s mass.

Roughly three categories of heavy elements are present on earth. In the earth’s core is a molten mass of iron while the surface mantle is rich in silicon and magnesium oxides. Sand is essentially a silicon oxide. Uranium, thorium, and potassium comprise the second category of essential elements, providing heat through radioactive decay deep inside the earth’s core during the first few billion years of the earth’s existence. The third set of essential elements are carbon, nitrogen, oxygen, hydrogen, and phosphorous, which comprise most of the elements in living organisms.

Exploding stars release the core elements as atomic dust that eventually cools and slowly aggregates. NASA scientists have captured spectacular images of star birth in which young stars form and simultaneously eject matter into space. The cycle by which stars explode and reform into new stars, creates an ever increasing proportion of heavier elements so that newer stars contain more heavier elements than old stars. Still, hydrogen and helium comprise almost 90 percent and 10 percent, respectively, of the “cosmic abundance” of the elements in our sun and the most common stars, with only traces of the heavier elements required for life. Cosmic particles ultimately experience a gravitational attraction and form a flat, rotating cloud known as a solar nebula. Nebulae evolve and form disks composed of gas, dust, and rocks orbiting a central sun.

New birth and rebirth of fundamental particles establishes a pattern that recurs throughout the universe. Hydrogen and helium form and fuse under intense pressure to form new elements that are redispersed as old stars die and new galaxies form. Evolutionary theory is built on the same
principle of death and new life that leads to better adapted organisms. Christians believe that Jesus is the pinnacle of this rebirth process, heralding the coming of a new person purged of the troubles of this world and set for eternity with God.

TIME BEFORE THE BIG BANG

Physicists wrestle with the concept of time, generally saying that the concept of a time before the Big Bang does not make sense. Einstein wrote that “People like us, who believe in physics, know that the distinction between past present and future is only an illusion, however stubbornly persistent.” There is no negative, backward-flowing time; time only flows forward from a certain point. And, strange as it may sound, according to modern physicists, before the Big Bang there was no time.

This idea is not new. Over 1,500 years ago St. Augustine thought about the perennial question of what existed before God created the world. Augustine’s answer was that there can be no time without creation, meaning that time is one of God’s creations just as much as the physical universe. Because God created all things, including time, he reasoned that there was no time before creation: “For there was no ‘then,’ when there was no time.”

If God is outside time, then how does God experience time? The classical religious view is that God perceives all cosmic history at the same “time,” raising interesting questions about free will. On one hand, God’s perception seems to imply that he knows the outcome of every event, including all free choices, but on the other hand, if those choices are free and future events are truly open and changeable then how could even God know the outcome? However the question is resolved, this classical theological position places God outside time in a mysterious way in much the same fashion as modern physics places time outside the beginning of the cosmos.

Physicists have devised several clever theories that avoid defining the universe’s precise beginning. In the bouncing universe scenario, the Big Bang causes an expansion just like a balloon being inflated. At a certain point inflation stops with gravity causing the universe to collapse.

9. Einstein, letter to Besso Family, quoted in Dyson, Disturbing the Universe, 193.
11. Augustine, Confessions.
The process parallels the way a deflating balloon full of air returns a rubbery mass. However the universe has the potential to repeat the process in an endless series of bang-crunch cycles. The universe exists eternally.

Eternal inflation describes an alternative beginning for the universe. A balloon-like universe continues to expand but with small patches at the surface that blister and rapidly expand to form a new universe bubble. Subordinate universes form at these attachment points which can, themselves, continue expanding in an eternally on-going process.

The Achilles heel of these theories is not so much the mathematics, challenging as it is, but the problem of verification. In a very real parallel to the problem of directly observing God, none of these theories can be observed directly. At the heart of cosmology is the difficulty of experimentally verifying processes of extreme size, heat, and density. Despite the Big Bang pushing the beginning of time back 13.7 billion years, the chain of explanation never ends. The question can always be asked: but what caused that? Ingrained into many cultures is the idea that something started this entire process, something that cannot be found using scientific laws. Ultimately individual belief is required to answer the question of where the world came from, either the universe always existed or something, God perhaps, brought the universe into being.

THE BIG BANG: CHANCE OR DESIGN?

The exquisite tuning of the universe and the amazing development of human life stuns scientists and has reinvigorated the search for life’s grand purpose. Perhaps the universe’s complex, intricate structure was encoded into the Big Bang in the same way that spectacular firework displays are encoded through a precisely orchestrated series of visual displays. Or perhaps this is just luck. Einstein captured this in his enigmatic way, saying "What I am really interested in is whether God could have made the world in a different way."

Physicists measure the size of the universe in terms of light years—the distance light travels in one year, which gives an estimate of the universe’s size at 13.7 billion light years. Compared to an individual person the universe appears astronomically large. But comparing a person to the size of their component atoms make people seem huge. An individual person lies roughly at the geometric mean size between the size of the

universe and an atom. The universe's size and age is intimately related. Small planets will agglomerate over time whereas large planets will collapse on themselves, which places restrictions on the type of planets capable of supporting life.

Two different approaches are taken to describe the universe's uniquely hospitable conditions for humanity's existence. The weak anthropic principle states that because there is only data for this universe, then scientists will inevitably find physical constants with values that allow for this universe's existence. Only because people exist can people reflect on ultimate origins. Even though the physical constants might potentially take an infinite number of values, only a few are possible because only those values allow for life to exist on earth. Ironically, this means that all of the planets and stars that pepper the night sky are part of an intricate system that is required for the universe to exist and for there to be life on earth. This is a paradoxical reversal of people's normal reaction to the universe's largess. Staring up at the night sky, people typically see the vast universe teeming with galaxies, realize their own comparative size and unimportance, and muse on the possibility for life on other galaxies. The weak anthropic principle reverses the lens to view the universe's amazing structure as a requirement for life to exist.

Cosmologists have long sought to explain the inherent order in the universe by assuming a series of successively more powerful underlying principles that reduce to just a few core mathematical equations; the Grand Unifying Theory—GUT. GUT deals with the fine-tuning dilemma by proposing that there is an underlying, and currently unknown, meta-law that exists and explains why the Big Bang would trigger a series of coincidences leading to this current world. GUT holds the potential for explaining many of the cosmic coincidences in terms of a simpler, fundamental theory. If successful, the GUT would provide a complete description at the physical level. Molecular interactions, forces, and particle properties would be fully understood and predictable. Despite the name, however, a successful GUT will still not provide sufficient detail to predict a person's every move and thought.

Developing a GUT is enormously complex. One promising approach that focuses on the intrinsic, minute structural details of atoms is string theory. String theory envisages very small particles held together by an attraction akin to that of a string of spaghetti. These very small strings resonate in many dimensions, giving rise to the properties of atoms, and are so small they are unobservable. Previously, the existence of
these fundamental particles has been inferred from the detectable paths left by a particle's interaction with a photographic plate or an electronic detector. One of the difficulties with current string theory is that of experimental proof. One estimate posits that the equipment required for proving string theory would be at least ten light years in length. The point at which string theory leaves predictive science and becomes an exercise in mathematics or philosophy is a difficult question.

Physics has been extremely successful at illuminating the intricate physical relationships that govern the world’s existence. Assuming that a GUT can be found, the existence of the few core principles might have arisen through a chance event that then led to the unfolding of the universe. Science can potentially uncover the underlying structure of the universe and maybe even the ultimate laws of nature. Two unanswered questions will remain: why do the laws have great structure, beauty, and elegance? And, how did the universe’s structure arise?

The strong anthropic principle claims that humanity had to exist and therefore the universe had to be fine-tuned. A helpful analogy to understand the difference between the weak and strong anthropic principles is to imagine a person standing in front of a firing squad. One hundred sharpshooters all fire but as the smoke dissipates the person is alive. One interpretation, corresponding to the weak anthropic principle, is that the person was just incredibly lucky. An alternative interpretation, corresponding to the strong anthropic principle, is that the person had to survive; the marksmen’s intention was to ensure that the person would live in just the same way that the fine tuning of the universe exists to allow life to develop.

A particularly ingenious way of requiring this universe to exist is to assume a multitude of universes. The multiverse theory views the 1 chance in $10^{60}$ as looking like incredibly good luck but with an infinite number of possible universes the chance becomes reasonable. If there exist an infinite number of universes then there must be a universe having exactly the character of our universe. The multiverse theory suffers from several unprovable assumptions, many which raise philosophical questions. Why are there random rather than non-random universes? Why are there an infinite number of universes? Furthermore, unlike most scientific theories, the multiverse theory is not testable.
THE HABITABLE ZONE

As stars die and explode they disperse their mass as the proverbial “dust of the stars.” Subsequent accretion leads to concentric rings of increasingly dense particles that collide, stick, and fragment like breadcrumbs in a kitchen mixer. Over time the “feeding zone” generates particles ranging in size from dust grains to small planetesimals. Eventually these coalesce to form planets. Each feeding zone consists of a specific mixture of elements, with the lighter, more volatile elements being increasingly found further from the central star like ash driven from a campfire. Paradoxically, nitrogen, hydrogen, carbon, and oxygen are light elements that are more prevalent on Mars and Jupiter than earth but are essential to life on the blue planet. Had earth formed closer to the sun there would be even less of these essential elements, whereas further from the sun there would be no earth, only a planet drowned in water.

Fortunately, the accretion process generated a delightful habitat for intelligent life on earth—politicians notwithstanding! Remarkably, the earth continues to reap 40,000 tons of interstellar compost annually. Most interstellar debris is small, but occasionally large meteors penetrate the atmosphere and arrive on earth’s surface. In all of earth’s bombardment by meteors, one stands out; an impact 4.5 billion years ago with an accretion the size of Mars. The seemingly chance event was essential for several of earth’s unique properties: the tilt axis of earth that’s responsible for the seasons, the length of the day, the spin direction, and most importantly the formation of an exceptionally large moon.

Gauging the precise requirements needed for a habitable planet is difficult because there is only one vantage point in the universe: earth. From this biased perspective earth seems ideally—even providentially—positioned for life. Astrobiologists have coined the phrase “habitable zone” to describe the distance a planet needs to be from a central star for life to exist. Just like toasting marshmallows, the main issue is one of temperature: a planet too close to a sun will be fried, whereas one too far away will remain frozen. Overlaid on top of this requirement is the change of the star’s luminosity over the extended periods of time required for complex life to develop. At the time of earth’s formation, the sun is estimated to have been about 30 percent fainter than at present so that as the sun ages the habitable zone drifts further away from the sun. As a reference point, complex life on earth has arisen only during the last 10 percent of the earth’s existence. Life can exist outside habitable zones in
the same way that astronauts can exist on the moon, but this is not favor-
able for complex life to develop. A relatively wide habitable zone exists for
microbes, which tolerate a much wider range of conditions than higher
life forms, with an ever narrowing concentric habitable zone in moving
up to plants and animals. Complex life, minimally animal life, requires a
habitable zone where the distance of an Earth-like planet from the central
star maintains an ocean of liquid water and an average global tempera-
ture less than 50 °C. Of all animal life on earth only a few extremophiles
would be able to survive outside these conditions.

Maintaining an optimal temperature depends on the distance of a
planet from the sun, which, for life to evolve, must coincide with habit-
able conditions on the planet’s surface to support life. An aging sun re-
leases more heat in a mad dash to use any available fuel, which moves the
habitable zone further outward. The more massive the star, the faster the
star brightens and the narrower the habitable zone. Although earth’s sun
is often viewed as a typical star, the earth’s sun is larger than 95 percent
of all known stars—anything but typical. The most common star in the
Milky Way has only 10 percent of the mass of the earth’s sun which re-
quires a planet to be much closer to be in the habitable zone. At this close
distance the gravitational tidal effect from the star induces synchronous
rotation of the planet with the star so that the planet rotates with the same
face toward the star. Just as with earth’s moon, this synchronicity leads to
excessive heating on one side of the planet while the other side freezes.
Life is confined to a narrow band between the two zones.

In the same way that the earth lies in the habitable zone mapped
out by the sun, the sun lies in a “galactic habitable zone” within the Milky
Way. Earth’s sun is about 25,000 light years from the center of the Milky
Way and located between the spiral arms where the star density is rela-
tively low. Closer to the galactic center, high energy sources bathe sur-
rounding planets in ionizing radiation, gamma rays and x-rays, which
destroy life, not to mention the occasional supernova. Ionizing radiation
dissipates further from the galactic center as do the number of heavy
elements required for life. Earth lies in the sweet spot in a spiral galaxy
ideally positioned for life.

Dramatic pictures of galaxies beamed down from the Hubble tele-
scope inspire awe and wonder. Some scientists assure us that these only
confirm the wonder of humanity’s chance existence. Is there a purpose to
this series of coincidences?
COMPLEXITY AND DESIGN

Seeking understanding is an essentially human quest because people are naturally curious, pattern-finding beings. People see the stars as outlines of animals in a starry zoo. Children persistently question “Why?” Science uses design axioms to understand diverse types of complex systems. And seemingly random coincidences are interpreted as arising by design. A plane smashing into a building is a devastating accident. Two planes crashing into the same building establishes a pattern and unleashes questions: Why? Who? Patterns, even in the midst of tragedy, often cause people to search for deeper meaning in their lives.

In Victorian England, the world’s complexity and structure was famously accredited to God when, in 1802, the Reverend William Paley published *Natural Theology, or Evidences of the Existence and Attributes of the Deity Collected from the Appearances of Nature*. Imagine walking across an English heath and finding a watch, “the inference we think is inevitable, that the watch must have had a maker”\(^{13}\). In the same way, the integrated parts of nature bear witness to God’s design. Paley’s natural theology resonated with believers and remained part of apologetics training for ministers up until the turn of the twentieth century. Darwin’s idea of descent with modification, however, provided a non-supernatural mechanism to explain design that ultimately became the demise of natural theology. Into the theological void sprang scientific creationism, an argument which explains the universe’s order as stemming from God’s omnipotent hand a mere few thousand years ago.

Battered by dramatic advances in science, scientific creationism had all but disappeared toward the latter part of the twentieth century. In the 1990s the basic argument that patterns in nature stem from an intelligent designer was reinvigorated. Some Americans with religious convictions were receptive to ideas that sought to show that the purpose evident in their personal lives was due to God’s inherent design of creation. Prepared as a legal case by lawyer Phillip Johnson, the book *Darwin on Trial* argued that the fossil record did not provide sufficient *scientific* evidence to support biological evolution’s claims. This was soon followed by biochemist Michael Behe’s book *Darwin’s Black Box*, which argued that gaps in the expected transitions arose because some biological entities were essentially *irreducibly complex* and could only have been made by an intelligent designer. Further support for the theory of “intelligent design” was

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advanced through a mathematical treatment of design that demonstrated how specified complexity is empirically detectable and therefore scientific.

The hope for an intelligent design research program has not materialized, but instead has alienated some scientists with Christian convictions.

Described as the most significant contribution to systematic theology this century, “Scientific Theology” offers a more moderate, and theologically oriented approach to the design in nature. In essence, biochemist-theologian Alister McGrath argues, the unreasonable effectiveness of mathematics and the regularity and intelligibility of nature do not prove the existence of God but do reinforce the plausibility of an already existing belief.¹⁴

This idea has grown into a more nuanced form of natural theology. This new form claims that belief in God provides a more complete and rationally persuasive view of nature that better fits with the lived human experience than a purely materialistic worldview. Today’s natural theologians begin with the belief in God, then ask what kind of a world would be expected from a good God, and only then look for evidence in the world around them that will confirm their belief. Any other approach, such as Paley’s, ultimately rests on an extra-religious assumption that builds a proof for God’s existence on a material basis.

The new form of natural theology augments evidence for an already existing belief by showing how the world is consistent with the existence of a loving God. The approach locates natural theology as a subset of theology rather than as an independent, materialist line of inquiry. Natural theology does not offer proof that God exists, but rather, helps to reconcile some of the apparent contradictions between nature and theology (for example, see chapter 3 for a theological discussion of how death and suffering in an evolutionary progression might be compatible with divine creation).

CONCLUSION

Can science interpret the amazing fine tuning of the world to extract a purpose within the universe? Pascal, the brilliant mathematician and philosopher, turned to statistics for an answer: either God exists or he doesn’t. If God exists and you believe in Him then the reward is life in

eternity. If God exists and you don’t believe in Him then you end up in eternal damnation. If God doesn’t exist and you believe, you’ve probably made a few sacrifices that you wouldn’t have otherwise have made whereas if God doesn’t exist and you don’t believe, then you’re even. If you gamble the best choice is to believe God does exist. This, however, while rational, is hardly the way that most people decide to believe in God.

Others seek purpose in the essence of nature. If people are ultimately only the product of nature and if individuals have purpose, then purpose must arise from natural processes. Does this type of purpose exist in cells or just in higher organisms? Answers to this question remain elusive.

Space agencies spend billions to find life in the outer reaches of the cosmos. If life can be found on other planets, on a remote moon, or tucked away in the corner of the galaxy then maybe the origin of life is not as special as it currently appears. The origin of life, and humanity in particular, might really be chance and a good chance at that.

What is life all about? Dramatic advances in cosmology reveal intricate details of the Big Bang. Does the fine structure of the universe impose meaning? People’s answers constitute part of a lifelong quest to discover and extract meaning from life. Some people interpret events as happenstance while others attribute positive outcomes to God’s providence. Theists believe that the evidence is overwhelming, whereas atheists assert that belief prevents humanity from making the next evolutionary progression to a higher form of intelligence. Who’s right? Only God knows!

DISCUSSION QUESTIONS

1. Science has been fantastically successful in unlocking the secrets of nature. Why is science so effective at being able to provide answers about how the world works? Why are people able to comprehend the universe?

2. Given the predicted end of earth’s solar system in about thirty million years, what is the most imperative aim for humanity?

3. Conflicts between scientific discoveries and religious doctrine have caused much difficulty for people wanting to live as intellectually honest followers of God. Are scientific discoveries ever able to change the interpretation of religion and are religious texts ever able to influence the pursuit of science?
4. Dramatic images of galaxies, star birth, and supernovae are available on the web and in television documentaries. These presentations often emphasize the awe and wonder of these images. Is this scientific or philosophical? Do these images and the feelings they invoke make you believe that they are the result of creation by God or the result of random chance?

5. If God made the universe then why isn’t there clear scientific evidence for God’s existence?

6. The standard Big Bang model envisages the intricate structure of billions of galaxies forming from an extremely dense, highly energetic singularity expanding in an extremely finely tuned manner. Is this equivalent to scientific belief in a miracle?

Further reading for “Is There Purpose to Life? Implications from the Big Bang”


2. Paul Davies, The Mind of God: Science and the Search for Ultimate Meaning. New York: Simon & Shuster, 1992. Paul Davies is one of the few scientists who does not subscribe to conventional religion yet is adamant that the world is teeming with purpose. This book visits answers to how the world might have arisen, why the world is understandable, and why the question of meaning is so important. The style is light and engaging with a focus on ultimate meaning rather than the underlying math and physics.


three-volume tome. The first three chapters on background, nature, and reality are excellent and reasonably accessible.


6. Rodney Holder, *God, the Multiverse, and Everything: Modern Cosmology and the Argument from Design*. Farnham, UK: Ashgate, 2004. Physicist-Priest Rodney Holder uses a mathematical probability analysis to probe whether fine tuning is best explained by steady state theory, multiverse theory, or divine fiat. An excellent summary of current arguments is followed by a mathematical treatment, the most intense of which is relegated to appendices. Prevalent use of analogy make this quite readable.


8. Peter D. Ward and Donald Brownlee. *Rare Earth: Why Complex Life is Uncommon in the Universe*. New York: Springer, 2007. Two experts in geology and astronomy join forces in showing just how special earth is. From earth's position in the habitable zone to early life on earth, plate tectonics, and the solar system, the authors describe a readable structure of the world that emphasizes its uniqueness.

9. Trinh X. Thuan, *Chaos and Harmony: Perspectives on Scientific Revolutions of the Twentieth Century*. Conshohocken, PA: Templeton Foundation, 2006. Combining his expertise in astrophysics with his Buddhist beliefs, Trinh draws out the world's beauty and elegance recently discovered by science. The style is engaging and poetic, readily accessible, and captures the depth and meaning in the human experience of interacting with the world.

11. Ian Barbour, *When Science Meets Religion*. New York: HarperCollins, 2000. Ian Barbour, one of the leaders in science and religion, provides an accessible book summarizing the key ideas in the field that is suited for academically inclined readers. The focus lies in showing the progression of science and religion from conflict, through independence, to dialogue, and now to integration.

2. The Origin of Life:
Who or What Creates Life?

“Science without religion is lame, religion without science is blind” wrote Einstein.¹ Pope John-Paul II refocuses Einstein’s idea to show how together the two disciplines work to uncover truth: “Science can purify religion from error and superstition; religion can purify science from idolatry and false absolutes.”² Nowhere is the intersection of science and religion more divisive than the origin of life and yet this area is where insight is most needed to guide thinking through knotty issues of genetic engineering, cloning, and stem-cell research.

Evolution is probably the greatest source of antagonism between science and religion. For religious people, God made all things. In contrast, biological evolution provides an account of life’s development from inorganic matter without the necessity for any external agent. Evidence from many scientific fields, biology, geology, anthropology, paleontology, and chemistry, provides a highly plausible evolutionary sequence from Big Bang to man. Evolution is not yet supported by seamless evidence from amoeba to zebra, as there are several very significant points awaiting evidence. Nevertheless, scientific advances have been very effective in filling in many details, raising the issue of where God’s influence might be.

An alternative to the explanations of a divinely created young earth or naturalistic biological evolution is an evolutionary process directed by God. Various forms of guided evolution have been proposed, ranging

1. Einstein, “Religion and Science.”
from direct intervention at strategic points, to God being only the initia-
tor of the universe’s evolution. Evaluating the competing theories of
earth’s evolution requires objectively examining the fundamental claims
of each.

DIVINE CREATION

The opening lines of the Bible set the stage for Christianity’s claim that
the Bible’s purpose is to reveal God’s love and desire for all people to live
in relationship with him. Sometimes called a hymn, Genesis 1 appears to
be a unique blend of prose and poetry. As poetry, the passage uses figu-
rative language to describe God’s activity by using human counterparts:
speaking and seeing, working and resting. In reading the first chapter
of Genesis, the question to consider is whether a poetic description of
the universe’s beginning could provide an accurate description of God’s
actions.

Genesis 1: The opening lines of the most published book in the
world’s history.

In the beginning God created the heavens and the earth. Now
the earth was formless and empty, darkness was over the surface
of the deep, and the Spirit of God was hovering over the wa-
ters. And God said, “Let there be light,” and there was light. God
saw that the light was good, and He separated the light from the
darkness. God called the light “day,” and the darkness he called
“night.” And there was evening, and there was morning—the first
day.

And God said, “Let there be an expanse between the waters
to separate water from water.” So God made the expanse and
separated the water under the expanse from the water above
it. And it was so. God called the expanse “sky.” And there was
evening, and there was morning—the second day.

And God said, “Let the water under the sky be gathered to
one place, and let dry ground appear.” And it was so. God called
the dry ground “land,” and the gathered waters he called “seas.”
And God saw that it was good.

Then God said, “Let the land produce vegetation: seed-
bearing plants and trees on the land that bear fruit with seed in
it, according to their various kinds.” And it was so. The land pro-
duced vegetation: plants bearing seed according to their kinds
and trees bearing fruit with seed in it according to their kinds.
And God saw that it was good. And there was evening, and there was morning—the third day.

And God said, “Let there be lights in the expanse of the sky to separate the day from the night, and let them serve as signs to mark seasons and days and years, and let them be lights in the expanse of the sky to give light on the earth.” And it was so. God made two great lights—the greater light to govern the day and the lesser light to govern the night. He also made the stars. God set them in the expanse of the sky to give light on the earth, to govern the day and the night, and to separate light from darkness. And God saw that it was good. And there was evening, and there was morning—the fourth day.

And God said, “Let the water teem with living creatures, and let birds fly above the earth across the expanse of the sky.” So God created the great creatures of the sea and every living and moving thing with which the water teems, according to their kinds, and every winged bird according to its kind. And God saw that it was good. God blessed them and said, “Be fruitful and increase in number and fill the water in the seas, and let the birds increase on the earth.” And there was evening, and there was morning—the fifth day.

And God said, “Let the land produce living creatures according to their kinds: livestock, creatures that move along the ground, and wild animals, each according to its kind.” And it was so. God made the wild animals according to their kinds, the livestock according to their kinds, and all the creatures that move along the ground according to their kinds. And God saw that it was good.

Then God said, “Let us make man in our image, in our likeness, and let them rule over the fish of the sea and the birds of the air, over the livestock, over all the earth, and over all the creatures that move along the ground.” So God created man in his own image, in the image of God he created him; male and female he created them. God blessed them and said to them, “Be fruitful and increase in number; fill the earth and subdue it. Rule over the fish of the sea and the birds of the air and over every living creature that moves on the ground.” Then God said, “I give you every seed-bearing plant on the face of the whole earth and every tree that has fruit with seed in it. They will be yours for food. And to all the beasts of the earth and all the birds of the air and all the creatures that move on the ground—everything that has the breath of life in it—I give every green plant for food.” And it was so. God saw all that he had made, and it was
The opening line of Genesis is unique among creation stories. In this and only this story God brings the universe into existence seemingly out of nothing. God’s actions and the world’s response, emphasized in the quotation with different type, demarcate an underlying pattern. The clear declaration that the God of the early Hebrews has made all of creation stands apart from the pagan myths of the neighboring prehistoric cultures. This statement of God’s creative activity has always been understood as “out of nothing,” a creation of matter and energy and time itself. Unlike the pagan gods who worked with pre-existing materials, God spoke and creation occurred.

The repeated phrase “And God said” appears at the beginning of each creative event and is followed by creation’s obedience: “And it was so.” Capping these creative events is the declaration: “And God saw that it was good.” Although the sections vary in length and minor details, they follow the same pattern to reiterate that God created everything and made all things well.

The poetic structure of Genesis has been recognized for at least two millennia. As with much poetry, it has a repetitive form at several levels. On the first day God makes light and three days later he makes the heavenly lights, the sun and moon. On the second day God makes the sky and sea and three days later, the birds and fish to populate those realms. On the third day, God makes land and vegetation, the prerequisites for the land creatures and people that appear three days later on day 6. The first three days parallel the second three days: light and darkness/sun and moon, waters above and below/birds and fish, land and ocean/animals and humans. In the first three days the world is formed, while in the following three days the world is filled. The point of this unraveling symmetry is order. Each part of creation is linked together in a beautiful plan in which creative acts bring forth ecological diversity in an integrated, interdependent structure. Day seven is God’s crowning glory consistent with the veneration of many ancient cultures for the number 7.

3. Gen 1:1–31