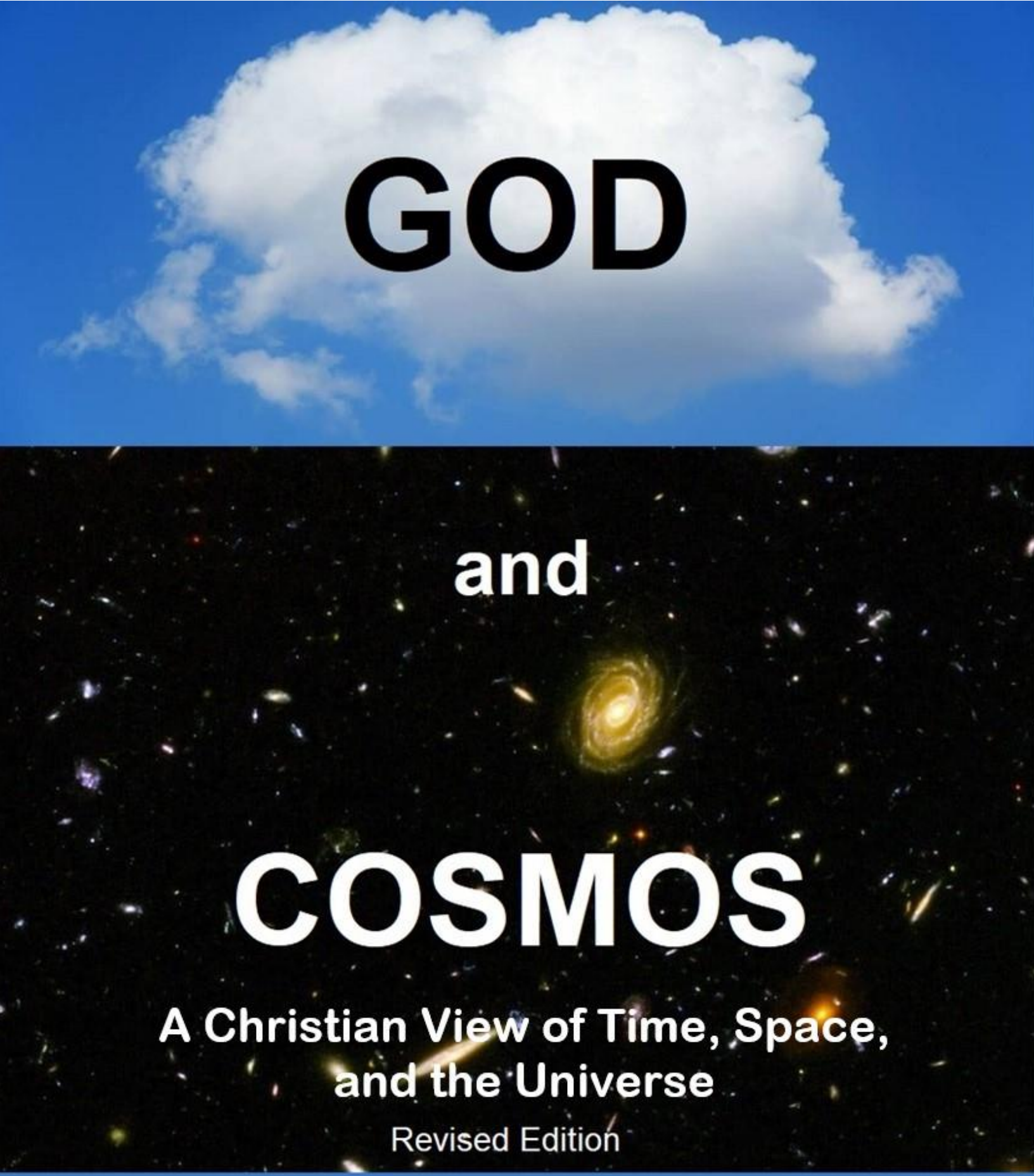

GOD

and

COSMOS

A Christian View of Time, Space, and the Universe

Revised Edition

JOHN BYL

God and Cosmos

A Christian View

Of

Time, Space, and the Universe

John Byl

GOD AND COSMOS

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Preface

This book is addressed to anyone concerned with defending the Christian faith in an age of naturalistic science. Much has been written about the relationship between science and religion. Relatively little deals specifically with interactions between cosmology and theology.

This book aims to probe beyond the usual questions of origins and to dig deeper into various underlying philosophical and theological issues. The emphasis will be on the philosophical presuppositions and theological implications of modern cosmology, on the one hand, and, on the other, the significance of the Bible for cosmology.

To be accessible to the general reader, I assume no prior technical knowledge of cosmology. Although specific cosmological models tend to be highly mathematical, this book has only a few simple equations.

I thank theological and scientific friends who have given their feedback on parts of this book. Particular thanks to Dr. Cornelis Van Dam, Emeritus Professor of Old Testament studies at Canadian Reformed Theological Seminary in Hamilton, Ontario, Canada and Dean Davis, Director of Come Let Us Reason, a ministry specializing in Apologetics and Worldview Studies.

1. Some Basic Questions

Cosmology is the most important subject in the world.

Why? Because it is the story of the entire world: its origin, structure, purpose, and destiny. As people in that world, its story necessarily forms the background for our own personal story. It concerns our deepest beliefs, values, and hopes.

Our cosmology forms the basis for our response to the most fundamental questions about our existence. Our cosmological beliefs shape our morality, religion, and culture. They largely influence our worldview.

Our prime aim is to examine and develop cosmology from a Christian perspective. Very briefly, Christianity holds that God created, from nothing, a two-realm universe consisting of both a visible and a heavenly part, whose history follows God's glorious plan. The original creation was good. It culminated in the creation of Adam, created in the image of God, to serve him and glorify Him. Unhappily, Adam's fall into sin corrupted man, along with the entire physical world. Happily, man can be redeemed through the gracious work of Christ. After the Day of Judgment, believers will be transformed to rule with Christ on a renewed Earth cleansed from sin and corruption.

The main challenger to Christian cosmology is Big Bang cosmology, the mainstream secular cosmology currently embraced by most Western scientists and scholars. It is taught at most schools and universities.

According to Big Bang cosmology, the universe began with the explosion (the "Big Bang") of a highly compressed ball of energy-matter. Its later expansion and evolution yielded galaxies, stars, and planets. On planet Earth simple life sprang forth, which eventually evolved into higher forms of life, including humans.

Big Bang cosmology aims to explain everything solely in terms of natural laws. It is claimed to be fully scientific, relying only on observation and reason, and banning divine revelation and miracles.

As such, Big Bang cosmology presents a vital background story for naturalism. Naturalism holds that only the physical universe exists, with no God, no heavenly realm, no absolute morals, and no purpose. The universe, and everything in it, is viewed as a huge accident. Humans, the chance products of evolution, have no purpose in life, and cease to exist at death. Morality and religion are merely human inventions.

Naturalism clearly stands in stark contrast to Christianity (for a detailed study of Christianity versus naturalism see Byl 2022). If its Big Bang story of the world is true, then Christianity is necessarily false. Since Big Bang cosmology is widely viewed as a scientifically proven fact, it poses a great challenge to Christianity.

How should Christians respond?

Positively, Big Bang cosmology seems to show a beginning to the universe and might thus supply apologetic evidence for a Creator. However, to what extent is Big Bang cosmology consistent with the Bible? Could one construct a Christian version of Big Bang cosmology? This raises the question of what the Bible says regarding cosmology. To accommodate the main features of Big Bang cosmology, what, if any, changes must we make in how we read the Bible? And with what theological consequences?

Alternatively, if that theological price is deemed too high, Christians could consider modifying their cosmological models. How well established is Big Bang cosmology? Is there scientific room for alternative cosmologies that might accord better with a Christian worldview?

Our aim is to examine some of the deeper issues behind these questions. Our investigations will take us into the realms of *cosmology*, the science concerned with the study of the universe as a whole, and *theology*, the study of God and his revelation.

How do theology and cosmology affect each other? To what extent is cosmology influenced by theological or philosophical biases? What, if any, theological consequences can be drawn from cosmology? Such questions will form the focus of this study. Our prime theological focus

will be on Christianity, taking the Bible as the main source of divine revelation.

What Is the Cosmos?

Cosmology (from the Greek words *kosmos*, “world,” and *logia*, “study of”) is the study of the universe as a whole: everything that exists. For something to exist means it is real, or actual, rather than merely a possibility or fiction. To exist means to *be*, to be *somewhere* in space.

So, what exists? First, there is the physical world of humans, trees, stars, and galaxies. These are the things that we can see or sense. It also includes the space in which they exist, and changes that occur within time.

Physical cosmology is concerned primarily with this *physical* aspect of the universe. It aims to describe and explain the origin and development of astronomical phenomena, such as stars and galaxies, in terms of natural laws.

Second, reality includes also more abstract things such as human thoughts. These find place in human minds, housed in human brains. It also includes the abstract laws of logic, mathematics, and morality, as well as the natural laws controlling physical objects.

Further, although many modern people assume that nothing exists beyond the physical world and human thoughts, Christians believe that everything was created by an almighty God, whose existence transcends his creation. He is, in fact, the necessary ground for all being, as well as the upholder of abstract laws.

Finally, Christians believe also in the existence of an invisible realm of heavenly creatures-- angels and demons-- who can cause physical effects in our visible world.

How Can We Know the Cosmos?

Our knowledge of the cosmos is acquired via various means.

Observations Are Basic

Cosmology, like any science, is necessarily grounded in our past and present observations of the physical universe. We observe the Sun, Moon, planets, stars, supernovae, galaxies, and the like. In recent decades, with ever more sophisticated telescopes and instrumentation, our celestial observations have become ever more detailed and precise. We currently have a wealth of astronomical data.

Nevertheless, our study of the universe is severely hampered by the fact that we can observe it from only one spatial position (*i.e.*, near the earth) over a small interval of time (*i.e.*, the last few centuries). What we can presently see may, for all we know, form only a tiny fraction of the entire physical universe.

Theories Explain and Extend

To transform the data observed by earth-bound detectors to information about far-away events requires various assumptions about the nature of the universe. For example, to infer that light we receive here by a telescope in AD 2024 left a particular galaxy billions of years ago, we assume that the light originated from the galaxy, that the calculated distance to the galaxy is correct, that the speed of light was constant during its travel here, etc. Such assumptions, no matter how seemingly plausible, can be difficult to justify.

Cosmology, as a science, aims not just to *observe* the universe, but to *explain* past observations and to *predict* future observations. To this end, the observed data are carefully examined for patterns, regularities, and laws. The goal is to explain events in terms of known

physical laws, and, in turn, to explain these laws in terms of more fundamental concepts, principles, and theories.

Thus, for example, our observations of solar planets suggest a general law that all planets orbit their sun in elliptical orbits; these elliptical orbits are then explained in terms of a broader gravitational theory such as Newtonian mechanics or Einstein's general relativity.

Since scientific theories are constructed to *explain* the data, reliable observational data always trumps scientific theories. Therefore, scientific reconstructions of the past may not contradict ancient observations preserved in reliable historical records of past events.

Cosmology is generally more concerned with the overall structure and history of the physical universe, than with specific details of individual astronomical objects, such as stars or galaxies. To this end, cosmologists construct cosmological *models*, which are simplified mathematical representations of the main features of the physical universe. For mathematical simplicity, such models make various simplifying assumptions. For example, it is often assumed that the universe is *isotropic* (*i.e.*, the same in all directions) and *homogeneous* (*i.e.*, the same at all places), at least at very large scales.

Choosing Theories

Cosmological models draw heavily upon theoretical assumptions. But what assumptions should we make? As we shall see, the observational data can often be explained in multiple ways, in terms of many competing models.

Moreover, simplifying assumptions, while needed to construct workable cosmological models, can often not be observationally confirmed. For example, it is commonly assumed the physical laws applicable here and now are universally valid always and everywhere. But this need not be so. For example, perhaps the gravitational constant, or the speed of light, vary in space or time. Several such proposals can be found in professional astronomical journals.

Given a large choice of possible theories, how can we hope to stumble upon the correct theory? Indeed, even if we were to chance upon the

best theory, how could we recognize it as such? Or, for that matter, how can we even choose the better of only two competing theories?

The difficulty is that scientific theories cannot simply be deduced from observations. Rather, their origin is now considered to be largely subjective. The noted philosopher of science, Sir Karl Popper asserts that "*we must regard all laws or theories as hypothetical or conjectural; that is, as guesses*" (1972:9); he sees theories as "*the free creations of our minds*" (1963:192). Or, as Carl Hempel puts it:

> *The transition from data to theory requires creative imagination. Scientific hypotheses and theories are not derived from observed facts but are invented in order to account for them (1966:15).*

It seems that theories are not so much *given to* us by nature as *imposed by* us on nature; they are not so much the result of rational thought as the creations of our irrational intuition.

Given the subjective origin of scientific theories, how can a particular theory be proven or disproven? A true theory should not contradict our observations. Hence, one might think that further research will falsify most theories.

In practice, however, theories are not so easily deposed. A favoured theory, such as Big Bang cosmology, can always be saved from observational disproof by suitably modifying it to fit the data.

A theory that must be supported by artificial, *ad hoc* (*i.e*., designed specifically to overcome a particular shortcoming) devices may not seem very plausible. Nevertheless, however difficult it may be to demonstrate a particular *ad hoc* theory to be true, it is even harder to conclusively disprove it. According to philosopher Imre Lakatos:

> *Scientific theories are not only equally unprovable, and equally improbable, but they are also equally un-disprovable (1980:19).*

While recognizing that there was no logic to the *discovery* of theories, Popper hoped to construct a rational process for the objective *selection* of theories. He proposed that genuine scientific theories should be

falsifiable (*i.e*., they should make definite testable predictions). Yet, if we were to apply this criterion to cosmology, we would have little theory left. Virtually all cosmological models are currently falsified by observations.

Moreover, Popper did not prove that easily falsifiable theories are more likely to be true than others. Nor is his proposal itself falsifiable, so that it fails Popper's own criterion of a scientific theory.

It is, of course, possible to play the game of cosmology under different rules. Perhaps we should prefer theories that are mathematically simplest, that make the most novel predictions, that fit in best with other accepted theories, etc. Although such criteria seem reasonable, and are commonly used in practice, they are not guaranteed to produce true theories. Why should simple theories, for example, be more likely to be true than more complicated ones?

Indeed, the creation of selection criteria is no less subjective than the creation of scientific theories. As Lakatos notes:

> *These scientific games are without genuine epistemological (i.e., having to do with knowledge, JB) content unless we superimpose on them some sort of metaphysical principle which will say that the game, as specified by the methodology, gives us the best chance of approaching the truth (1980:122).*

In short, science in general - and cosmology in particular - is plagued by the lack of definite, objective criteria that might allow us to easily separate true theories from false ones. At this crucial point we must rely on extra-scientific considerations.

We can refer to this as *the problem of scientific knowledge*: we have no justifiably valid criteria for finding true theories. The only place where it is relatively easy to draw a line is between observations and theories that are devised to explain or extend the observations. I say here "relatively" since even our observations are to some degree theory laden. For example, our theories determine what we look for, how we interpret what we find, how confident we are about the reliability of any particular observation, and so on.

Even so, our observations are still much more secure than their theoretical extrapolations. While some scientific disputes concern the actual observed data, most involve the *interpretation* of the data within competing theoretical frameworks. Thus, we should accept as scientific fact only reliable observed data. Once we step beyond the observations, we are set adrift in a sea of subjective interpretation and speculation.

The Role of Worldviews

Our choice of scientific theories depends largely on what we assume about the universe as a whole. These assumptions reflect our most basic notions regarding reality, our *worldview*.

Thus, also in cosmology, extra-scientific biases can play a large role. For example, the choice for or against the Big Bang is sometimes strongly influenced by religious factors. Fred Hoyle (1975a:684) rejected Big Bang cosmology at least in part because the sudden appearance of the universe at a finite time in the past seemed to him to imply a supernatural cause. On the same grounds, some Christians such as William Craig (1993) and Hugh Ross (1993) embraced Big Bang cosmology partly because it aided their proof for the existence of God.

At heart scientists cannot avoid being guided by their deepest religious and philosophical convictions. These can play a decisive role in the creation, assessment, and selection of cosmological theories.

Religious and philosophical prejudices may easily blind their adherents to blatant deficiencies in their own favoured theories and to obvious advantages in rival models. It is thus important that such presuppositions be made very explicit. To minimize undue distortion and bias, our premises and criteria should at least be openly acknowledged.

As we have already noted, the dominant worldview in modern cosmology is naturalism, which has no place for God or miracles. Modern man wants to ban supernatural causes and divine revelation from science. However, this can be done only by prior assumption,

rather than by any objective proof. After all, how could one ever prove that miracles are impossible, or that God has not revealed truth?

The Christian worldview, in contrast, takes God to be the ultimate reality. Since God is our starting point, we trust his revealed Word as a most trustworthy source of knowledge beyond our observational horizon. Through it we get knowledge of God and his creation. Since God is sovereign, he sets physical laws and changes them as he wants. God's complete control makes plausible the possibility of miracles, even the colossal miracle of the instantaneous creation of the entire physical universe, by a mere divine word.

A Christian View of Knowledge

A crucial question in studying reality is how to rate our various sources of knowledge. In particular, given a Christian worldview, how should we rate the Bible as a source of knowledge?

The Bible is the written Word of God, revealed to human authors inspired by the Holy Spirit**.** Since God never errs or lies (*e.g.*, John 17:17; 2 Tim.3:16; Titus 1:2), his word should be accepted as inerrant and fully authoritative in all it says, also when it concerns cosmological matters.

However, the Bible itself testifies to the importance also of first-hand experience. For example, "*many believed in his name when they saw the signs that he was doing*" (John 2:23). Belief in Jesus' resurrection is grounded in the disciples' actual experiences:

> *When therefore he was raised from the dead, his disciples remembered that he had said this, and they believed the Scripture and the word that Jesus had spoken (John 2:22).*

Paul backs up his claim of Christ's resurrection by appealing to eye-witnesses of the risen Christ (1 Cor. 15:5-8); John, too, bases his teachings on what he has personally heard and seen (I John 1:1-5). Luke writes his gospel, based on eyewitness reports, so that the reader may have certainty concerning the things taught (Luke 1:1-4). Jesus rebukes Thomas, "*Have you believed because you have seen me? Blessed are those who have not seen and yet have believed*" (John

20:29). Now we see dimly, but then I shall know fully, “*face to face*” (1 Cor.13:12).

Our senses are reliable because they are of divine origin (*hearing ear and the seeing eye, the Lord has made them both,*" Prov.20:12). We need these to hear the gospel ("*so faith comes from hearing,*" Rom.10:17) and to read the Bible.

Since the Bible presents eye-witness reports of historical events, it supplies reliable observational evidence. Hence, such biblical data should constrain scientific explanations in the historical sciences, including cosmology.

Further, we must rely on deductive logic and mathematics. It is evident that God has made the universe in such a way that it has logical and mathematical properties. God has endowed man, created in his image, with the analytical abilities to use these laws, although man, due to his finite, fallen nature, can make mistakes.

Our reasoning powers are not confined to the mere application of logic and mathematics but also include the ability for imaginative, theoretical thought. Unfortunately, particularly after the Fall, our reasoning is a tool that is controlled by our inner desires. As such it can easily be misguided: "*for out of the heart come evil thought*" (*Matt.*15:19). Clearly, man is responsible for his thoughts and hence also for their products: scientific theories. After all, as we have seen, scientific theories are but the speculative inventions of man's creative imagination. Nowhere does the Bible suggest that God reveals himself through fallible human theorizing. Indeed, the Bible stresses the limitations of human knowledge, particularly with regards to origins (see, for example, Job 38-41; Isa. 41:21-24; Eccl. 3:11).

A proper theory of knowledge (or *epistemology*) will thus give high weight to Scripture, observations, and logic. These are all God-given and will thus be in harmony; they form the touchstone of our knowledge.

On the other hand, human theorizing, in all its forms, is in a much lower category of knowledge. If it fails the test of logic, observation, and

Scripture then we can reject it as certainly false. Even if it passes this test, we must be cautious: any claim that goes beyond observation and Scripture is still likely to be false.

The Nature of General Revelation

It is often said that God reveals truth through two books: the Bible (so-called *special* revelation) and nature (so-called *general* revelation), through his Word and his works. God's revelation through nature is expressed in texts such as:

> *For his invisible attributes, namely, his eternal power and divine nature, have been clearly perceived, ever since the creation of the world, in the things that have been made. So, they are without excuse. (Rom. 1:20)*
>
> *The heavens declare the glory of God… (Psa. 19:1)*

It is then argued by some that, since God is the author of both books, these cannot contradict each other. Hence, we should interpret the Bible in line with scientific knowledge.

For example, David Diehl (1987) has urged that general revelation should include not only knowledge of God, but also that of his works in nature. He has in mind not just observations of nature but also scientific theorizing that goes beyond the observations. According to Diehl, some scientific views that have been unpopular with theologians are so well-established that it would be truly unscientific and unfair to general revelation to reject them. Special and general revelation should, asserts Diehl, have equal authority, each having final authority within its own territory.

What are we to make of this? To be sure, we affirm the importance of our *observations* of nature. In this sense *general revelation* (I would prefer the term *creation* or *nature* here) is surely authoritative: we must appeal to it, or at least our experiences of it, as a check on all our scientific theorizing.

The difficulty with Diehl's position arises when he extends the contents of "*general revelation*" beyond observational data and logic to include also scientific theories (see Byl 1989). If, as Diehl believes, general

revelation is infallible, then such infallibility must also be granted to some scientific theories. But which ones? The history of science is filled with many examples of failed scientific theories that were once held as undoubted truths. The most famous such case is that of Newtonian mechanics, which was for centuries considered as absolute truth, but which has now been dethroned by Einstein's theory of relativity. Diehl offers no criteria by which we can distinguish true theories from false ones.

Historically, the doctrine of the two books has led to a decline in biblical authority. Once we allow the premise that some scientific theories can be taken as divine truth, then we permit the "*book of science*" to modify Scripture. In the absence of valid criteria for detecting true theories, our reading of the Bible will be forever in a state of flux, driven by whatever theories are currently in vogue.

Note that, in the biblical texts cited above, nature's message concerns only the knowledge of *God*: his eternal power and deity. Moreover, this message is so immediate and clear that everyone is "without excuse." There is no need of special scientific knowledge. It seems that God has created us with the innate sense of clearly discerning God's glory in nature.

Moreover, if nature is to be viewed as a book, then it is a special type of book. Unlike the Bible, nature is not a book containing propositional truth. Rather, it is a picture book, where the letters are creatures such as people, birds, trees, stars, and the like.

Further, the book of nature covers all of history since Creation. Yet the only pages we can now read are those pertaining to today, circa AD 2024. Those pages currently visible tell us nothing about biblical history, which stops before 100 AD. There can therefore be no conflict between biblical history and what we can observe from the book of nature.

We must not confuse our observations of nature with science, our fallible human effort to understand nature. The Bible is the reliable testimony of the Creator himself regarding truth that may be inherently

inaccessible to human perception and inquiry. Hence, we should read the book of nature using the spectacles of Scripture.

Interpreting the Bible

Thus far I have defended the position that the Bible is the written Word of God, and as such should be accepted as inerrant and fully authoritative in all it says, including cosmology. But what does the Bible say on cosmological matters? How are we to interpret those passages that seem to deal with this issue? What hermeneutical principles should be employed?

The question of the proper interpretation of Scripture has been disputed already from the early days of Christianity. To minimize human bias and distortion in reading the Bible, proper, objective hermeneutical rules should be followed. Two basic rules, stressed by the Reformers, were:

1. *The natural sense*. We should interpret the Bible in its obvious, plain sense, taking context into account, unless internal evidence indicates otherwise.
2. *Scripture interprets Scripture*. The clearer passages shed light on the less clear passages. We must read the Bible on its own terms, letting the exegetical chips fall where they may.

What about the claims of natural knowledge? Should they influence our hermeneutics? Our hermeneutical principles should be consistent with our epistemology. Hence, remembering the critical distinction between observation and scientific theory, we must be careful not to let fallible human theorizing shape the contents of God’s word.

Thus, Augustine, and later Aquinas, argued that natural knowledge was to be over-ridden by Scripture, unless it could be proven to be true. The lightest word of God was to have precedence over the heaviest word of man, unless the latter could be conclusively demonstrated. In that case, since God's word cannot conflict with the truth, it is evident that another interpretation is required.

But what would constitute a valid proof of the correctness of any item of extra-biblical knowledge? Since the 16th century, with the rise of science and Bible criticism, various aspects of the traditional

interpretation of Scripture, particularly Genesis, were challenged. These included its creation account, the story of Adam and his fall, Noah's Flood, and so on. Some Christians steadfastly held on to the old reading of Scripture, denying that the new scientific ideas had been adequately demonstrated. Many, however, felt the need to modify their reading of Scripture at least to some degree.

At first the troublesome portions of Scripture were merely reinterpreted to accord with modern learning. Elastic methods of interpretation were advocated. A typical example of such *concordism* are the words of Christian geologist Davis Young:

> *We need not twist or misinterpret the facts in order to get agreement between the Bible and science. Christians must realize that the Scriptures do not require us to believe in six twenty-four-hour days of creation. There is legitimate internal biblical evidence to indicate that the days of creation may have been indefinite periods of time. Moreover, the genealogies of Genesis 5 and 11 need not be taken in a rigidly literal fashion...It is not entirely clear that the Bible is talking about a geographically universal flood...There is considerable room for legitimate variation of interpretation of the creation and the flood (1982:152).*

The obvious difficulty with such a flexible approach to Scripture is the danger of merely reading out of Scripture what we put in, reducing the divine light of Scripture to a mere reflection of human insight.

The inadequacies of concordism have been stressed by none other than Young himself in a later work, where he frankly repudiated his earlier concordism:

> *...all the variations of the concordist theme give us a Bible that is constantly held hostage to the latest scientific theorizing. Texts are twisted, pulled, poked, stretched, and prodded to "agree" with scientific conclusions, so that concordism today undermines honest, Christian exegesis (1987:6).*

In short, concordism is inconsistent with an epistemology that stresses the supremacy of God's word. It is crucial that we embrace a hermeneutic that is not unduly influenced by human theorizing. If we are to listen to God's word with an open ear then we must strive to interpret the text objectively, applying sound hermeneutical principles. Again, the most direct, natural interpretation is thus generally to be preferred, unless internal Scriptural evidence indicates otherwise.

The Scope of Biblical Authority

It is noteworthy that Young concludes that, leaving aside extra-biblical considerations, the natural, traditional interpretation of Genesis is, after all, exegetically preferred.

Nevertheless, Young believes that the weight of scientific evidence falsifies the traditional reading. Therefore, having rejected concordism, Young opts to limit biblical authority. He advocates that we treat Genesis 1 not as a scientific or historical report, but as a piece of ancient literature with well-defined thought patterns, structures, symbols, and images, intended to convey theological truths (Young 1987:303).

In recent years the nature and extent of biblical authority has been much discussed in evangelical circles. One increasingly popular position is that science and Scripture do not *contradict* each other but *complement* each other. Astronomer Howard Van Till, believing in the religious neutrality of science, has vigorously supported this point of view. According to Van Till (1986), the evolutionary and biblical views of the cosmos are complementary descriptions that answer different types of questions. Science reveals information about the physical structure and past history of the universe; the Bible tells us about its relation to God. Science answers question of "*how*" and "*when*"; the Bible answers questions about "*who*" and "*why*".

However, the Bible itself gives no hint that its authority is limited to theological questions of "*who*" or "*why*"? In fact, it seems to speak rather clearly about historical issues, concerning matters of *how* and *when*, also regarding the origin of the physical universe. On what grounds, then, can we set a boundary to its authority? and how can we determine where the boundary would be?

Van Till distinguishes the *divine contents* of a biblical story from the *human packaging* in which it comes. The theological thrust of a biblical passage can be taken as trustworthy, but not the specific physical details that form the "*packaging*". Van Till explains:

> *so we as readers of Scripture must be studiously and prayerfully wise in separating the contents (the trustworthy teachings of God) from the vehicle and packaging. Neglecting that separation would be as foolish as attempting to eat a granola bar without first removing it from its wrapper...(Van Till 1986:15-16).*

Yet one may well ask how Van Till can be so certain that the "*packaging*" is not divinely inspired as well? Or, conversely, if the packaging is not inspired, why should the message be? How, in the absence of clear, divinely ratified criteria can we ever hope to disentangle the allegedly divine message from the allegedly human wrappings? Ultimately the discernment of the divine teachings contained in Scripture is left to the subjective whims of the human reader.

There are other options beyond concordism or complementarianism. But whenever one's reading of Scripture depends in any degree on science, the problem arises as to where to objectively draw the line.

Thus, whereas concordism unduly distorted the biblical message by its elastic hermeneutics, complementarianism distorts it by imposing unwarranted limits on biblical authority. Those who wish to modify the traditional reading of Scripture are plagued with the lack of clear, valid criteria for separating the wheat from the alleged chaff. If we cannot accept *all* of Scripture as authoritative, how can be sure *any* of it is?

Note that affirming the epistemological supremacy of Scripture implies its inerrancy. If we accept Scripture as the highest standard of truth, then we have no higher judge to test its accuracy; inerrancy must be assumed from the start. If we follow the principle that Scripture must interpret Scripture, then our interpretation of Scripture should be internally consistent: there should be no internal errors.

Of course, the Bible does make specific predictions regarding the future, such as the imminent return of Jesus Christ. Hence biblical claims are ultimately testable. Meanwhile, however, we must resist the temptation to "prove" inerrancy by appealing to scientific evidence, for that, in effect, makes the scientist, fallible man that he is, the judge of Scripture. Inerrancy must be our starting point, not our conclusion.

Is the traditional interpretation of an all-authoritative Scripture still tenable in our scientific age? That is the prime question to be addressed in the chapters ahead. Note that, if scientific "*facts*" are to be limited to direct observations, there will be little actual conflict between the Bible and scientific knowledge. After all, the Bible is concerned with events in the distant past, in the (as yet unobserved) future, and in the (unseen) heavenly realm. Since scientific *observations* concern only the present and the very recent past, clashes arise primarily between the Bible and scientific *theorizing*.

A fundamental question that must be posed is, therefore, whether the scientific theories of modern cosmology, uncertain as they may be, are nevertheless sufficiently established to warrant their elevation above Scripture.

Preview

Our study will focus on two basic questions:

1. What does theology have to say to cosmology?

How have theological considerations influenced the construction, assessment, and selection of cosmological theories? What does the Bible have to say regarding cosmology?

2. What does cosmology have to say to theology?

How have cosmological models influenced theology? What theological consequences can be drawn from modern cosmology? How reliable are cosmological models?

We shall begin, in the next chapter, by examining what the Bible has to say regarding cosmology. This will be followed by a brief historical survey, from ancient Near East cosmology through medieval

cosmology, leading up to modern cosmology. The following chapter focuses on Big Bang cosmology. Its strengths, weaknesses, and underlying assumptions will be discussed. Various alternative cosmological interpretations of the observational evidence will be considered.

Further chapters examine various theological implications that have been drawn from Big Bang cosmology. Cosmological evidence has been used in several proofs for the existence of God. The validity of such proofs is the topic of one chapter. Another chapter deals with the future of the universe, particularly with regards to life. The possibility of extra-terrestrial life will be examined. Supporters of modern cosmology have proposed a variety of gods allegedly more feasible in the modern world than the Christian God. These strange gods, and the hope they might present for a life hereafter, will be discussed in a further chapter.

This is followed by a chapter examining the implications of Big Bang cosmology for Christianity. The next chapter presents a variety of cosmological models built upon biblical givens. The validity and function of such models are discussed, particularly with an eye on their usefulness as an apologetic tool. A final chapter summarizes the conclusions reached.

2. The Bible on Cosmology

What does the Bible have to say about God and his creation, particularly concerning cosmology?

God and Creation

Before the creation of the world God existed by himself from eternity. God is a spiritual being, all-knowing, all-powerful, perfectly good, wise, just, and holy. God is self-existent and self-sufficient, dependent on nothing beyond himself. God is infinite, in that he is unbounded, free from all limitations. This is shown in his *eternity*, which has no bounds in time ("*your years have no end,*" Psa.102:27), and his *immensity*, which has no spatial limitations.

God is a living God who acts and interacts. He is tri-personal, consisting of the Father, the Son Jesus Christ, and the Holy Spirit. The Bible relates that "*before the foundation of the world*" God the Father loved his Son (John 17:24) and glorified him (John 17:4). Thus, already before creation, there was love, glory, and fellowship within the persons of the divine Trinity.

God's Grand Christ-centered Plan

God did not need to create the universe, but freely chose to do so according to his sovereign will:

> *for you created all things, and by your will they existed and were created (Rev. 4:11).*

The ultimate purpose for which everything was created was to reveal, and share, God's magnificent glory (“the heavens declare the glory of God,” Psa.19:1), especially through the work of his Son, Jesus Christ.

So, before creation, God the Father prepared his Grand Plan for the universe. God's detailed plan encompassed *all things* in heaven and earth, which, in the fulness of time, will all be united in Christ (Eph.1:3-11).

Although this creation is planned by God the Father, it was carried out by Christ, by whom,

> *"all things were created in heaven and on earth, visible and invisible...all things were created through him and for him. And he is before all things, and in him all things hold together" (Col. 1:16-17).*

Christ is both the creator and sustainer of the universe. Without his continuous word of power the universe would instantly cease to exist: "*he upholds the universe by the word of his power*" (Heb.1:3). Christ was given all authority in heaven and on earth (Matt. 28:18).

God, through Christ, providentially guides the universe throughout history to ensure that his all-encompassing Plan is completely fulfilled. Nothing happens without God's will.

That Plan included the entrance of sin into the universe, and its ultimate conquest through Christ. God ordained Christ to redeem the elect (1 Peter 1:20), who were chosen before creation (Eph.1:4; Rev.13:8). Christ is the creator, sustainer, incarnated redeemer, judge (2 Cor. 5:10), and ultimate ruler of the entire universe.

The present state of the universe, holding so much pain and misery, is clearly not the best of all possible worlds. Yet, since God is perfectly wise, we can be assured that the full story of the universe is the best possible story. It is the most perfect expression of our wondrous God, glorifying his perfect power, holiness, justice, mercy, and love. God’s perfect Plan will culminate in the best possible world, at least for those who love God and long to share in his glory.

Creation Out of Nothing

The early church was challenged by the notion that matter had always existed. Some (*dualists*) held that God created the universe by ordering pre-existent material. Others (*pantheists*) equated the world with God. Opposing such views, the traditional Christian teaching is that the universe is distinct from God and was “created out of nothing” (*creatio ex nihilo* in Latin). The “nothing” refers to the notion that, before

the creation of the universe, there was no physical material. The entire universe, including its matter, was created solely by God, in accordance with his Plan.

The explicit expression "*created out of nothing*" is not found in Scripture. Yet this teaching seems to be confirmed by the Bible: "*In the beginning God created the heavens and the earth*" (Gen.1:1) implies that the physical universe had a beginning in time, being created by God. Consider also:

> *By faith we understand that the universe was created by the word of God, so that what is seen was not made out of things that are visible. (Hebr. 11:3)*

Nothing would have existed if it were not for God's will. God simply spoke and things came into existence: "*for he spoke, and it came to be*" (Psa.33:9). The doctrine of *creatio ex nihilo* asserts that the universe was created, at some point in time, from nothing, by God.

Creation and Providence

Some theologians have exchanged a *creatio ex nihilo* for a *creatio continua* (Latin for "*continuous creation*"). For example, theologian Ian Barbour (1971:384) argues that *creatio ex nihilo*, particularly if associated with an absolute beginning, is an unbiblical concept. Whereas *creatio ex nihilo* suited the static universe of medieval cosmology, the modern universe is dynamic and evolving. It is still incomplete, still being created. Barbour views the coming-to-be of life from matter as equally representative of divine creation as the primeval production of matter out of nothing. Barbour merges continuing creation with providence and minimizes *creatio ex nihilo*.

Theologian Ted Peters, too, even though he defends *creatio ex nihilo* against Barbour, agrees on the importance of *creatio continua*. According to Peters, God's creative work is not yet done: "*we today are still somewhere within the first six days*" (Peters 1989:96).

However, although God continuously sustains the universe, the Bible speaks clearly about its creation being a *past* event. At the end of the sixth day "*God saw everything that he had made, and behold, it was very good*" (Gen.1:31). Elsewhere, too, the six days are referred to as

a *past* event: "*in six days the LORD made heaven and earth, and on the seventh day he rested and was refreshed*" (Ex.31:17). Thus, *creatio continua*, with its mistaken notion that the universe is still evolving upward, has no biblical support.

The Creation of the Cosmos

Thus far we have discussed several general issues about creation. We now examine some specifics that can be gleaned from the creation account of Genesis 1, particularly the work the first four days, which refer to cosmological matters.

Day One

> *In the beginning God created the heavens and the earth. The earth was without form and void, and darkness was over the face of the deep. And the Spirit of God was hovering over the face of the waters. (Gen. 1:1-2)*

The Bible starts with the well-known words "*in the beginning, God created heaven and earth*" (Gen. 1:1). Is this a summary of what follows, or the first creation act? According to Old Testament scholar Cornelis Van Dam (2021:91-94), since the second verse goes on to describe the earth, which is then already in existence, the first verse describes God's very first act of creation on Day 1.

If the first verse is just a summary or heading of what follows, then the creation account does not specifically mention the creation of the earth nor the creation of the angelic heaven. Elsewhere, however, we are told that these were part of the six-day creation (Ex. 31:17), and that heavenly angels existed before the creation of the earth (Job 38: 4-7).

Initially, then, God created two things: heaven and a watery earth, from which the entire physical universe was later formed (Gen.1:6-19). A few points of cosmological interest can be noted.

1. A Finite, Bounded, Physical Universe

The primeval earth was dark, structureless, and largely in liquid form. Since the waters covering the earth are said to have a "face" or surface, it was a finite, bounded volume of matter. Further, since darkness and the Spirit of God are found "*over the face*", beyond the created matter, the finite physical universe seems to be embedded within a larger space, empty of material things.

2. The Heavenly Realm

In addition to the physical universe, God also created a heavenly realm. The Bible speaks about "heaven" or the "heavens" (Hebrew *shamayim*, which is always plural) in three different senses. Heaven can refer to the atmosphere, in which birds fly (Gen.1:20), the celestial realm of the stars (Gen.1:14), or to the heaven of heavens, where God's throne is found (Psa.103:19). Since the first two senses of heaven are situated within the "expanse" formed on Day 2, the "heavens" of Day 1 probably refers primarily to the heaven of heavens, which was created by God (Psa. 33:6).

Nothing further is said here about the third heaven. However, whereas the earth was initially dark, unstructured, and empty, heaven seems to have been created from the beginning as bright, structured, and full. Its inhabitants, the angels, were each created directly, and did not have to multiply to fill heaven.

It must be stressed that the biblical heaven is no mere spiritual abstraction but has a concrete spatial aspect. Jesus called heaven a "*place*" (John 14:2). The Bible describes it as being above the earth, a place from which God looks down onto the earth (Psa.14:2). Archangel Michael and his angels fight in heaven against Satan and his angels, who were defeated, and "*neither was their place found anymore in heaven*" (Rev.12:7-8). Angels, even as spirits, occupy places in heaven (or earth), and can be displaced.

Moreover, heaven has physical objects. The Bible book of Revelation pictures heaven with the ark of the covenant (Rev. 11:19), a sea of glass (Rev. 4:6), God’s heavenly throne, white clothes, and palm branches (Rev. 7:9), a golden altar with smoke of incense (Rev. 8:4), trumpets (Rev. 8;6), and so on. Since Revelation describes a vision

and uses much symbolic language, it may well be that not all of these are physically real.

However, we do know that heaven certainly contains the physical bodies of Enoch (Gen. 5:24), Elijah (2 Kings 2:11), and Jesus Christ. Christ's human body was a necessary part of his human nature (Hebr. 2:17). At Christ's resurrection, he received a permanent glorified human body (1 Cor. 15:23). In his ascension, Christ was bodliy taken up into heaven (Acts 1:9-11), from where he reigns today.

Angels and demons can act effectively within our physical world. Hence, we must allow that some physical events may have angelic or demonic causes. The physical universe is thus not a closed system entirely explicable in terms of physical causes.

Normally, heaven is invisible to man. However, it is sometimes opened (see, for example, II Kings 6:17, Eze.1:1, Mark 1:10, John 1:51), so that man may catch a glimpse of heavenly things. Heaven, although invisible, seems to be very near, like a universe parallel to our physical universe. How heaven intersects with our physical universe is at present a mystery. Perhaps both are embedded within a larger, multi-dimensional space.

Heaven and earth are both later redefined in a narrower sense, "*heaven*" as the expanse (Gen.1:8), and "*earth*" as dry land (Gen.1:10).

3. God's Heavenly Throne

Although God is omnipresent, he does not manifest Himself everywhere in the same manner. God the Father dwells more fully "*in heaven*" (Matt.6:9), seated on his throne (Psalm 47:8), along with God the Son at his right hand (Hebr. 1:3; Rev.3:21; Rev. 22:1).

Since God rules and judges from his heavenly throne, this forms the dominant position, the ultimate standard of rest, for the universe. Although God's throne is not necessarily at the exact geometric center of the universe, it is certainly the prime focal point for the Christo-

centric universe. In the next life, God's throne will be moved from heaven to the New Jerusalem, situated on the renewed earth.

4.The Creation of Light

> *And God said, 'Let there be light,' and there was light. And God saw that the light was good. And God 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.'(Gen.1:3-5)*

The creation of light was the first of three separations transforming the initial formless matter into a structured cosmos. It marked the beginning of a continuous succession of days and nights, alternating periods of light and darkness. Note that "*day*" is explicitly defined here to be a period of light, followed by a period of darkness.

Since the Sun and other celestial bodies were not created until Day 4, what was the source of light on Day 1? We are not told. Theologian Douglas Kelly (1997:204) suggests that the light source before the creation of the Sun may well have emanated from the theophanic presence of God Himself.

In a similar vein, Russell Humphreys(1994:76) believes that the Spirit of God, moving over the surface of the waters, Himself becomes a light source for the surface, in much the same way that he will again become a light source at a future time (Rev.21:23, 22:5). This gives the surface of the deep a bright side and a dark side, the movement of the light source bringing about the ensuing succession of days and nights. On the other hand, Cornelis van Dam (2022:185) cautions that we should be careful to distinguish between God's eternal divine light and the created light of Genesis 1.

Another possibility is that God created light photons directly. Since we are not told what the light source was, and since it apparently no longer exists, it is prudent not to put much weight on any particular proposed solution.

Day Two

> *And God said, 'Let there be an expanse in the midst of the waters, and let it separate the waters from the waters.' And God made the expanse and separated the waters that were under the expanse from the waters that were above the expanse. And it was so. And God called the expanse Heaven. And there was evening and there was morning, the second day. (Gen.1:6-8)*

Here we have a second separation, this time a spatial one. The expanse (Hebrew *raqia*), called Heaven, is created to separate the waters into two distinct layers, above and beneath the expanse. The expanse is generally taken to include both the atmosphere about the earth and the further portions of space wherein we find the Sun and stars. The expanse clearly can't be solid, since the Sun and stars move through it (Gen. 1:17) and birds fly across it (Gen. 1:20).

What are "*the waters above the expanse*"? This has been the source of much speculation. Many commentators, including John Calvin, consider these waters to refer merely to clouds in the atmosphere.

Others, such as Gerardus Bouw (1992:322) and Russell Humphreys (1994:35), contend that, since the Sun and stars are later placed *in* the expanse, the waters *above* the expanse must be beyond the stars. Both these authors depict the universe as a huge sphere, centered on the earth, surrounded by a thin shell of water. Whatever difficulties such a watery shell may pose for physical explanations, the positioning of this shell beyond the observational horizon at least places the problem out of sight.

Bible scholar G.K. Beale (2008:184) notes that the language used for the creation of the universe (Gen.1) is very similar to that used for the making of the tabernacle and the temple. If God's cosmos is a giant temple, as Beale suggests, then temple imagery should be considered when reading Genesis 1.

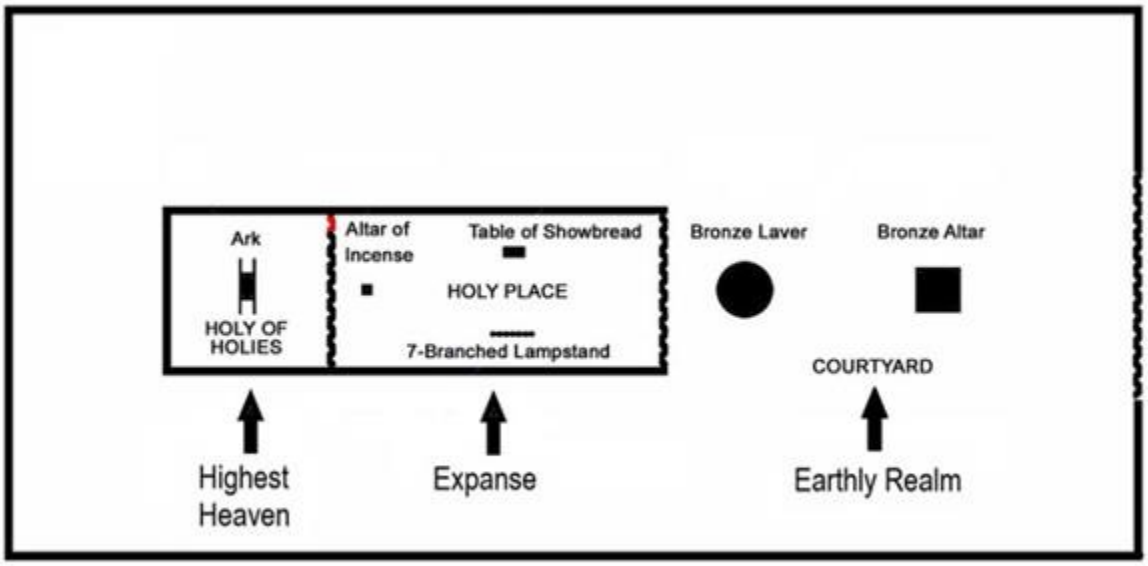


Figure 2.1. The Tabernacle as a Model of the Cosmos.

He contends that the outer courtyard of the tabernacle/temple corresponds to the earth (where man dwells), the Holy Place corresponds to the starry sky, and the Most Holy Place corresponds to the third heaven (containing God's throne, angels, etc.), which is distinct from the visible sky. According to Beale, the *raqia* ("expanse") of Gen.1:6

> *"…appears to be an other-dimensional reality that separates the observable sky from the invisible heavenly temple, so that it may be a reality that overlaps with both the earthly and heavenly dimensions" (Beale 2008:203).*

A similar view is taken by James Jordan (1999:180), who argues that the waters above the expanse are in the third heaven, on the far side of the expanse. He equates this water with the sea of glass, crystal, and ice, seen in visions of heaven in Ezekiel and Revelation. He finds confirmation for this in the fact that God's upper chamber is built upon the waters (Psa. 104:2-4). The expanse separates heaven and earth, placing heaven in another dimension. This barrier will be removed in the distant future, when heaven and earth are renewed, the sea is no more, and the New Jerusalem comes down from heaven (Rev. 21).

Day Three

> *And God said, 'Let the waters under the heavens be gathered together into one place, and let the dry land appear...'*
>
> *And God said, 'Let the earth sprout vegetation, plants yielding seed, and fruit trees...'*
>
> *And there was evening and there was morning, the third day. (Gen.1:9-13)*

The third day brought about the separation of water and dry land. Both water and the elements of the earth seem to have been created from the start, on day one. Since no mention is made of the creation of land, the matter created on the first day seems to have been a mixture of undifferentiated water and mud (Kelly 1997:182).

Day Four

> *And God said, 'Let there be lights in the expanse of the heavens to separate the day from the night. And let them be for signs and for seasons, and for days and years, and let them be lights in the expanse of the heavens to give light upon the earth.' And it was so. And God made the two great lights--the greater light to rule the day and the lesser light to rule the night--and the stars.*
>
> *And God set them in the expanse of the heavens to give light on the earth, to rule over the day and over the night, and to divide the light from the darkness. And God saw that it was good. And there was evening and there was morning, the fourth day. (Gen.1:14-19)*

Some commentators (*e.g.*, Ross (1998:44)) believe that the Sun and stars were already created on the first day, and that the fourth day just describes the clearing of a previously opaque atmosphere. Then the Sun and stars merely *became visible* from the earth for the first time.

Yet, this contradicts the text, which clearly teaches that God, on the fourth day, creates celestial bodies that were not previously in existence. Moreover, if the Sun had been created earlier, why doesn't the Bible say that the Sun "*appeared*" on Day 4, like the dry land "*appeared*" on Day 3?

The stated purposes of these lights was to serve as lights for the earth, divisors of day and night, and calculators of days, years, and seasons. Elsewhere, the psalmist relates: "*the sun to rule over the day...the moon and stars to rule over the night*" (Psa.136:8-9); "*He made the moon to mark the seasons*" (Psa.104:19).

What about their functions as signs? Kelly considers the signs to include the stars' function as aides in navigation and surveying. Also, "*the heavens declare the glory of God; and the sky above proclaims his handiwork*" (Psa.19:1). Further, their activities can also be signs that the Lord will do what he has promised:

> *'This shall be the sign to you from the LORD, that the LORD will do this thing that he has promised: Behold, I will make the shadow cast by the declining sun on the dial of Ahaz turn back ten steps.' So, the sun turned back on the dial the ten steps by which it had declined. (Isa. 38:7-8)*

There are also celestial signs of the coming day of the Lord:

> *...and I will show wonders in the heavens and on the earth, blood and fire and columns of smoke. The sun shall be turned to darkness and the moon to blood, before the great and awesome day of the LORD comes. (Joel 2:30-31).*
>
> *And there will be signs in sun and moon and stars... (Luke 21:25)*
>
> *But in those days, after that tribulation, the sun will be darkened, and the moon will not give its light, and the stars will be falling from heaven... (Mark 13:24-25)*

The creation of the celestial bodies *after* the earth and *for* the earth stresses the prime importance of the earth in the universe.

Days 5, 6, and 7

On Day 5 God created the birds, fish, and other creatures of the sea. On Day 6 God created the land animals. The culmination was the creation of Adam and Eve, who were created in the image of God. They were given the mandate to multiply and fill the earth, to subdue it, and to have dominion over every living thing on earth. Then, having finished his creative work, God saw everything that he had made and found it to be "*very good*."

On Day 7 God rested. God blessed this day and sanctified every seventh day as a holy Sabbath (Hebrew for "rest") day, to commemorate the fact that God created heaven, earth, and sea in six days and rested on the seventh day (Ex. 20:8-11).

The Nature of the Creation Days

Were the creation days of Genesis 1 real days, long ages, or merely metaphorical poetry? That has been an issue of much recent debate.

Favoring literal days is the fact that the creation "day" is defined as a period of light, followed by "night," a period of darkness (Genesis1:5). The sun is created on Day 4 to rule the day (Genesis 1:16). Thus, the last three days are certainly solar days. Further, the Sabbath (Day 7) was a real day, since it was blessed, and set the pattern for the following Sabbaths (Exodus 31:12–18).

It is noteworthy that many Christian scholars grant that the literal view is exegetically preferred, but nevertheless reject it because they are convinced of the truth of mainstream chronology (*e.g.*, J.P. Moreland (1998:219-220) and Gleason Archer (1994:196)). For example, Howard Van Till (1986:91) asserts that "*the days of the Genesis 1 story are clearly ordinary days*," even though, based on astronomical evidence, he believes the universe is billions of years old.

How about Hugh Ross's (2014) day-age view, where each day corresponds to an era of millions of years? One might contend that Day 1 to 4, before the creation of the Sun, were long periods of time. However, these days were still alternating periods of light and

darkness. If Day 3, when plants were created, was millions of years long, would the following night not be equally long, causing the newly-created plants to die for lack of light? Moreover, the *order* of events contradicts mainstream science. For example, Genesis has fruit trees created first, then birds, then mammals; mainstream science has exactly the reverse. Genesis has the earth before the Sun and stars; mainstream science has the Sun and stars before the earth. The day-age view thus satisfies neither sound exegesis nor mainstream chronology.

So, to accommodate mainstream science, some theologians (*e.g.*, Waltke 2001:61) take Genesis 1 to be merely a literary framework, with metaphorical days. As such, its message is mainly theological, simply declaring that God created the entire universe. A clash with mainstream science is thus avoided by emptying Genesis 1 of any specific historical content.

Does Genesis 1 have a clearly defined literary pattern? Although various possible literary structures have been proposed, none of these gives an exact fit with the actual text (Bedard 2013). In fact, the most obvious pattern is the traditional “six days plus one” view (Exodus 20:8–11).

Yet, even if Genesis 1 were to display a highly stylized literary form, why should that diminish its historicity? This is a false dilemma. Genesis could be *both* well-written *and* factually correct. God created according to his perfect plan; hence, one might expect that his work would show perfect structure.

After examining the various views about the nature of the creation days, Cornelis Van Dam concludes,

> *“There is nothing to suggest that the days…in Genesis 1 are anything other than literal days. Indeed, grammatically, textually, and contextually the text clearly refers to a day as customarily understood. This conclusion does not mean that we can fully comprehend what those days entailed." (Van Dam 2022:138).*

Thus, the biblical text favors the historical, literal-day view, where the events referred to really happened as described. This conclusion has

been defended in detail by Bedard (2013) and Jordan (1999), among many others.

The Fall and its Consequences

At the end of the sixth day of creation "*God saw everything that he had made, and behold, it was very good*" (Gen.1:31). Yet shortly thereafter evil entered the cosmos. Apparently, it originated in heaven when Satan, the devil, initially created as a good angel, rebelled against God: "*the devil has been sinning from the beginning*" (1 John 3:8). Many other angels joined his rebellion. The devil, taking on the form of a serpent (Rev.20:2), then appeared to Eve, enticing her and Adam to sin (Gen.3). As a result of Adam's disobedience, all humans became enslaved to sin and subject to physical death.

Adam's Fall had a drastic effect also on the earth, over which man had been appointed steward. God cursed the ground, so that it would now bring forth thorns and thistles (Gen.3:17-18). Animals also seem to have been adversely affected, becoming violent (Gen. 6:12). Many theologians, including John Calvin, Martin Luther, and more recently the philosopher Greg Welty (2018:166), believe God's initially "*very good*" creation had no natural evil, which came later due to Adam's fall.

Does the entrance of sin have any implications for cosmology? The Bible mentions no particular changes to the sun, moon, or stars. Nevertheless, the Bible clearly teaches the cosmic effects of sin. For example, the apostle Paul writes,

> *For the creation was subjected to futility, not willingly, but because of him who subjected it, in hope that the creation itself will be set free from its bondage to decay and obtain the freedom of the glory of the children of God. For we know that the whole creation has been groaning together in the pains of childbirth until now" (Rom. 8:20-22).*

The reference to "*the whole creation*" suggests that the entire creation was affected (see Venema 2000: 459-468). Indeed, the biblical eschatological terms of "*renewal*", "*redemption*", "*reconciliation*" all imply a future restoration back to an *original good state*. The

entire cosmos—both heaven and earth--was adversely affected by sin, from which it will be cleansed and recreated into a new heaven and earth (*e.g.*, Isa. 65:17, Rom. 8:18-25, 2 Peter 3:5-13, Hebr. 12:26-28, Rev. 21:1).

How might the cosmos have changed? Might its natural laws have been altered? Some believe that the Second Law of thermodynamics first came into effect after Adam's Fall. For example, Henry Morris (1963:37) writes:

> *The universal validity of the second law of thermodynamics is demonstrated, but no one knows why it is true...But the biblical explanation is that it is involved in the curse of God upon this world and its whole system, because of Adam's sin...Therefore, we conclude that the Bible teaches that, originally, there was no disorder, no decay, no aging process, no suffering, and above all, no death, in the world when the creation was completed. All was 'very good.'*

It is hard to imagine what the universe would be like without the second law of thermodynamics. Would this imply, for example, that there was no friction to slow down a ball thrown through the air? If so, how could birds fly?

Whatever changes the Fall may have brought about on the cosmos, there was still much continuity. After the Fall, trees still bring forth fruit, birds still fly and multiply, man still eats and digests fruit, talks, and so on. All this suggests that, although the Fall profoundly affected the physical well-being of man, the basic laws of nature were probably left substantially intact.

Could the second law of thermodynamics have held before the Fall, but without any negative effects? The present decay of the universe is compared to the wearing out of a garment (Psa. 102:26). Yet, after the Exodus, God prevented the Israelites' clothes from wearing out for forty years (Deut. 29:5). Perhaps God similarly kept the universe from wearing out before the Fall. Biologist Kurt Wise suggests (2002:160) that this might have entailed the application of some restorative force acting to counter some of the negative effects of the second law of thermodynamics, thus preventing death and decay. After the Fall, this special restorative force ceased operating.

Eschatology

The cosmic extent of sin and evil are clear also when we consider biblical eschatology.

The last days will be marked by dramatic celestial events. The apostle Peter speaks about the burning of the heavens:

> *…waiting for …the coming of the day of God, because of which the heavens will be set on fire and dissolved, and the heavenly bodies will melt as they burn! But according to his promise we are waiting for new heavens and a new earth in which righteousness dwells. (2 Peter 3:12-13).*

We are also told,

> *At that time his voice shook the earth, but now he has promised, "Yet once more I will shake not only the earth but also the heavens." This phrase "Yet once more" indicates the removal of things that are shaken – that is, things that have been made - in order that the things that cannot be shaken will remain. (Heb. 12:26-27).*

And

> *Then I saw a new heaven and a new earth, for the first heaven and earth had passed away. (Rev.21:1)*

Will the sun, moon, and stars be annihilated? Some people believe so, based on passages such as

> *And the city has no need of sun or moon to shine on it, for the glory of God gives it light, and its lamp is the lamb. (Rev.21:23)*

However, this says only that the sun and moon are no longer *needed* for light, due to God's glory. It does not say that sun and moon no longer exist. The reference to "*the tree of life with its twelve kinds of fruit, yielding its fruit each month*" (Rev. 22:2) suggests that months will still be used to measure time. A month, with its various phases, requires the existence of both sun and moon. The twelve months

suggest that the future length of the year will be unchanged. Unless such passages are meant to taken figuratively, merely as symbols of a joyful, fruitful future.

It seems that the earth and the heavenly bodies will not be destroyed but, rather, cleansed from the corrupting effects of sin. They will be renewed to a more glorious state. Therefore, although there will be significant changes, we can also expect much continuity between the present and future states.

When Christ returns to the earth, he "*will reconcile to himself all things, whether on earth or in heaven*" (Col. 1:19-20). Paul also speaks about a "restoration" of all things (Acts 3:21). The terms "*reconciliation*" and "*restoration*" mean a return to a former state, a cleansing of all creation from its bondage to sin and decay.

The renewed creation can thus be expected to have much in common with the original creation. Indeed, the biblical images of life on the renewed earth are very similar to life before the Fall. Sin, death, pain, and mourning are once again absent (Rev. 21:4-8), as is the curse (Rev.22:3). Wild animals will again become peaceful vegetarians (Isa. 65:23). The tree of life will again be available (Rev. 22:2), and full fellowship with God will be restored (Rev. 22:5).

As shown by Zachery Klein (2020), the notion that the restored heavens and earth will be like their pre-Fall state has been held by many interpreters and theologians. Perhaps the laws of nature, to the extent they were changed after the Fall, will also revert to their pre-Fall form. Thus, it has been postulated that in the restored cosmos the second law of thermodynamics will again be countered by a special restorative force preventing decay.

The transformation at the eschaton will be very rapid. Our bodies will be transformed "*in the twinkling of an eye*" (1 Cor. 15:52). In his vision, the apostle John sees the transformed new heaven and new already before the new Jerusalem comes down from heaven (Rev. 21:1-2). Hence the re-creation must be a very rapid event. Just like the first creation, where God spoke "*and it was so*."

In sum, we know very little about what changes in the celestial heaven were caused by the Fall or will occur when Christ returns. There

appears to be much continuity from one era to the next. However, if any major changes did occur, we can expect the new celestial heaven to be more like the pre-Fall celestial heaven than the present one.

Natural Laws and Uniformity

A most basic assumption in science, particularly cosmology, is that the same natural laws and processes that we see here today apply everywhere and always throughout the universe. This is known as the Uniformity Principle.

Although this general assumption may seem very reasonable, it is impossible to prove. As British philosopher David Hume pointed out already in 1739, it can't be proven by observation, since the unobserved universe is, by definition, unobserved. Nor can logic justify it since there is no logical reason why the universe must behave uniformly. For all we know, the universe beyond our experience may be quite different from what we might expect. Scientists assume uniformity solely because it is the simplest assumption. They have no better alternative.

A Christian might justify uniformity on theological grounds, appealing to God's covenant with his creation (*e.g.*, Gen. 8:22). God is a God of order, not confusion (1 Cor. 14:33). He has set bounds and ordinances for his creatures (Job 38-41; Jer. 33:25). God has set up a law structure for his creation so that he normally supports various regularities.

It is due only to God's faithful, continuous, regular sustaining of his cosmos that science is at all possible. Science could not succeed in a chaos, but only within a universe of regular patterns that man can observe, study, and use as a basis for predictions.

Nevertheless, this covenant is limited. The Apostle Peter warns against scoffers who deny Christ's second coming on the grounds that "*all things are continuing as they were from the beginning of creation*" (2 Pet. 3:4). Against such faith in uniformity, he highlights the special word of God that caused the Flood and will burn up the heavens, and the earth, at the coming Day of the Lord (2 Pet. 3:1-13).

As we have already noted, natural laws could well change significantly at the time of the Fall, the Flood, and the eschaton. God can change natural laws in time or space as he wants, to suit his purposes. Also, it is very likely that the natural laws of Heaven are quite different from those of our physical world.

Miracles

Yet God does not limit his actions to regularities: he also performs miracles. These are not to be viewed as divine interventions in a world that otherwise runs its own course, since God continuously upholds his creation. Rather, law and miracles should be considered as merely the regular and irregular manifestations of God's will.

The main purpose of miracles is to show the almighty power of God: "*that you might know that the LORD is God; there is no other besides him*" (Deut. 4:35). Miracles are performed, not only by God directly, but also through the prophets (*e.g.*, Elijah and Elisha) and Christ's disciples; as well as by angels (John 5:4; Acts 5:19) and demonic spirits (2 Thes. 2:9; Rev. 16:14).

Thus, in our study of cosmology we must keep in mind that the physical universe is not a closed system of uniform physical causes and effects. First, these laws may well vary with time and place. Second, the physical universe is not closed, but is open to interactions with spiritual beings such as angels and demons. Third, God may at times act in miraculous ways.

The Date of Creation

Until quite recently, most Christians believed that the world was relatively young. The theologians Augustine, Martin Luther, John Calvin, and Abraham Kuyper all explicitly affirmed that the world was less than 8000 years old. So did scientists such as Johannes Kepler and Isaac Newton. Davis Young, who himself rejects a young earth, concedes:

> *It cannot be denied, despite frequent interpretations of Genesis 1 that departed from the rigidly literal, that the almost universal*

> *view of the Christian world until the eighteenth century was that the earth was only a few thousand years old (Young 1982:25).*

This was based primarily on the six-day creation of Genesis 1, and the genealogies of Genesis 5 and 11. According to the Genesis genealogies, when Adam had lived 130 years he fathered Seth, when Seth had lived 105 years, he fathered Enosh, and so on. Adding up all such links yields about two thousand years from Adam to Abraham. From other evidence we know that Abraham lived about two thousand years before Christ. This puts the creation of Adam at about 4000 B.C., and the creation of the world six days earlier.

The days of creation were generally regarded, by both the church fathers and, later, the Reformers, as ordinary days. Although texts such as 2 Peter 3:8 ("*with the Lord one day is as a thousand years*") were used to make a connection between the creation days and long periods of time, this was applied not to the creation week but to human history: many early theologians thought that the six creation days pointed to six thousand years for the totality of history.

The consensus for a young world was challenged by geological and astronomical theories demanding a much greater age for man, the earth, and the stars. Other interpretations of Genesis were then looked for. At first the creation days were often reinterpreted as long periods of time. Later, when this was found to be untenable, as we saw, it became popular to view the creation days as a mere literary device, a tool used to convey deeper theological truths.

As to the Genesis genealogies, it was not until 1863 that was first postulated that they were incomplete. The Presbyterian theologian W.H. Green (1890), pressed by the much longer chronology of mainstream science, suggested that the formula "*when Seth had lived 105 years, he fathered Enosh*" could be read "*when Seth had lived 105 years, he fathered an ancestor of Enosh*". Hence, he contended, there might be large gaps, making the genealogies useless for dating the events of Genesis 1-11.

This avoided a clash with mainstream science. Yet, stretching the genealogies from 2000 years to more than 60,000 years meant that the vast bulk of the generations were missing.

This approach has met exegetical objections, most recently by James Sexton (2018a,b), who argues that the Hebrew text does not allow for such gaps. According to Sexton, even if the text allowed that Seth did not sire Enosh directly, it still specifies that Seth was 105 years old when Enosh was born.

The actual numbers in the genealogies differ somewhat between manuscripts. Allowing for uncertainties due to textual variants and the like, Chris Hardy and Robert Carter (2014) put the biblical date for Adam's creation somewhere between 5665 BC and 3822 BC.

In conclusion, the biblical evidence points to the creation of Adam on Day 6 less than eight thousand years ago. Days 5 and 6 were clearly solar days. Days 1 through 4 were four alternating periods of light and darkness, probably of similar length, but possibly not.

Whether a young age for the universe can be worked into a workable cosmological model will be addressed in a later chapter, when we investigate various creationist cosmologies.

God, Creation, and Time

Many scientists believe that the physical universe began from an infinitely dense point of space (the so-called Big Bang *singularity*), which marked the beginning also of space and time. This belief is embraced also by some Christian apologists in a proof for the existence of God. They reason that, if space and time did not exist before creation, then the universe must have been created by a cause transcending space and time, which they equate with God.

This raises some deep questions. Did space and time really begin to exist along with the physical universe? or did our physical universe begin within a pre-existing space and time? Is God really "beyond" space and time?

What Is Time?

First, let's consider the nature of time. What is "time"? Time is closely associated with *change*. We measure the *passage* of time by seeing change*,* perhaps by watching a clock or the varying position of the sun, or even mentally by our flow of thoughts.

"Time" is that which makes change possible within that which exists. A "moment" of time is how the universe is at one particular time. No change occurs within any individual moment, but only over a succession of moments. Time consists of an ordered set of moments. Time enables the occurrence of events and processes. A world without time is a static frozen world where nothing ever happens.

Creation and Time

The Bible, in its very first verse, relates, "*In the beginning, God created the heavens and the earth*". Elsewhere, this beginning is referred to as "*the beginning of creation*" (Mark 10:6), not necessarily the beginning of time itself.

If time was created along with the universe, then the universe has *always* existed, in the sense that there was no time when the universe did *not* exist. Indeed, if there was no time before creation then we cannot even speak of anything existing "before" creation. The notion that the universe began to exist makes sense only if there was an earlier time when the universe did not exist.

It seems clear from the Bible that God existed before he created the universe. As we have already noted, “before the foundation of the world”, God already enjoyed inter-personal fellowship within the divine trinity and set up his grand Plan. God self-exists and is the source of all other existence. The Christian notion of creation from nothing (*creatio ex nihilo*) implies that there was a time when only God existed, whereafter he created the material universe from no prior substance.

Dynamic Versus Static Time

Is the passing of time real, or just an illusion? The common-sense view is that only the present "now" moment of time exists, ever moving from no longer existing past moments to not yet existing future moments. This view of time is called *presentism*, *dynamic* time, *tensed* time, or *A-theory* time. In this view, the present exists, the past has passed away, and the future is yet to come.

Presentism is denied by some philosophers and physicists (including Einstein), who believe that the world is a four-dimensional space-time "block" universe, where the past, present, and future are equally real. The clear flow of time that we all experience must then be considered just an illusion. This view is known as *eternalism*, *static* time, *tenseless* time, or *B-theory* time.

The Bible seems to reflect the common-sense dynamic view of time. It views history as real, with only the present existing. For example, God says:

> *"Behold, the former things have come to pass, and new things I now declare; before they spring forth, I tell you of them." (Isa. 42:9)*

God is referred to as he "*who is, and who was, and who is to come*" (Rev. 1:8).

Presentism entails that there is an absolute, universal time, set by God's view of things. At creation, God freely created the first moment t1 of our physical universe, followed by a succession of moments t2, t3, ... wherein his Plan is gradually actualized.

Note that, according to presentism, time travel to the past is impossible since the past no longer exists. We can only travel forward in time, towards the yet-to-be future, following the usual succession of moments.

If the future does not yet exist, how can God know the future? God does not literally have to "see" the actual future to know it. God merely refers to his established Plan, which fully encompasses all future moments in all their detail.

The Plan can be likened to a book or movie, where each page or frame is analogous to a moment of time. The Plan, which God sees as one unified whole, holds the entire potential history of the universe. The Plan, taken as a whole, is analogous to static time, in that it covers all prospective moments of time. Yet the Plan differs from actual history, in that each page of the Plan is merely a divine idea, until its actualization makes it a concretely real historical fact. In the concrete historical actualization of the Plan, where history unfolds in dynamic time, only the current page standing for the present state of the universe has real existence.

Time everlasting

A basic tenet of the Christian faith, expressed in the Apostle's Creed (as well as the Athanasian and Nicene Creeds), is the belief in "*life everlasting*", an endless future life in which believers praise God and reign with him forever (Rev.22:5).

The created world has a definite beginning, a finite time ago, but will continue forever, without end. God, on the other hand, exists with both a beginningless past and an endless future: "*before...ever you had formed the earth and the world, from everlasting to everlasting, you are God*" (Psalm 90:2).

Some philosophers, such as William Craig (1993), object to the notion of a beginningless past. Their prime concern is that, to reach the present moment, an actual infinite number of past moments must then have occurred. This they believe to be impossible. On the other hand, they do accept the possibility of an endless *future*. This, they claim merely involves a *potential* infinity, in that the number of passing moments becomes ever larger but always stays finite, never reaching actual infinity. The time between now and any specific future event is always finite, no matter how distant it is.

Craig believes an actual infinite to be impossible because of many contradictions that allegedly arise concerning infinite sets. However, there is nothing logically or mathematically incoherent about infinite sets; mathematicians use them often. The problem is that infinite sets have special properties that may seem to be counter-intuitive to those used to

dealing with finite sets. Contradictions only arise when we try to apply properties of finite sets to infinite sets. A detailed critique of Craig's arguments against the existence of an actual infinity ,including an infinite past, has been made by philosopher Wes Morriston (2010).

Further, the status of an endless past seems much like that of an endless future. Consider, for example, God's Plan. Since God knows everything, he also knows every future state of the universe. If God's Plan encompasses the entire future, we could correlate the Plan's first moment t1 with integer 1, the second moment t2 with integer 2, and so on. Then the entire set of positive integers will be contained within the plan, yielding an actual infinite set. Thus, if an actual infinite set of moments is to be banned, this applies as much to an endless future as it does to a beginningless past.

Moreover, if we can correlate the positive integers with the moments *after* creation, why could we not similarly correlate the moments *before* creation, still existing as thoughts in God's perfect memory, with the negative numbers? Surely a beginningless past has the same ontological status as an endless future, at least for God.

There is a further problem. Philosophical arguments against a beginningless past conclude only that the past must be finite, without yielding any specific numerical limit. In that case, for any past number of moments N you care to name, you could increase it to, say, (N+1) since (N+1) is also finite. It follows that N clearly has no upper bound. Hence, the present can be reached from *any* particular past point, no matter how distant. This entails that the past is infinite. This is like the negative integers, which as a whole form an infinite set, even though the distance between any two specific negative numbers is always finite.

Therefore, it seems possible, at least on logical and mathematical grounds, that time could persist from a beginningless past to an endless future.

In sum, there seem to be good biblical grounds for viewing time as an attribute of God, in that he fully controls time's flow and content. God uses time to actualize and fulfill his plan. The Bible reflects the commonsense view that only the present moment exists. There are no

valid logical or mathematical objections to the notion that God persists throughout time from a beginningless past to an endless future.

God, Creation, and Space

Let’s consider next what the Bible says about God, creation, and space.

What is Space?

What do we mean by "space"? Very roughly, "space" forms the background for reality. Space makes it possible for things to exist. Generally, for something to "exist" means that it can be found *somewhere* at some location within space. Even immaterial spirits, who may lack any spatial *extension*, still have a spatial *location* (Rev.12:7-8).

Since unicorns have not yet been found anywhere in the real physical world, we assume they don't presently "exist." On the other hand, the *idea* of a unicorn exists in my mind, which is spatially within my brain.

Space can be viewed as a "container" in which objects can exist at different "locations". Space can also be seen as a set of relations between different existing objects. Space enables us to separate objects, and to distinguish between them.

Space in the Bible

What does the Bible say about space and creation? Earlier, in our discussion of Genesis 1, we noted that, since the initial watery earth had a surface, the physical universe could be viewed as a finite, bounded volume, embedded within a larger space empty of material things.

God also created a heavenly realm with its own space and containing physical things, as well as angels. Although usually invisible, heaven seems to be nearby (Acts 7:55-57), like a universe parallel to our

physical universe, with which it can interact. Both might be embedded within a larger, multi-dimensional space.

God and Space

We are told that God made heaven and earth, and all that is in them, but *not* that he created the larger space *containing* heaven and earth. This leaves open the possibility that space existed already before the creation of our universe.

1. Omnipresence and universal time

How does God relate to space? The Bible affirms that God is not a spaceless abstraction but, rather, a triune, personal, living God who is fully present everywhere at the same time (his *omnipresence*). God fills heaven and earth (Jer. 23:24); in him, we live and have our being (Acts 17:27-28). In fact, not even earth and heaven can contain God (1 Kings 8:27). God's presence extends beyond the universe he has created and is without spatial limits (his *immensity*).

God's omnipresence is intimately related to his knowledge of what is happening everywhere (part of his *omniscience*) and his ability to control all that is happening (his *omnipotence*). Further, since God is fully present everywhere at once, and since only the present moment of time exists, each location within the universe exists at the same moment of time. There is thus a universal time throughout creation: earth, the rest of the physical universe, and heaven all follow the same universal time.

2. God's throne at the center

We noted earlier that God rules and judges from his heavenly throne. Hence this forms the central position, the ultimate standard of rest, for the universe. Although God's throne is not necessarily at the exact geometric center of the universe, it is the prime focal point for the theocentric universe.

3. God's own space?

Where did God live before he created our universe? Since the Bible does not directly address this question, theologians can only guess.

Some theologians (see Muis 2021) have conjectured that God has always lived in his own, uncreated, higher-dimensional space. For example, the Dutch theologian Luco van den Brom (1991) proposes that God exists spatially in his own more-dimensional, perhaps even infinite-dimensional, universe. He reasons that, if God has existed from everlasting, and if God is spirit, then God's place, the spiritual world, must have always existed. Consequently, van den Brom suggests that, in his act of creation, God made room for the created 3-d physical world and the created Heaven in his own higher dimensional world.

Some Cautions

Although I endorse the notion of a spatial heaven, beyond our three physical dimensions, and of a deeper spatial reality even beyond that, a few words of caution are in order.

First, any higher dimensions may be qualitatively quite different from those of the 3-d stellar world. In these higher dimensions physical laws, such as the limited speed of light, may not apply or may take on very different forms. Nor should these higher dimensions be confused with the extra-spatial dimensions required by, for example, superstring theories in physics. Such dimensions are little more than mathematical abstractions.

Second, our knowledge of God and of the spiritual realm is confined to what God has revealed to us in his Word, and, as such, is very limited. As finite, fallen humans, we are surely in no position to fully understand God. Hence, we must be careful in speculating about God. Certainly, in this life, we are constrained to look through a glass darkly.

Current mainstream cosmology, on the other hand, views the stellar universe as all that exists, having no edges, center, or preferred position, and where space-time cannot exist in the absence of matter. In a later chapter we shall see that this is mere assumption, going well beyond the scientific evidence.

Summary

Our conclusions about what the Bible says about cosmology can be summarized as follows:

1. God, time, and possibly space, existed before the creation of the cosmos. The cosmos was created *ex nihilo* and has a finite history.

2. The cosmos consists of two parts: the stellar universe and a heavenly realm. The stellar universe is finite and bounded, contained within a larger three-dimensional space. Heaven exists within its own space, holding physical objects. It is parallel to the stellar universe, with which it can interact. The physics of the stellar realm may not apply in Heaven, and our stellar realm must reckon with the possible influence of heavenly forces. Both realms may be embedded within a higher-dimensional space.

3. The stellar universe and Heaven both partake of the same universal time, which flows from no longer existing past moments to not yet existing future moments.

4. The focal point of the entire creation is God's heavenly throne, from where he rules the universe. This may serve as the prime reference point in the created cosmos.

5. God upholds the universe at each instance and can act in both regular and miraculous ways. History unfolds completely according to God's Grand Plan, set up before the creation of the cosmos.

6. Genesis 1 should be taken as historical narrative. The creation days are alternating periods of light and darkness; Day 5-7 are clearly solar days. The expanse (*raqia*) of Genesis 1 refers to the atmosphere and space; the "wa*ters above the expanse*" are less certain. Adam, the first human, was created on Day 6, less than 8000 years ago.

7. It is not clear how the stellar cosmos was affected by the Fall. The stellar cosmos will be renewed after Christ's return, possibly restoring it to be physically much like its pre-Fall condition.

3. A Brief Historical Sketch

We shall first make a quick survey of the history of cosmology. Our focus will be on medieval cosmology, a very ambitious combination of science and theology. To supply some background we shall look first at ancient cosmology, particularly that of the Greeks. Then we shall examine medieval cosmology, its demise, and later cosmological developments up to the beginning of the last century.

Ancient Cosmology

No doubt God had revealed to Adam, the first man, how he had created the universe. This revelation likely lies behind the creation account of Genesis 1, which formed the basis for Jewish cosmology. Since all humans descend from Adam, we might expect other ancient cosmologies to be derived, in distorted form, from Adam's original creation account. Hence, we can expect similarities between ancient cosmologies and the biblical creation account.

The creation myths of the Ancient Near East (ANE), Mesopotamia and Egypt, date back to least 2000 BC. They describe the world as beginning as a watery abyss, from which gradually appeared a blind, formless spirit. The mingling of this spirit and the watery abyss produced the various gods and goddesses, as well as the contents of the present world. The prime functions of these gods were to serve and protect humanity.

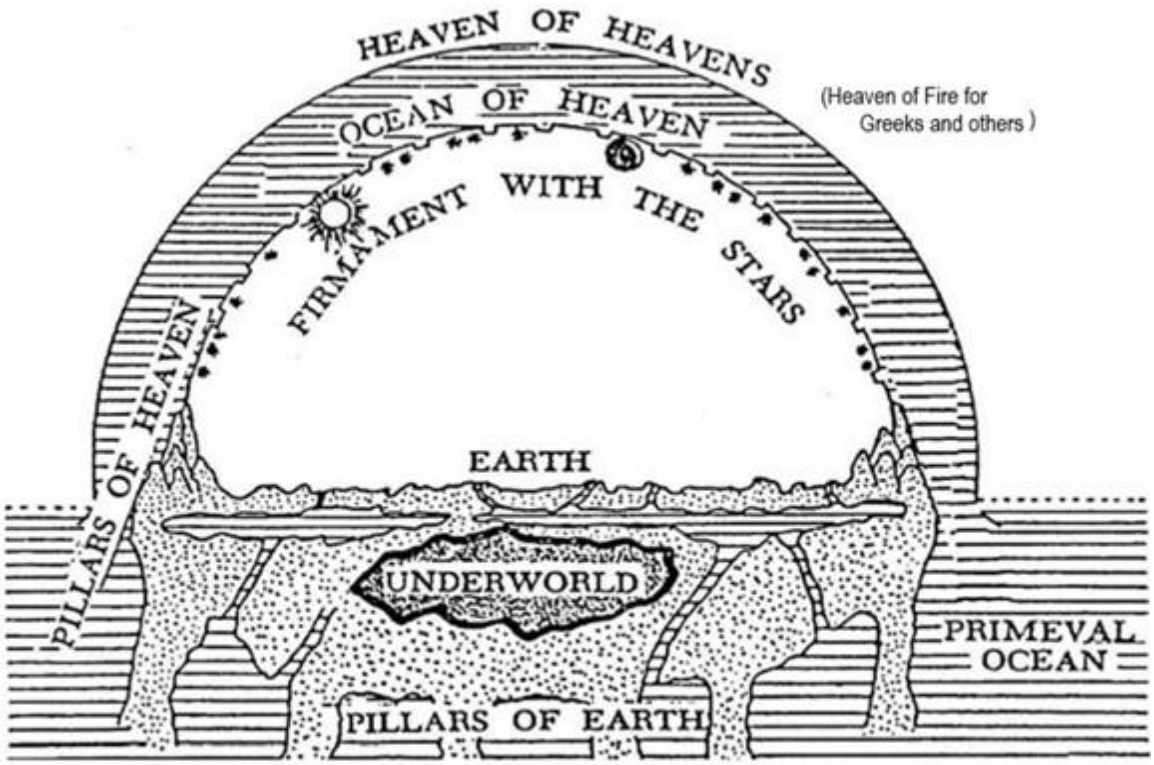
In addition to his interest in the origin of the universe, ancient man was also a keen observer of the universe, particularly the starry heavens. The Babylonians, for example, had already by 2000 BC divided the sky into constellations. Later, they compiled star catalogues, recorded the movements of the planets, and prepared calendars to forecast the seasons and the times of full moon.

However, although they collected many observations, they did not unify these by way of theoretical principles. Their celestial observations were not explained in terms of cosmological theories or models. The ANE literature has no systematic descriptions or diagrams of the

universe. They were more interested in mythology, in relating themselves to their gods, than in cosmology.

The Myth of the Solid Dome

A common modern misconception, embraced by many Bible scholars, is that people of the Ancient Near East (ANE) believed that the sky was a fixed solid dome - in which the Sun, moon, and stars were embedded - supported by pillars, or mountains, at the ends of a flat earth. The Israelites are said to have shared this mistaken ANE cosmology, which is allegedly the underlying idea behind the "firmament" or “expanse” (*raqia*) of Genesis 1.



Based on Peter Jenson, 1890. *Die Kosmologie der Babylonier.* Strassourg: Trubner, p. 579.

Figure 3.1. Mistaken Modern View of ANE Cosmology.

Theologian Peter Enns (2010), for example, referring to Figure 3.1, concludes, "*Genesis 1 and 2 tell the story of creation, and it says things that are at odds with what modern people know to be true*..."

Similarly, theologian John Walton (2009:14) believes the Israelites, embracing ANE cosmology, where were so dim-witted that "*they did not know that the Sun was further away… than the birds flying through the air*". According to Walton, Genesis 1, like other ANE literature, is about functionality rather than about physical origins. He advises that, to learn about origins, we must look to modern science, not Genesis.

Paul Seely (1991a,b) contends that the Hebrews, being scientifically naïve, were influenced by their Babylonian and Egyptian backgrounds to believe that the *raqia* of Genesis was solid.

Enns, Walton, and Seely all believe that, in Scripture, God accommodated himself to the mistaken scientific and historical knowledge of the time, to convey a theological message. Paul Seely, for example, asserts,

> *"The biblical Flood account is thus not accurate history. It is an accommodated Mesopotamian historical tradition revised to teach lessons of faith and morals" (Seely 2008).*

Likewise, Enns judges,

> *"any thought of Genesis 1 providing a scientifically or historically accurate account of cosmic origins, and therefore being wholly distinct from the 'fanciful' story in Enuma Elish, cannot be seriously entertained" (Enns 2012:40-41).*

Such a notion of accommodation clearly makes much of Gen.1-11 factually unreliable.

It is noteworthy that the Bible itself nowhere suggests that God sometimes says something which is factually false, simply to accommodate Himself to human understanding. Further, once we allow accommodation at one part of the Bible, where do we stop? Could God not have accommodated his message also to limitations of ancient human ability about theology or morality?

How can we distinguish between what in the Bible is revealed truth and what is mere accommodation to human error? Presumably, we must turn to biblical scholars, such as Seely, Enns, and Walton. Yet God,

who is all-powerful and all-knowing, made man in his own image. He created language. He spoke directly to Adam, Noah, and Moses. Did God really have to wait until the advent of modern scholars to tell us what he had really meant to say, but was unable to?

A detailed critique of the accommodation advocated by Enns and Seely was made by James Scott (2009).

Reading Genesis as accommodation to mistaken ancient pagan cosmology, is motivated by the desire to avoid confrontation with modern mainstream science. As such, the notion of divine accommodation is just another ploy for humans to accommodate Scripture, and its scope, to human reason. The notion of divine accommodation serves only to undermine biblical inerrancy and authority.

Not a Fixed Dome but a Rotating Sphere

Were ANE people in general, and the Israelites in particular, really so dense as to believe in a literal solid dome, as pictured above? Ancient man may have lacked modern technology, such as telescopes and computers, and sophisticated mathematical theories. But he was not blind or stupid. As we noted, he was very well acquainted with the night sky.

It was obvious to ancient man, as it is to us, that the Sun and Moon move across the sky every day, rising in the East and setting in the West. So, the Sun and Moon are clearly not attached to a fixed dome. The Sun and Moon, rising and setting beyond the furthest visible mountains, were obviously much more distant than any flying bird.

What about the stars? Anyone watching the stars for a few hours sees them moving through the sky, much like the Sun and Moon (see Figure 3.2). So also, the stars are clearly not attached to a stationary dome.

Moreover, the stellar motions clearly have a pronounced pattern. The stars near the star Polaris (above the Earth's North pole) travel in complete circles; stars further away rise in the East and set in the West, so that different stars are visible at different times of the night.

https://pixabay.com/photos/star-trails-night-stars-rotation-1846734/

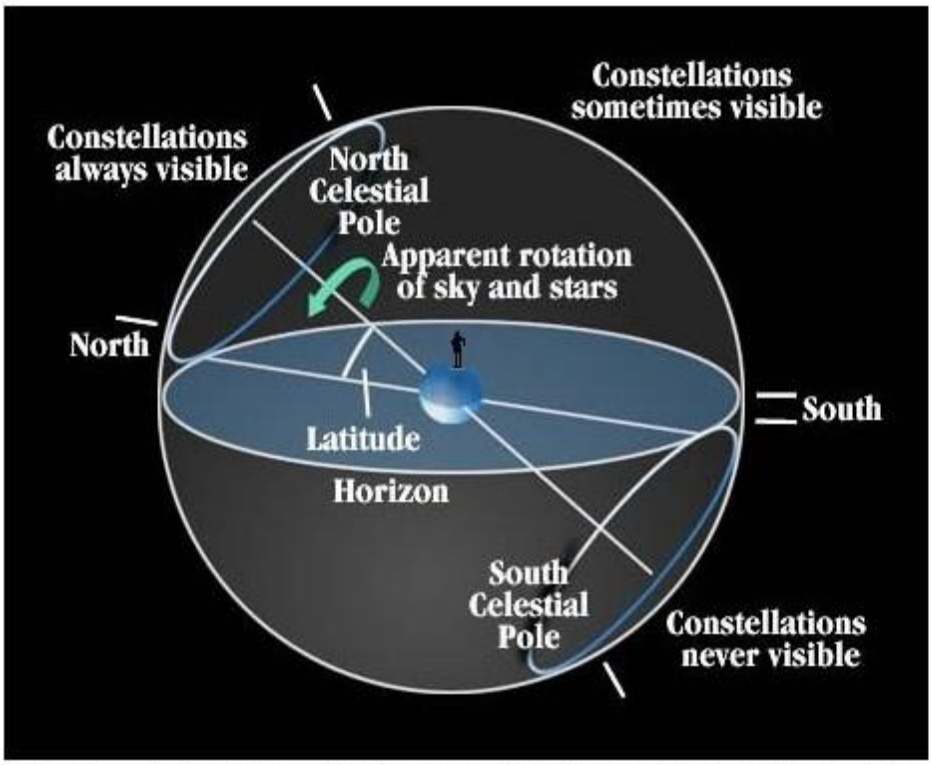
Figure 3.2. Star-trails Time Exposure.

In short, the revolving stars seem to be fixed, not to a stationary dome (a semi-sphere), but to a rotating sphere, called the *celestial sphere*. The celestial sphere surrounds the earth and is not supported by it (see Figure 3.3).

Although the stars seemed to be fixed to the celestial sphere, it is easily seen that the Moon moves along this sphere roughly once a month, the Sun once a year, marking off months, seasons, and years (Gen.1:15), and the planets ("wandering stars") each with its own orbit.

Ancient man was much more aware of the details of the night than modern desk-bound scholars, who spend their nights inside, and whose stars are obscured by city lights and smog. They saw the daily rotation of the Sun and stars. Hence the sky could not be a solid hemisphere held up by pillars fixed on the earth. Further, they discerned months and seasons, and knew that the sun, moon, planets (Mercury, Venus, Mars, Jupiter, and Saturn), and stars moved at

different speeds. Thus, they could not be fixed to a stellar shell, even



https://w.astro.berkeley.edu/~basri/astro10-03/lectures/CelestialSphere.htm

Figure 3.3. The Celestial Sphere.

if that shell was rotating. Indeed, the ancient Egyptians marked the beginning of their year by the first dawn appearance of Sirius, the brightest star in the sky.

In line with such simple observational considerations, ANE scholar Margaret Huxley (1997), upon close examination of many cuneiform sources, concludes that ancient Mesopotamians thought the sky to be a rotating sphere with a polar axis, rather than a stationary vault.

Moreover, ANE literature has no actual diagrams such as that shown above, which is merely a construction by 19th century scholars based on their (faulty) conception of ANE cosmology. As such, it is more a reflection of the ignorance of modern scholars than that of ancient civilization.

In sum, there is no basis for the notion that ANE people, including the Israelites, ever believed that the sky was a solid dome.

The Origin of the Myth

If the alleged solid dome is so contrary to common sense and has no historical basis, how did it come to dominate biblical scholarship?

Randall W. Younker and Richard M. Davidson (2011) find that the idea that the ancient Israelites believed in a solid vault resting on a flat earth appeared during the early 1800s, primarily through the American writer Washington Irving (1783-1859). Irving invented the myth that most ancient and medieval people believed in a flat earth, until the time of Columbus.

Younker and Davidson conclude that, in fact, the majority of early Christian and medieval scholars,

> *"believed in a spherical earth, surrounded by celestial spheres that conveyed the sun, moon, stars, and planets in their orbits around the earth. Moreover, the concept of a heavenly vault does not appear in any ancient Babylonian astronomical documents. Rather, this notion was erroneously introduced into the scholarly literature through a mistranslation (1890) of the Enuma Elish by Peter Jensen."*

Genesis says nothing about the earth being flat, with pillars supporting the sky. Seely's case rests primarily on one word: the *raqia* (*expanse*) of Gen.1:7, which he claims refers to the common ANE conception of the sky as a solid dome.

Rather than reading presumed ancient cosmology into Genesis, we should simply read it on its own terms. Doing so, we see that the *raqia* of Genesis 1, called heaven (Gen.1:8), is clearly not solid, since birds fly in it (Gen.1:20, cf. Deut.4:17) and the sun, moon, and stars move through it (Gen.1:14-18). In fact, the *raqia* simply refers to the sky, including the atmosphere and outer space.

Finally, ancient cosmology as such does not really go back earlier than about 550 BC, with the advent of Greek science. Before that cosmology was intertwined with mythology, making it very difficult to discover what the ancients believed about the nature of the physical

universe. Moreover, there was no uniform ANE belief about cosmology/mythology; Sumerian, Egyptian, Canaanite, and Babylonian mythologies had significant differences. Noel Weeks (2006, 2016) elaborates on these in his detailed critiques of Seely and Walton.

The close connection between ancient cosmology and mythology underscores a further crucial factor. Modern man views ancient man as scientifically naïve, mistakenly believing the ancient view was one dimension short (*i.e.*, an alleged flat earth). However, ancient man understood that the universe was much broader than the mere three dimensions we normally see. The ancient view of the universe included space for God, heaven, angels, and demons.

It is thus modern cosmology, with its simplistic materialist reduction of reality, that is in fact one dimension short. Ancient attempts to depict their god-filled universe are bound to be distorted by modern man when he interprets these in terms of his truncated three-dimensional model of reality.

Greek Cosmology

Scientific models of the universe first arose out of Greek thought. The Greek philosophers rejected magic and myth; they strove to find naturalistic explanations for the universe. Relying heavily on careful observation and critical thought, they devised simplified mathematical models of the universe. These are still the fundamental elements of science as practiced today.

The origin of science and philosophy is often traced to Thales (621-543 BC), a native of Miletus in Ionia. Thales achieved fame in 585 BC by predicting a solar eclipse. He reduced the multiplicity of the universe to a unity by postulating that all things were ultimately composed of the same, all-pervading substance: water. According to Thales, the world evolved out of water by purely natural means.

Anaximander, a younger associate of Thales, rejected the notion that water was the basic element of the universe. He postulated that all things consisted of combinations of four substances: water, air, fire, and earth. These elements were in turn derived from a more basic substance called "apeiron", meaning "boundless". In the beginning

there was only apeiron. Air, fire, earth, and water were formed from the primordial apeiron by a whirling motion, through which the various elements were separated. This whirling at the same time explained the motions of the stars. In the center of the universe was the earth, which was cylindrical in shape. Man lived on one of its flat faces.

From these simple beginnings the Greeks constructed a host of cosmological models. Generally, they strove to explain the universe in terms of some key fundamental element, physical principle, or numerical concept. Many of the Greeks held that the universe was the product of, or under the guidance of, a rational intelligence. Yet there were some who rejected any notion of divinity.

The latter group included the atomists Leucippus (5th century BC) and his disciple Democritus (5th-4th century BC). Leucippus believed that the universe consisted of only two things: atoms and empty space. The atoms, infinite in number, moved through infinite space; collisions between atoms resulted in the formation of new objects. Eventually the various objects decayed back into individual atoms. This universe of endless worlds was in a constant state of flux, producing an unlimited variety of objects. Asserting that the universe had existed since eternity, the atomists tried to avoid the need for not only a designer, but also for a creator.

Classic Greek Cosmology

While the atomist model had a distinctly modern flavor, it had little effect on medieval cosmology. Indeed, despite the vast variety of Greek cosmology, the only system that heavily influenced medieval cosmology was that derived from the two greatest ancient philosophers: Plato (427-347 BC) and his pupil Aristotle (384-322 BC).

The essential features of Plato's cosmological system were presented in his book *Timaeus*. Plato believed that the Creator made the universe according to a rational plan. By this time, it had become commonly accepted - at least by philosophers - that the earth was a sphere. The earthly sphere was placed in the center of the universe (Figure 3.4).

Peter Apian's *Cosmographicus Libre* (1539). This includes Plato's inner spheres of earth and water, air, and fire.

Figure 3.4. Peter Apian's Universe.

It was formed from earth, water, air, and fire. Around the earth were seven planetary spheres and an eighth outer sphere for the stars. The outer sphere, carrying the stars, rotated daily; the intermediate spheres, carrying the planets, rotated at various rates. Intelligent spirits caused the motions of the spheres.

Everything on earth was imperfect and changing, while the heavenly objects were perfect. All things were arranged hierarchically according to their inner dignity and perfection; the whole cosmos bore witness to God's existence and his concern for his creation. According to Plato, the world was not eternal. Rather, it was made by the Creator from a

model previously present in his mind. Everything was formed from an initial chaos in accordance with a perfect plan. Even time itself was created as the most perfect possible imitation of eternity.

Plato's cosmology was developed further by Aristotle. The inner, sublunar sphere held the four terrestrial elements of earth, water, air, and fire; the rest of the universe was filled with a fifth element called ether. The natural motion of the terrestrial elements was up and down. By this they looked to find their proper places according to weight. The natural motion of the ether was perfect, endless circular motion about the earth.

Since every motion must have a cause, there must be an unmoved prime mover, situated beyond the sphere of the fixed stars. The prime mover set the outer movable sphere in motion. From this sphere motion was transmitted through the various spheres for the heavenly bodies, so that the whole system was kept in motion. According to Aristotle, the prime mover moves everything else "by being loved". Both Plato and Aristotle believed that the order of the universe pointed to the existence of a creator.

The perfect motion of the ethereal spheres, controlled by intelligent agents, was without beginning or end. In contrast to Plato, Aristotle held that the universe had existed essentially unchanged from eternity. Since the outer boundary rotated about the earth in a finite time (*i.e.*, 24 hours), it followed that the universe was necessarily finite.

Saving the Phenomena

This ambitious cosmology did, however, have one major deficiency. Whereas the fixed stars did indeed display the prescribed perfect circular motions, the "wandering" stars (*i.e.*, the planets) did not quite follow such simple orbits. Their motions varied significantly from that of uniform speed over perfect circles. This was noted already by Plato, who assigned his students the problem of devising mathematical hypotheses that would "*save the appearances*". Thus, astronomers were set the task of reconciling theory and practice. How could the complicated motion of the planets be reduced to uniform circular motion? Aristotle tried to solve the problem, but at considerable

expense: he needed 55 intermediary spheres. Even then his model fell short of the observations.

The problem was eventually solved through the efforts of Claudius Ptolemy in about AD 150. In doing so Ptolemy invented several novel geometrical devices: the *epicycle* (a small circle superimposed upon a larger circle, called the *deferent*), the *eccentric* (a device making the center of the circle rotate off-center about the earth), and the *equant* (another off-center point from which speeds were calculated, to make the speeds uniform). These concepts are all are depicted in Figure 3.5.

In Figure 3.5 a planet revolves about a small circle, an *epicycle*, which in turn revolves about a larger circle, the *deferent*. The deferent is *eccentric* when its center is not at the earth. The *equant* is a non-central point about which the epicycle moves at a constant angular rate.

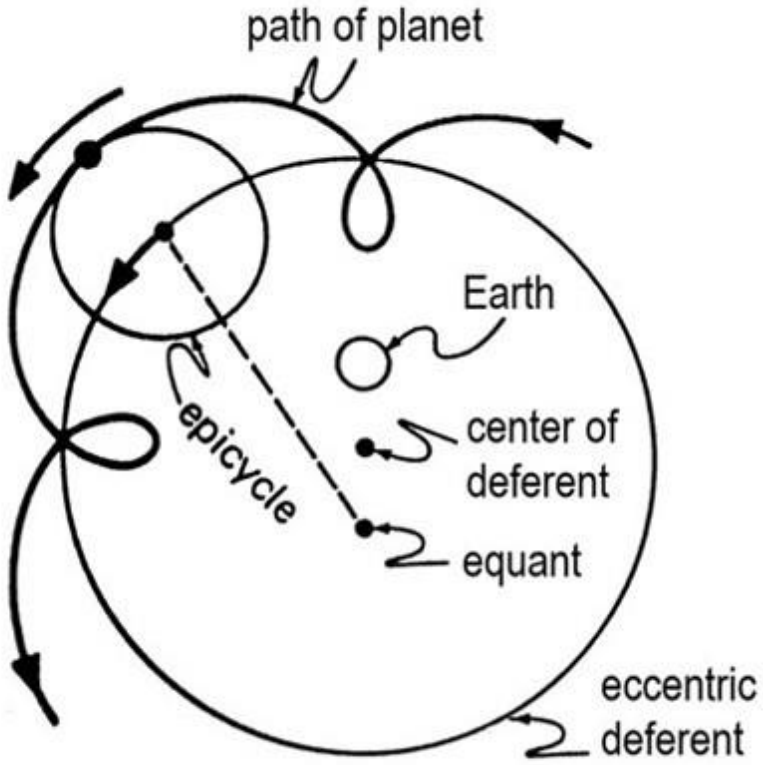


Figure 3.5. Epicyclic Theory.

The resulting geometric model worked very well, closely approximating the observed motions, and thus enabling astronomers to predict future planetary positions. However, in the case of some planets it was found

necessary to add further epicycles, smaller epicycles moving about larger ones, to adequately describe the observed motions. The complete Ptolemaic system consisted of 40 epicycles.

Nevertheless, despite its practical success, the model gave no physical explanation of planetary motion. Indeed, in Aristotle's cosmological model of solid spheres rotating about a central earth, motions corresponding to epicycles, eccentrics and equants were physically impossible.

Ptolemy defended his mathematical model by adopting an anti-realist (also called *instrumentalist*) view of scientific theories, claiming that astronomical hypotheses were merely useful fictions, or instruments, that enabled one to make practical predictions. His prime criteria in choosing theories were (1) accuracy in "saving the appearances" and (2) maximum simplicity. Ptolemy believed that physical explanations were necessarily speculative, that philosophers would never agree on them, and that only mathematical models could yield solid conclusions free of doubt.

This view of scientific theorizing was quite different from the rival, "*realist*" position that had been defended by Aristotle, who believed that theories should not only fit the observations but should also accord with the true nature of things. Thus, his followers rejected Ptolemy's system as contrary to the principles of Aristotle's physics.

The struggle between realist and instrumentalist views of scientific theorizing continues up to this day, with the realists claiming that their theories portrayed deeper truths of reality, and the instrumentalists questioning the ability of science to penetrate deeper than the observed phenomena.

Medieval cosmology

The early church fathers struggled to reconcile the Bible with the scientific thought of the Greeks. Several approaches were taken. One school of thought, associated mainly with the Syrian church, adopted a negative attitude toward Greek cosmology. Insisting that truth was to be found only in God's word, they dismissed Greek science and

philosophy. On the other side there were those, particularly in Alexandria, who were much impressed with Greek learning. They tried to harmonize Scripture with pagan teaching. Most popular, however, was a middle-of-the-road course which made much use of Greek thought but at the same time held on to the historical sense of Scripture, rejecting pagan learning where there was a clash. This latter view formed the basis for medieval cosmology.

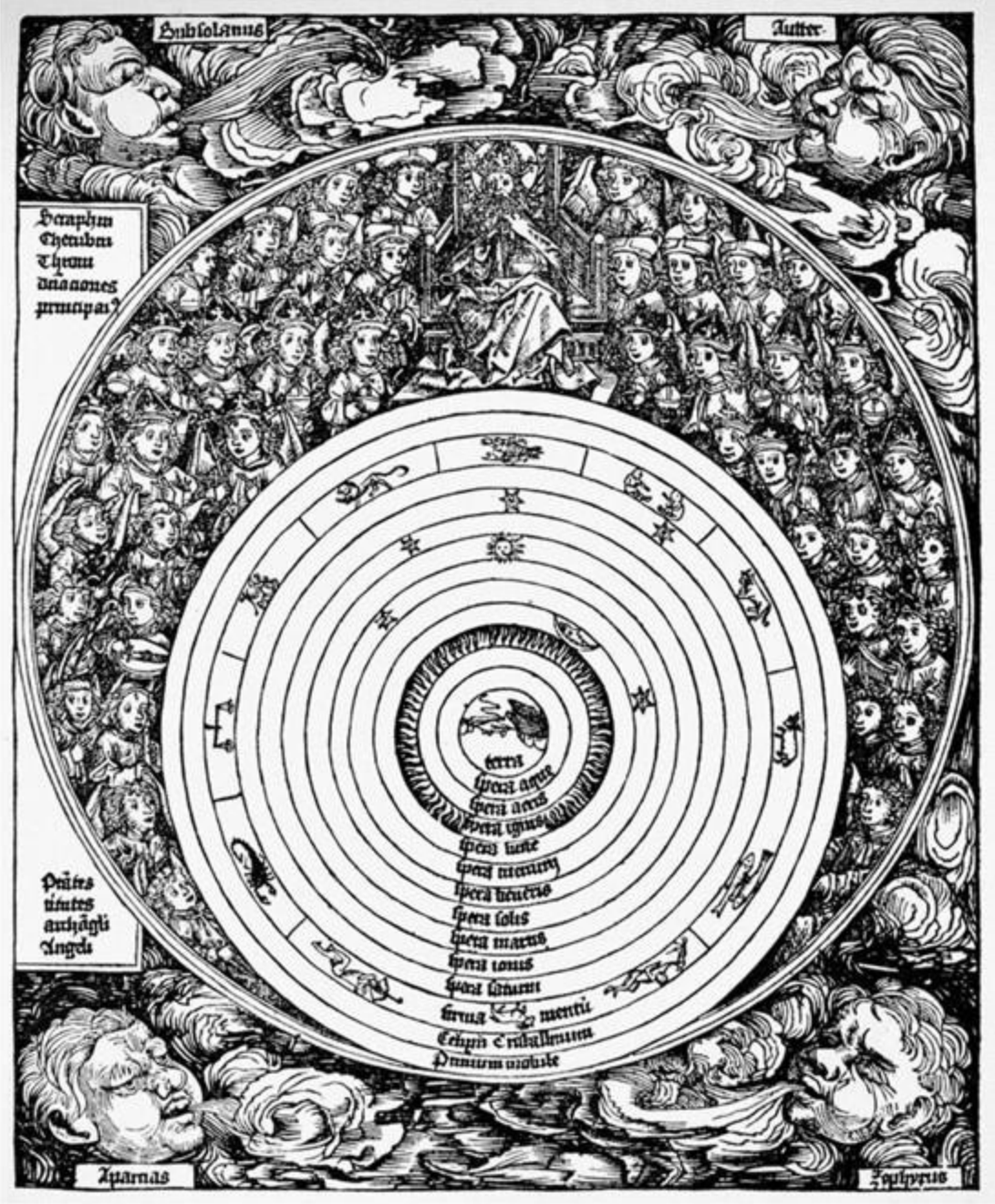
The Perfect Harmony

Many of the early church fathers saw a great similarity between the cosmological teachings of Plato and the first book of Genesis. Indeed, it was commonly thought that Plato had somehow been influenced by Moses. In both cases, for example, a single Creator fashions the cosmos according to a rational plan where the focus of the universe is upon the man-centered earth.

Plato's cosmology was incorporated within Christian theology largely through the writings of Pseudo-Dionysius (he claimed to be the Dionysius converted by Paul in Athens, as described in Acts 17:34), who wrote at about 500 AD. In the Middle Ages his works were accepted as genuine and became very influential, often taken as the highest authority after Scripture itself.

Pseudo-Dionysius interpreted Plato's hierarchy of spirits, who moved the spheres, as angels. He arranged the angels mentioned in Scripture into a hierarchy of nine orders, one for each heavenly sphere. His classification lists, in ascending order: angels, archangels (I Thes.4:16), principalities, powers, mights, and dominions (the last four from Eph. 1:21), thrones (Col. 1:16), cherubim (Ezek. 10), and seraphim (Isa. 6). Above the hierarchy of angels, in a tenth sphere, was the abode of God: the empyrean heaven (see Figures 3.4 and 3.6). The universe was thus populated with a continuous chain of creatures, stretching from God, in the highest heaven, to the lowest dweller of hell at the center of the earth.

As we noted earlier, medieval man believed the earth to be a globe, and not, as is commonly but erroneously believed, flat. C.S. Lewis (1963) finds that, although in the early Middle Ages a few authors argued for a flat earth, virtually all writers in the later Middle Ages agreed that the earth is a sphere.



From Schedel's *Nuremberg Chronicle* (1493). The nine orders of angels are listed on the left, flanking God's throne.

Figure 3.6. The Medieval Universe.

Medieval cosmology was brought to its fullest development through the work of Bonaventura (1221-1274) and Thomas Aquinas (1224-1274). Aquinas was concerned with reconciling the philosophy of Aristotle, whose works had only recently been rediscovered, with Christian theology. The main difficulty with Aristotle was his insistence that the

world was eternal. On this point Aquinas affirmed that, although God could have created a universe of eternal duration, God's revelation shows that the universe began to exist a finite time ago.

In medieval cosmology the universe was a perfectly ordered machine. It consisted primarily of a system of spheres which were embedded within each other like the rings of an onion. At the center was the fixed earth, divided into the four elementary spheres of earth, water, air, and fire. Next came seven spheres holding the moon, Mercury, Venus, the sun, Mars, Jupiter, and Saturn. These were all encompassed by the three heavenly spheres: one for the stars, one for the crystalline heaven (this referred to the waters of Gen.1:6), and one for the empyrean, the abode of God. This was essentially the same as Aristotle's cosmos, except that the "*nothingness*" beyond the stellar sphere was now replaced with the heavenly dwelling of God.

In line with Plato and Aristotle, it was believed that there was a fundamental difference between the earthly and heavenly spheres. Earthly objects were imperfect and transitory, while the heavenly bodies were perfect and imperishable. The perfection of the heavenly bodies was illustrated by their circular motion, as opposed to the more linear motion of earthly matter.

The world consisted of a huge hierarchical structure carefully arranged from the lowest level at the center of the earth, where hell was found, through the various divisions in society and church, the planetary spheres, to the ultimate perfection of the empyrean. This is illustrated in Figure 3.7, depicting the Italian poet Dante Alighieri’s (1265-1321) conception of the universe in his *The Divine Comedy*.

This world machine was set in motion by God through the angels who moved the various spheres. The planets, through their movement, exerted an influence on all physical things on earth and were thus instruments used by God to bring about material events. It was for the benefit of man, the crown of creation, that God continually guided the world.

While the *structure* of the medieval cosmos owed much to Greek thought, the account of its *origin* was based upon the Bible. Throughout the Middle Ages innumerable commentaries were written on the six creation days. As to the date of creation, the virtually unanimous

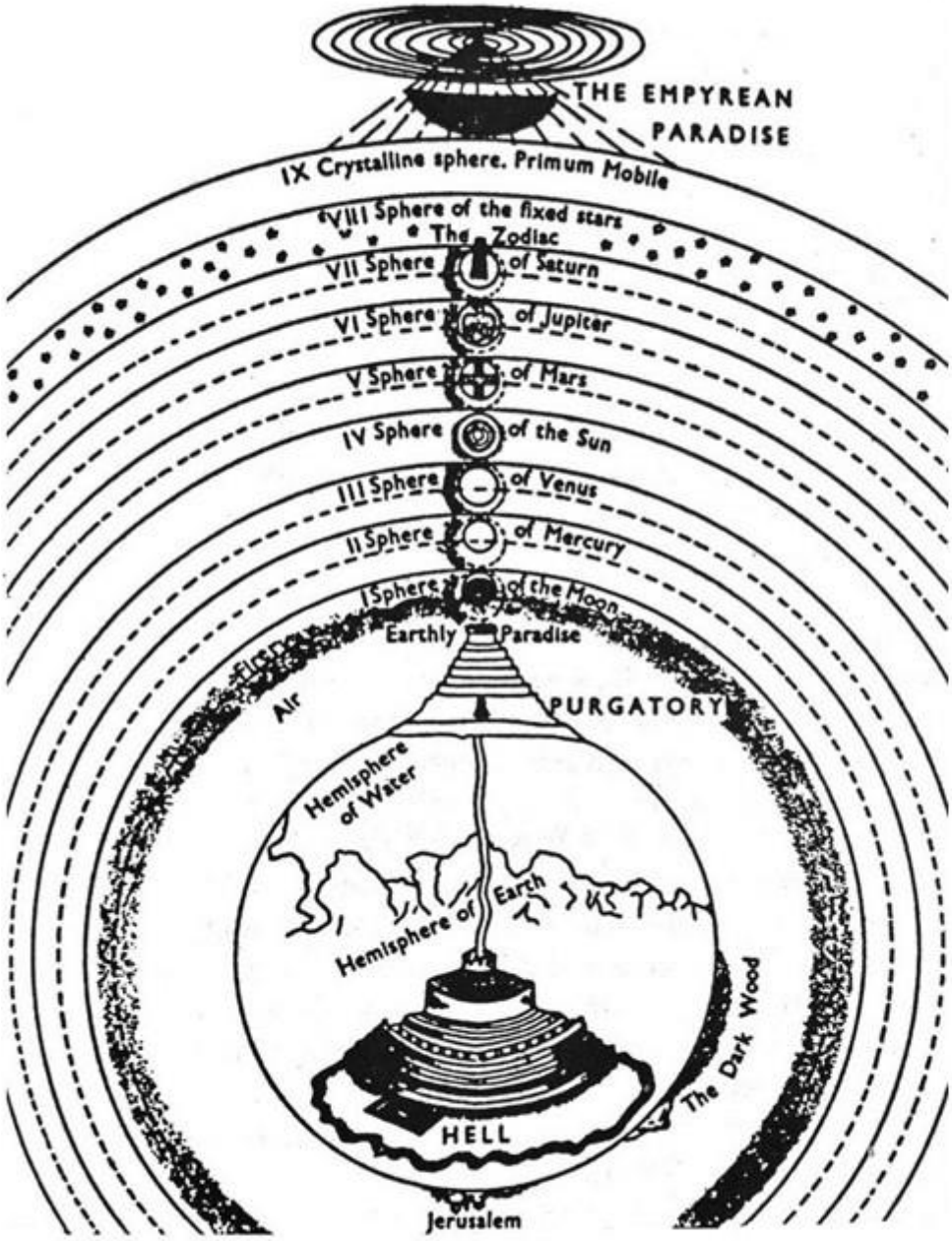


Figure 3.7. Dante's Universe.

opinion - based on the Genesis genealogies and other biblical chronological data - was that the world was created only a few thousand years before Christ.

The medieval conception of the universe achieved a harmonious unity between the concepts of God, the world, and man. The universe was seen to reflect both God's wisdom and love: wisdom because everything displayed perfect order, love because it was an expression of his concern for man.

In short, the medieval universe was a perfectly ordered whole. It was static, hierarchical, and anthropocentric. Unfortunately, the harmony between cosmology and theology would also prove to be a weakness, for the demise of medieval cosmology led also, for many, to the downfall of the accompanying theology.

The Demise of Medieval Cosmology

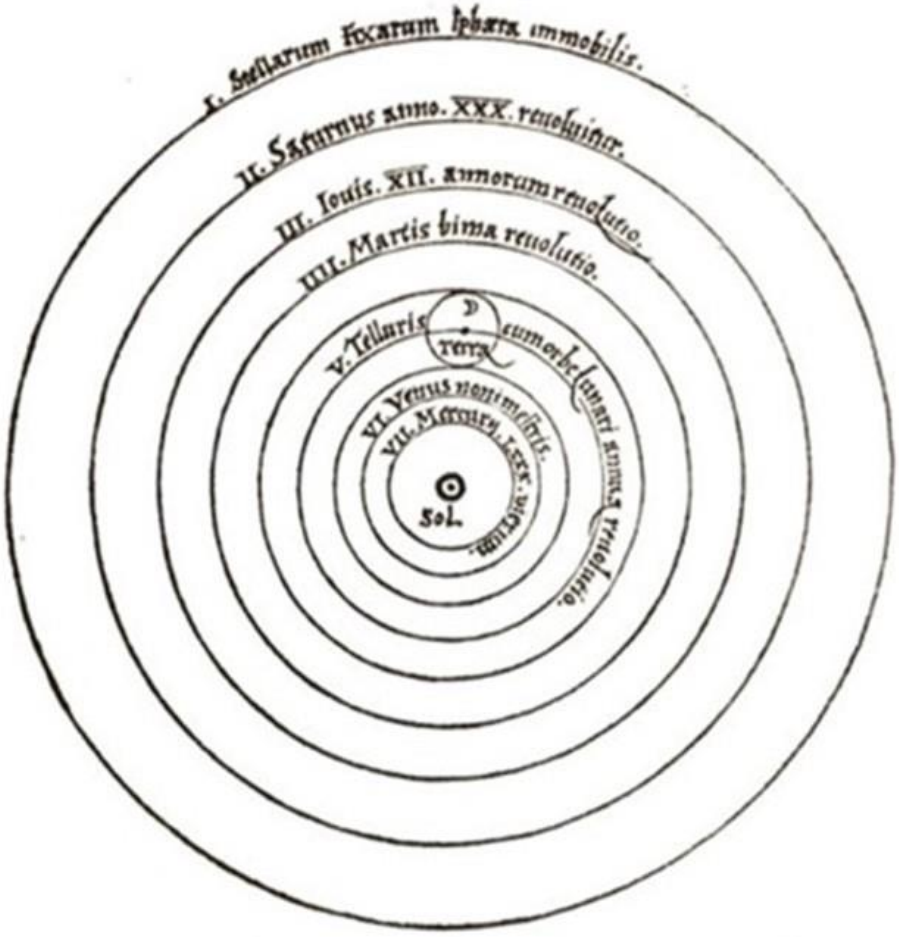
This wondrous marriage between theology and science was to remain the dominant cosmology until the 17th century. Several factors contributed to its ultimate collapse. Foremost among these was the trend in the new science to place great weight upon direct observation, rather than relying on the authority of the ancients. Consequently, it became increasingly clear, particularly in the 16th century, that Aristotelian physics and Ptolemaic astronomy were deficient.

Thus, for example, serious damage was caused by two events recorded by the Danish astronomer Tycho Brahe (1546-1601). On November 11, 1572, he discovered a new star (*i.e.*, a "nova"). This contradicted the basic doctrine that all change was confined to the sublunar, earthly sphere. Shortly thereafter, Tycho demonstrated that the great comet of 1577 was not a sub-lunar phenomenon, as comets had until then been considered. Rather this comet moved through the planetary spheres. This shattered the belief in the immutability of the skies and the solidity of the celestial spheres.

The telescope, invented only a few years later, soon revealed further difficulties. In 1610 Galileo showed that the surface of the moon was not perfect, as asserted by Aristotle, but had mountains and valleys, like the earth. This suggested a similarity between earthly and

NICOLAI COPERNICI

net, in quo terram cum orbe lunari tanquam epicyclo contineri diximus. Quinto loco Venus nono mense reducitur. Sextum deniq; locum Mercurius tenet, octuaginta dierum spacio circũ currens. In medio uero omnium residet Sol. Quis enim in hoc



pulcherimo templo lampadem hanc in alio uel meliori loco ponere, quàm unde totum simul possit illuminare? Siquidem non inepte quidam lucernam mundi, alij mentem, alij rectorem uocant. Trimegistus uisibilem Deum, Sophoclis Electra intuentẽ omnia. Ita profecto tanquam in solio regali Sol residens circum agentem gubernat Astrorum familiam. Tellus quoq; minime fraudatur lunari ministerio, sed ut Aristoteles de animalibus ait, maximã Luna cũ terra cognationẽ habet. Concipit interea à Sole terra, & impregnatur annuo partu. Inuenimus igitur sub hac

Figure 3.8. Copernicus's Universe.

heavenly matter. Later in the 17th century this likeness was further confirmed by Isaac Newton, who showed that the same physical laws applied to both. The development of Newtonian mechanics completed the overthrow of Aristotelian physics.

The Copernican Challenge

The most serious blow to medieval cosmology, however, was the removal of the earth from the center of the universe. The notion of a heliocentric universe had already been entertained by the Greek astronomer Aristarchus of Samos (about 310-230 BC). Although it had never been very popular, this ancient idea was again taken up by Nicolas Copernicus (1473-1543), who hoped to simplify the calculation of planetary positions. His heliocentric system is shown in Figure 3.8, taken from his book *De Revolutionibus Orbium Coelestium* (1543).

The Copernican system was no simpler than that of Ptolemy, still requiring 48 epicycles, compared to Ptolemy's 40. Nevertheless, it did have the advantage of offering a simple explanation of certain peculiarities of the planetary motions, as well as allowing the calculation of the relative distances to the planets.

However, one could still devise equivalent earth-centered models. For example, Tycho Brahe's model, where the planets encircled a sun rotating about a stationary earth, explained the planetary motions as well as the heliocentric system. His system is shown in Figure 3.9, from his book *De Mundi Aetherei Recentioribus Phaenomenis* (1588).

The Copernican theory gradually became more widely accepted, leading to the famous clash between the Italian scientist Galilei Galileo (1564-1642) and the Roman Catholic Church. Galileo promoted the Copernican theory that the earth was moving about a fixed sun; the Roman Catholic Church held this to be contrary to the Bible, which spoke of a fixed earth. This resulted in much debate. Which was in absolute motion: the Sun, or the Earth?

The evidence presented by Galileo in favor of the Earth's motion consisted primarily of observations made with the recently invented telescope. This included such novelties as the satellites of Jupiter, the

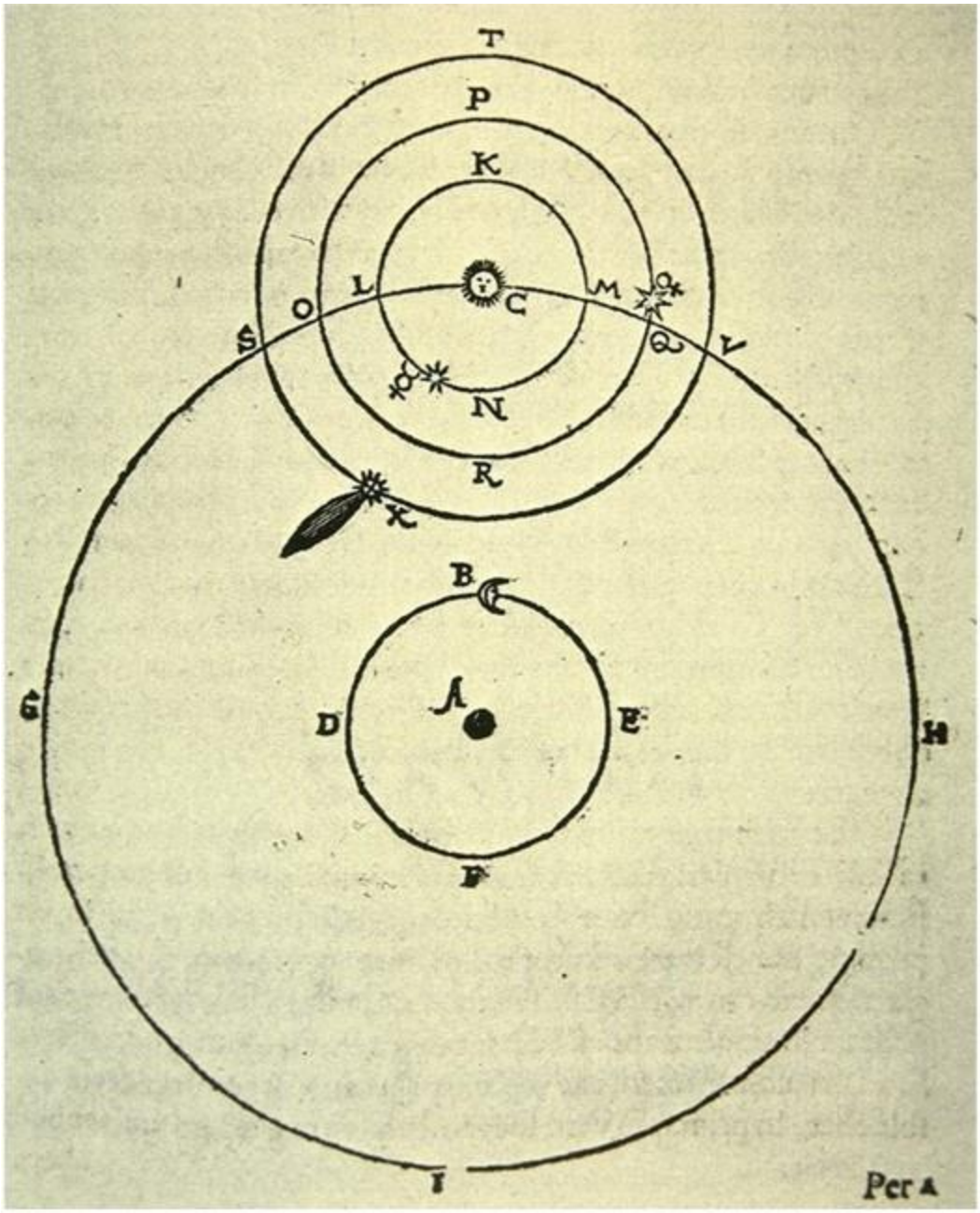


Figure 3.9. Tycho's Universe.

phases of Venus, craters on the Moon, and many new stars. Yet, these observations, though consistent with the Copernican model, could also be explained using a geocentric model.

The lack of any direct proof for Copernicanism led the formidable Roman Catholic theologian, Cardinal Robert Bellarmine, Consultor of the Holy Office, and a leader in the 1616 trial of Galileo, to write to Galileo:

> *If there were a real proof...that the Sun does not go around the Earth but the Earth around the Sun, then we would have to proceed with great circumspection in explaining those passages of Scripture which appear to teach the contrary, and we should rather have to say that we did not understand them than declare an opinion false which is proved to be true. But I do not think there is any such proof since none has been shown to me.*
>
> *To demonstrate that the appearances are saved by assuming the sun at the center and the earth in the heavens is not the same thing as to demonstrate that in fact the sun is in the center...I believe that the first demonstration may exist, but I have grave doubts about the second; and in case of doubt, one may not abandon the Holy Scriptures as expounded by the holy Fathers... (Koestler 1968:454).*

Bellarmine had no problem adopting the Copernican model as a useful hypothesis. To accept it as truth, however, would require definite proof, proof that Galileo could not supply.

On March 5, 1616, the General Congregation of the Index ruled that the doctrine of the motion of the Earth and the immobility of the Sun was "*false and altogether opposed to Scripture*" (Koestler 1968:462). Although politics, personality clashes, and Aristotelian physics had all played major roles, the prime obstacle against the Copernican universe was the traditional reading of the Bible.

Theological Considerations

The crucial issue in the Galileo case was that of epistemology: how can we know if some claim about reality is true? In particular, the debate raged over the nature and extent of biblical authority, as well as over the status of scientific theories. As we already noted, Galileo presented the Copernican system not as a mere theory, but as the truth, a truth before which Scripture, or at least the Church's interpretation of it, had to retreat. He advocated a realist view of scientific theories, as opposed to the more moderate claims of Bellarmine's instrumentalist suggestion.

Galileo discussed his views on the relationship between science and Scripture in his "*Letter to the Grand Duchess Christina*" (1615). There he argued that certain passages in Scripture should not be taken literally, one reason being that:

> *These propositions uttered by the Holy Ghost were set down by the sacred scribes in order to accommodate them to the capacities of the common people, who are rude and unlearned (Galileo 1615:182).*

A second reason he gave was that cosmology is irrelevant to the central purpose of the Bible, which is to teach us how to attain salvation: "*Scripture tells us how to go to heaven, not how the heavens go*" (Galileo 1615:188). Also, Galileo affirmed,

> *I think that in discussions of physical problems we ought to begin not from the authority of scriptural passages, but from sense experiences and necessary demonstrations...nothing physical which sense experience sets before our eyes, or which necessary demonstrations prove to us, ought to be called into question (much less condemned) upon the testimony of biblical passages which may have some different meaning beneath their words. We must take heed, in handling the doctrine of Moses, that we altogether avoid saying...anything which contradicts manifest experience and reasoning of philosophy or the other sciences. For since every truth agrees with all other truth, the truth of Holy Writ cannot be contrary to the solid reasons and experiences of human knowledge (Galileo 1615:182-6).*

For Christians, the drama of salvation had always been central, and therefore more important than nature. Now Galileo considered the Book of Nature to be as significant as the Book of Scripture, and even speaking more clearly, at least on non-salvation issues. With Galileo, the scientific enquiry of nature achieved an independent status to which other truths had to conform. Galileo's attitude posed a threat to the Christian worldview:

> *...a tradition was forged in which the increasing clarity discerned through nature was set against the prevailing unclarity of Scripture, with the attendant hope that thereby the latter might be purged of its obscurity. In retrospect, it is clear that this can only be accomplished by a logic which no longer took its cue from the biblical revelation but from a philosophy which determined the content from its own angle of vision. In Galileo, an independent natural basis for religion had begun to determine the biblical understanding of revelation. Of this Galileo was certainly unaware (Dillenberger 1960:90).*

Whether Galileo was aware of it or not, his epistemology led to a slow but steady reduction in biblical authority.

Many others who accepted the new astronomy also accepted Galileo's view of the relationship between the two Books. The prominent German astronomer Johannes Kepler (1571-1630), who also was much concerned with reconciling science and Scripture, was prepared to re-interpret Scripture in a flexible manner through the widely held notion of accommodation.

Many theologians were alarmed by such downgrading of Scripture. For example, the Lutheran theologian Abraham Calovius (1612-86) declared, in the middle of the 17th century, that in natural matters Copernicus was not to have more authority than the word of God. He feared that accepting that some biblical passages had been accommodated to common ways of thinking would be like opening a hole in the dyke which would eventually destroy the dyke itself. Hence Calovius held that no error, even in unimportant matters, could have any place in Scripture.

As discussed in detail by Dutch historian Rienck Vermij (2002), Copernicanism became a major issue of contention in the Reformed Church in the Netherlands. Many theologians and academics had been heavily influenced by the rationalist philosophy of Rene Descartes (1596-1650), who spent much of the last twenty years of his life in the Netherlands. Descartes stressed the supremacy of human reason.

By 1656 the Reformed Church was divided between theologians who embraced Cartesian philosophy (which included heliocentricity), re-interpreting the Bible accordingly, and more orthodox theologians who

upheld the authority of the Bible, which they viewed as opposing heliocentricity. The prominent Reformed theologian Gisbert Voetius (1589-1676) strongly rejected both Cartesianism and heliocentricity. At that time this conflict almost caused a split in the Dutch Reformed Church.

Then, as now, the central issue concerned the nature of biblical authority and interpretation. The Cartesians argued that the Bible was written to accommodate the unlearned masses, and, hence, was not a source of knowledge in natural philosophy. The orthodox Reformed theologians, on the other hand, insisted on a fully authoritative, inerrant Bible that must be interpreted in a literal, rather than allegorical, manner. Thus, Voetius affirmed biblical inerrancy even in scientific matters.

Similarly, the eminent Reformed theologian Francis Turretin (1623-87) considered the admission of any error, however small, as a repudiation of the authority of Scripture (Dillenberger 1960:165). Therefore, on Scriptural grounds, these men rejected Copernicus. They sensed that yielding on any point would lead to capitulation all along the line.

Many intellectuals were not content to look for other interpretations of Scripture. They considered that science had proven false the geocentric viewpoint of the Bible. This led to their rejection of the inerrancy of the Bible and, eventually, to the rejection of all revealed religion. This led to Deism, which rejected every form of revealed religion as incompatible with science and tried to construct a natural theology. Deism became prominent in the 18th century. God was seen primarily as the architect of the universe, leaving it to run by itself following the laws he had imposed on nature. Atheism, which came into prominence also in the 18th century, went even further by explicitly rejecting any concept of God.

The triumph of Copernicanism has had far-reaching effects on the Christian community. By accepting the new astronomy Christians gave tacit approval to the underlying secular epistemology of Galileo and his supporters. In allowing a scientific theory to dictate the interpretation of Scripture they abandoned the epistemological supremacy of Scripture. Human reason came to be considered as an independent source of

truth, a source superior to that of Scripture - at least in scientific matters.

Geocentricity and Genesis

There are many similarities between the 17th-century battle against Copernicus and the current debate on origins. In both cases, the main issue was one of biblical authority versus scientific theorizing. In both cases, the Bible was challenged by dogmatic scientific claims going well beyond the observational evidence. In both cases, the data can be readily explained by alternative theories more consistent with the biblical givens. In both cases, many theologians surrendered too readily, over-estimating the power of human science, and lacking sufficient confidence in God's word.

The two issues are intricately connected. For example, the Dutch theologian N. H. Ridderbos was convinced, on purely exegetical grounds, that the Genesis days were literal days. However, he thought this entailed geocentricity since, among other things, the earth was created before the Sun and stars. Consequently, Ridderbos (1957:42-44), believing geocentricity had been scientifically falsified, embraced a non-literal interpretation of Genesis 1.

The Reformed theologian R. Scott Clark (2008) contends that, although before Copernicus all Christians were geocentrists, today hardly anyone is. Christians changed their understanding of Scripture due to science. The lesson he draws from this is that we should be wary of using the Bible to settle scientific issues. Like Ridderbos, Clark concludes that we should not insist on a literal view of Genesis 1 but, rather, we should leave room non-literal interpretations.

Science and the Earth's Motion

After heliocentricity's eventual apparent victory, the Roman Church became very embarrassed by its treatment of Galileo. After enduring centuries of ridicule, the Roman Church, in October 1992, finally reversed its judgment on Galileo.

Had the Roman Church erred in its condemnation of Galileo? Were Voetius and Turretin wrong?

Historically, the issue was whether the Earth was at rest in some absolute sense. The medieval pre-Copernican view was that the earth was at rest at the center of the universe, with the Sun revolving about the earth once a year, in addition to its daily cycle. The new Copernican view, on the other hand, was that the rotating earth revolved about a stationary Sun.

Who was right? Certainly, an earth-bound observer sees the sun move about a stationary earth. However, on observer on the sun would see the earth move. Such *relative* motion clearly depends on our vantage point. Unhappily, even with a telescope, all we can ever see is only *relative* motion. We get exactly the same observations whether we assume the sun moves around the earth or vice versa.

So how can we prove that the earth is really moving in some *absolute* sense? To determine absolute motion, we need an absolute reference point. What point might that be? Perhaps the sun or a distant galaxy? But how do we know that the sun or a distant galaxy is at absolute rest? And at absolute rest with respect to *what*? The implication is that there exists some feature of the universe with respect to which the absolute motion of the stars can be measured. This in turn raises the further question as to whether this new feature is "at rest" and with respect to what. And so on.

The Copernican case was greatly bolstered in 1687, when the great English scientist Isaac Newton (1642-1727) published his *Principia Mathematica*. Newtonian mechanics explained a vast variety of physical phenomena, including the motion of stars and planets. Newtonian defined absolute rest in terms of a reference frame in which his laws of motion were valid. By that definition, the earth was in absolute motion, as shown by its equatorial bulge, Coriolis forces, stellar aberration, and the like. So, for that matter, was the sun, which moved with respect to the stars . That seemed to settle the issue.

However, this now raised the question of whether Newton’s laws themselves were true. Could mechanics be reformulated to uphold a stationary Earth or to avoid any absolute frame of reference?

Albert Einstein (1879-1955), the famous physicist, stressed *relative* motion between equivalent observers. His general theory of relativity (1915), which dethroned Newtonian mechanics, abolished absolute space. According to Einstein,

> *Either coordinate system could be used with equal justification. The two sentences "*the sun is at rest and the earth moves*" or "*the earth is at rest and the sun moves*" would simply mean two different conventions concerning two different coordinate systems (Einstein 1938:248).*

In this regard, Lynden-Bell, D., Katz, J. and Bicak, J. (1995) showed that, in general relativity, the universe rotating about a fixed earth produces Coriolis and centrifugal forces, the equatorial bulge, and all other phenomena previously believed to prove that the earth is rotating. Further, any changes in the direction or angular speed of the axis of rotation (*e.g.*, due to a large earthquake) are instantaneously communicated to the entire rotating universe.

Would this not result in galaxies revolving about the earth at speeds greater than the speed of light? Yes. However, general relativity does not forbid such high speeds. It merely stipulates that any two objects passing each other must have a relative speed less than the speed of light. This constraint would be satisfied if the entire cosmos, with all its galaxies, revolved about the earth as a unit.

According to general relativity, then, a geocentric universe is scientifically workable. Consequently, it is nowadays generally granted by scientists that the question of absolute motion is not a scientific one. To quote the British philosopher Bertrand Russell,

> *Before Copernicus, people thought that the earth stood still and that the heavens revolved about it once a day. Copernicus taught that "really" the earth revolves once a day, and the daily rotation of sun and stars is only "apparent"... But in the modern theory the question between Copernicus and his predecessors is merely one of convenience; all motion is relative, and there is no difference between the two...*
>
> *Astronomy is easier if we take the sun as fixed than if we take the earth... But to say more for Copernicus is to assume*

> *absolute motion, which is a fiction. It is a mere convention to take one body as at rest. All such conventions are equally legitimate, though not all are equally convenient (Russell 1958:13).*

It is amusing to note that in scientific circles there has been some discomfort over Galileo's stance. After the Vatican's 1992 rehabilitation of Galileo an editorial in *Nature* (5 Nov. 1992:2), a prominent British science magazine, admonished the Vatican for doing it so belatedly and grudgingly. But then the editor goes on to wonder whether the Earth goes about the Sun in any but a relative sense, adding "*Galileo was probably too good a scientist to commit himself to an absolute view*". Here the Nature editor is wrong: it was precisely Galileo's insistence on an absolute view of the earth's motion that got him into trouble.

Several Christian scientists, such as Gerardus Bouw (1992) and Robert Sungenis & Robert Bennett (2010) have made detailed defenses of geocentricity. However, any empirical proof of geocentricity is as elusive as its disproof. As we noted, the choice must be based on extra--scientific theological or philosophical considerations.

The Absolute Standard of Rest

You might think it implausible for the immense visible universe to revolve around a tiny, fixed earth. This, however, presumes the materialist error that the visible physical world is all that exists. Christians know better. God’s creation is much larger, encompassing also the vast, spatial heaven where God and his angels live. Ultimately, an absolute standard of rest for the created universe can be set only by its Creator.

The laws of nature that we see in our physical universe do not necessarily apply to heaven, which may well have its own laws. Hence, even if there were scientific proof for the earth's absolute motion within the visible physical universe, this would not prove the earth's motion within the universe as a whole.

The ultimate focal point of the entire creation is God's heavenly Throne. Would it not be most fitting for God to appoint this place, the dwelling place of the Absolute, as the ultimate standard of absolute rest?

The link between the earth and God's throne will become even more obvious in the future after the earth is renewed. Then God's dwelling place shall descend from heaven to be with man (Rev.21:1-4), and the throne of God and of the Lamb shall be established on the earth itself (Rev.22:1-5). The universe in its fullest sense is, therefore, neither *helio*-centric nor *geo*-centric but, rather, ***Christo-***centric.

The earth's rest, defined in terms of God's holy Throne, serves to remind us of the presence of God and of the multi-dimensional richness of his creation. Of course, such geocentricity, correlated as it is to a currently *invisible* heaven, does not necessarily have any scientific consequences, since scientific observations and laws are limited to merely the visible universe.

Newtonian Cosmology

The cosmological model of Copernicus was still bounded by the outer sphere of fixed stars, now centered on the sun rather than on the earth. However, since the motion of the outer sphere was now attributed to the motion of the earth, the stellar sphere could be at rest. The removal of the motion of the stellar sphere swept away the prime argument for its finite size. Thus, as a natural consequence of Copernican cosmology, an infinite universe could now be contemplated.

This step was taken in 1576 by the English astronomer Thomas Digges (1543-1595), an early convert to Copernicanism. He took away the outer edge of the universe, placing heaven with its celestial beings within an infinite space of stars. Figure 3.10 is from Digges' *A Perfect Description of the Celestial Orbs* (1576).

The new cosmology that replaced the old owed much to Isaac Newton. Through his theories of gravity and motion, the universe came to be seen as a huge machine governed by mathematical equations. Yet this clockwork mechanism, created by God, was not perfect. Newton found that his mechanics could not account for the stability of the solar

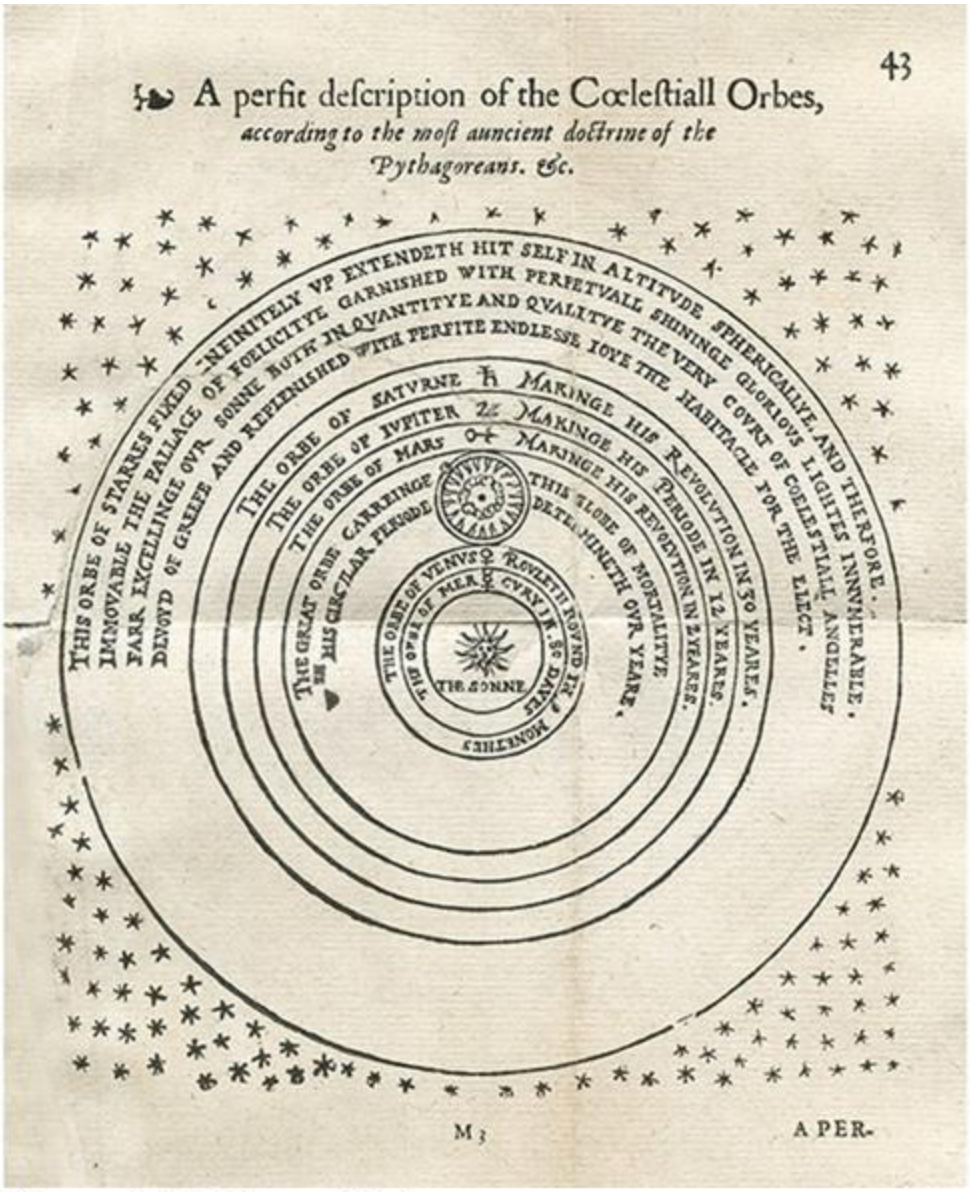


Figure 3.10. Digges' Universe.

system. He proposed that God interfered from time to time to keep the planetary motions on track. Indeed, Newton saw this mechanical deficiency as a proof for the existence of God. This extraordinary dependency on God was removed in the next century by the Frenchman Pierre-Simon Laplace (1749-1827), who was able to show that Newtonian mechanics itself sufficed to keep the solar system stable: no supernatural intervention was needed.

According to Newton, time and space have always existed. The material universe was created a finite time ago in an infinite empty space. Newton considered the material world to be of finite size,

surrounded by an infinite empty space. His followers, however, soon let the material universe fill all infinite space, since they saw no reason to limit God's creative activity to just a small part of space. Similar reasoning led to the removal of restrictions on God's creative action in time: the created world became infinite in both space and time.

Since an infinite and eternal world has no need of creation, God soon became superfluous as a creator. Moreover, while Newton had considered space to be an attribute of God, embodying his presence and action, the new philosophy gradually came to look upon space more as the void of the ancient Greek atomists. Space was emptied of everything - including God (see Koyre 1957:274-6). Despite Newton's aim to bolster a theistic concept of the universe, the cosmos that arose from Newtonian mechanics had no need for God.

Thus, the movement started by Copernicus and continued by Kepler, Galileo, and Newton promoted an increasingly mechanistic view of the universe. God was gradually removed as an active force in the physical world. Thomas Kuhn summarizes this trend as follows:

> *In the clockwork universe God frequently appeared to be only the clockmaker, the Being who had shaped the atomic parts, established the laws of their motion, and then left them to run themselves. Deism, an elaborated version of this view, was an important ingredient in late 17th and 18th century thought. As it advanced, the belief in miracles declined, for miracles were a suspension of mechanical law and a direct intervention by God and his angels in terrestrial affairs. By the end of the 18th century an increasing number of men, scientists and non-scientists alike, saw no need to posit the existence of God (Kuhn 1957:233).*

Not only did the medieval world-view allow for the direct interaction of God with his creation, it also had a special place for God: the throne of God was in the heavenly Empyrean, which lay beyond the finite sphere of the fixed stars. Before Copernicus, most Christians had considered heaven to be a physical place found beyond the stars. The Copernican revolution, by eventually replacing the closed universe with an infinite space, left no place for heaven. Although, as we saw, Thomas Digges still placed mingled his stellar and theological heavens, God was

gradually expelled from this heaven, leaving only the stars. Thus, man was left alone, lost in an infinite maze.

For example, the liberal theologian Rudolph Bultmann asserted,

> *"we no longer believe in the three-storied universe which the creeds take for granted...there is no longer any heaven in the traditional sense of the word...the story of Christ's descent into hell and of his Ascension into heaven is done with...we can no longer look for the return of the Son of Man on the clouds of heaven... or believe in spirits, whether good or evil, ...because the forces and the laws of nature have been discovered." (Bultmann 1984:1-4)*

The Dynamic Universe

Initially the Newtonian universe was static, not changing much over time. This conception did not last long. By the 18th century the notion of change over time became popular in various disciplines, particularly in geology and biology. Increasing interest was shown in the question of origins. So, new cosmological theories were proposed to account for the formation of the stars and planets.

The infinite Newtonian universe had abandoned both geocentricity and heliocentricity. Infinite space was at first thought to be uniformly populated with stars like the Sun. Further observations showed, however, that the stars were not randomly scattered through space. Rather, most were grouped together in the Milky Way. Thomas Wright (1711-86) conjectured in 1750 that the Milky Way consisted of a sphere, or perhaps a disk, of stars circling about the center. The center was a supernatural source from whence originated all the laws of nature. By this time, several faint and fuzzy objects had been observed. Wright conjectured that these distant clouds, or "nebulae," were in fact collections of stars like the Milky Way. According to him, the universe was filled with infinitely many centers of creation.

Shortly thereafter, in 1755, the German philosopher Immanuel Kant (1724-1804) went a step further and proposed a naturalistic origin for all celestial bodies in the universe. He suggested that initially the universe consisted of an infinite, nearly uniform gas. Due to gravitational attraction, collections of matter were formed. Their random motions gave the condensing clumps of matter a small spin. As the systems contracted further their spins increased and galaxies were formed. Inside the galaxies a similar process formed individual stars and planets.

Laplace, too, expounded the "nebular hypothesis" for the origin of the universe. The main point of contention concerned the interpretation of the faint nebulae. Laplace thought they were merely clouds of gas associated with the Milky Way. His universe was centered upon a single gigantic Milky Way surrounded by circling clouds of gas. The opposing view, of Wright and Kant, was that of an infinity of "island universes" like the Milky Way. This debate was finally resolved in the 1920's, when new observations vindicated the multi-galaxy position.

The notion of a dynamic, evolving universe became extremely popular in the latter half of the 19th century, particularly with the development of biological evolution. The writings of Charles Darwin (1809-1882) were particularly influential. His principal work, *On the Origin of Species* (1859) dealt with the evolution of plants and animals. In his *Descent of Man* (1871) he extended the principle of evolution to also include the origin of man. This idea was soon applied also to society, incorporating the attractive ideal of human progress. In short order the evolutionary model of the universe became the dominant worldview. From the start, there had been opposition from religious quarters, but most theologians managed to adapt their Christianity to the evolutionary cosmos.

Thus, a naturalistic, scientific model finally claimed to account for the formation of the entire universe, with all its contents. The static, finite, geocentric, and theistic clockwork mechanism of medieval man had been replaced by a dynamic, infinite, materialistic organism continually evolving upwards.

Heat Death

The establishment of the evolutionary cosmos initially generated an optimistic view of the future. The defenders of evolution felt that the universe was steadily improving. Darwin himself concluded:

> *...as natural selection works solely by and for the good of each being, all corporeal and mental endowments will tend to progress towards perfection. (Darwin 1859:486)*

This optimistic spirit was soon to be severely jolted.

The challenge came from the new science of thermodynamics, the study of heat. The industrial revolution, which had gained momentum in the early 19th century, was strongly dependent upon the development of efficient machinery. By 1850 studies of steam engines and other processes involving energy exchanges led to the discovery of two fundamental principles.

The first law of thermodynamics, as it became known as, had to do with the conservation of energy. This law postulates that, while energy can be transformed from one form to another, energy can never be created or destroyed. Consider, for example, a waterfall. As the water plunges downward, its gravitational potential energy, due to its height, is converted to mechanical energy. If this is used to drive a turbine, the energy can in turn be transformed to electric energy. Were this power to be used to run a pump, we could pump the water back to its original height. The first law asserts that, if we could neglect energy loss due to friction, the waterfall generates just enough electrical power to enable all the water to be pumped back up. No new added energy can be generated.

If we take friction into account, as we must in any realistic situation, the situation worsens. This brings us to the second law of thermodynamics, which deals with the amount of *useful* energy available. It was first formulated in 1851 by Rudolph Clausius (1822-1888) in Berlin and William Thomson (known as Lord Kelvin, 1824-1907) in Glasgow. The second law specifies that, in any actual physical process, useful energy is always lost; frictional effects will always

dissipate some useful energy as heat. If we drop a ball onto a flat, steady floor, we find that it will never quite bounce back to its starting position. Some mechanical energy is always lost, transformed into heating either the ball or its surroundings.

Thus, while the First Law states that in any process the final energy output cannot exceed the energy input, the Second Law stipulates that we can't even break-even: the usable energy generated by a machine is always less than the energy input. Perpetual motion machines do not exist. It is commonly believed that the Second Law of Thermodynamics is one of the most basic laws of all science.

Clausius defined the "entropy" of a system to be a measure of the state of disorder, or randomness, of the system. The higher the degree of disorder, the higher the entropy. Consider, for example, a room full of air molecules. If the air molecules all happen to be in one half of the room (a most unlikely event!) this would correspond to a highly ordered state, having an extremely low entropy. If the air molecules are mixed throughout the room the order is lost and the entropy is now high. According to Clausius, all systems tend to develop toward a state of "equilibrium", where there is no net flow of energy. Systems tend to go from an ordered state to a disordered state, rather than vice-versa. Thus, left to itself, a sandcastle will degenerate into a pile of sand, while the reverse does not happen. Real processes tend to be irreversible.

Applying this principle to the universe, Clausius concluded that the total energy in the universe is constant, and its entropy tends towards a maximum. The German physicist Hermann von Helmholtz reached a similar verdict in 1854 and deduced some far-reaching consequences. If the universe is continually running down into a state of disorder, then it must have been "wound up" some finite time in the past by some process violating the second law. Furthermore, at some finite time in the future the universe will become totally disordered. It will tend toward an equilibrium state where each region has the same temperature. At that time, the universe will have no more useful energy left and life in any form must disappear. This has been called the "heat death" of the universe.

The new thermodynamic laws put fundamental restrictions on cosmological theorizing. The Second Law, with its gloomy predictions of the future demise of life in the universe, snuffed out the optimistic

view of the universe evolving to ever greater perfection. In its place came a sense of despair, a feeling that our inhabitable universe was a mere statistical accident, with no prospects, and no ultimate purpose.

4. Modern Cosmology

In 1848 Edgar Allen Poe, of short story fame, first suggested that our universe originated in a gigantic explosion. Poe, in his small book *Eureka,* describes how God created the universe, out of nothing, as an exploding primordial particle. Initially, matter shot out in all directions. As the universe expanded, gravity gradually caused the atoms to condense into stars and planets. In the distant future, gravity will halt the expansion and a contraction will set in. Eventually, our cosmos will return to its first state, a tiny point, at which time it disappears. God then generates a new universe, another pulse in an eternal cycle.

Poe thought that our universe is finite, one of infinitely many such universe, each with its own god. These universes are so immensely far from each other that they cannot interact or communicate with each other.

Poe's exploding universe would prove to be remarkably like Big Bang cosmology, the focus of this chapter. Yet, at the time, Poe's model did not attract many scientists. Most continued to believe in some form of infinite, dynamically static, Newtonian universe.

Modern cosmology really began in 1917, when Albert Einstein first applied his new gravitational theory - known as *general relativity* - to the entire universe. He made various assumptions that are still common to most modern cosmological models.

Basic Cosmological Assumptions

All science, including cosmology, is based on observations. Since cosmology tries to explain the history of the entire physical universe, and since we can observe only a small portion in space and time, cosmology rests heavily on various assumptions we must make about the universe.

Let's examine three assumptions that apply to most current cosmological models.

1. Uniformity

The most basic assumption is that of *uniformity*. We assume that the laws of physics, observed here and now, apply everywhere and always throughout the cosmos. This is known also as the *principle of uniformity*.

As we noted earlier, justifying uniformity is a challenge for all science. In cosmology, it is even more acute since cosmology is further removed from direct observation and experimentation. This is particularly the case in standard cosmology, where we assume these laws stay valid under extreme circumstances, such as the tremendous temperatures and pressures thought to apply near the beginning of the universe.

Some cosmologies, we shall see, relax the uniformity assumption by postulating that some physical constants, such as the gravitational constant or the speed of light, may change over time. Yet even here it is assumed that such changes are governed by some higher law, taken to be universally applicable.

2. General Relativity

Most modern cosmologies are based on general relativity. Classical physics was based on Isaac Newton's notions of *absolute* space and time, which existed independently of each other. Newton held that they did not exist by themselves but depended on God's omnipresence and eternality. There is a universal clock, a universal "now," so that each location in space follows the same absolute time.

Absolute space and time fit in well with the notion of dynamic time or presentism, where only the present moment exists. Absolute space supplied a preferred frame of reference, a God's view of reality, defining position and motion. This ensured an objective ordering of events (*absolute simultaneity*) independent of an observer's position or motion.

Empirically, Newton defined absolute space in terms of a reference frame in which his laws of motion held (called an "inertial frame"). In

such a frame the Earth's annual revolution about the Sun, as well as its daily rotation, were thought to reflect absolute motion. Given, however, that all we can ever observe is relative motion, this raised the question of whether the laws of motion could be reformulated to apply to other conceptions of absolute space, such as, for example, one upholding a stationary Earth.

Albert Einstein's theory of special relativity, on the other hand, stressed *relative* motion between different observers. It assumed that no observer is privileged but that all have equal standing. Hence, there is no longer an absolute frame of reference. Further, two observers moving relative to one another could view the same set of events in different sequences, so that an event that is past for one observer might be future for another observer. Consequently, absolute simultaneity (where a set of events has the same absolute order for all observers) is replaced with *relative* simultaneity, while a universal "now" is replaced with a different local time for every observer.

Special relativity is simplistic since it ignores gravity. Einstein's theory of general relativity generalizes special relativity to include gravity. General relativity postulates that massive objects warp 4-d space-time so that both space and time are distorted. General relativity, too, is widely viewed as refuting absolute simultaneity and the existence of a universal “now”.

In the most popular interpretation of special and general relativity, space and time are intertwined into a four-dimensional space-time block universe where past, present, and future times all co-exist eternally. Our strong common sense experience of the flow of time is then reduced to a mere delusion. This static view of time (eternalism) opposes the dynamic time of presentism, where only the present moment exists, moving from a no longer existing past to a yet-to-exist future.

Nevertheless, both special and general relativity can readily be reconciled with presentism. Even with relative simultaneity, one is still free to imagine there is a sort of "metaphysically preferred frame" whose definition of simultaneity is "true" while the others are "false" in a metaphysical sense. Although no possible physical experiment could allow us to empirically prove (or disprove) that preferred frame to be

"true", it could still be chosen based on philosophical or theological considerations.

Thus, even if relativity treats all potential observers equally, we could still choose, for example, a stationary observer in Greenwich, UK to have a preferred status. We could then define the absolute reference frame to be centered on Greenwich, so that the absolute position of any other point would be defined by its position relative to Greenwich. Greenwich time could be defined as the absolute time. Clocks associated with other observers could then be synchronized with Greenwich time so that a universal "now" is associated with Greenwich time.

We could also rewrite special and general relativity in terms of absolute space and time. For example, the "Neo-Lorentzian" version of special relativity keeps absolute (3-dimensional) space plus an absolute time independent of space. Similarly, J. Brian Pitts (2004) has shown that absolute time can be kept in general relativity by using a Hamiltonian version of general relativity. Such absolute versions of relativity are observationally indistinguishable from the space-time block universe view. As in the earlier case, however, the absolute frame must be chosen based on metaphysical, rather than empirical, considerations.

In quantum mechanics, a measurement performed on one of two entangled particles has an instantaneous effect on the other particle, even when they are far apart. The two events are simultaneous, no matter how fast any observer is moving. According to Jeffrey Koperski (2015:122), this supports an absolute simultaneity, with an objective flow of time.

General relativity, which deals with the very large (*e.g.*, stars and galaxies), and quantum mechanics, which deals with the very small (*e.g.*, atoms), are two of the most successful theories in modern physics. Yet, they are very difficult to reconcile, suggesting that at least one of these theories is incomplete. Currently, there is no widely accepted theory of quantum gravity. One theory of quantum gravity proposed by Petr Horava keeps the notion of absolute time (Koperski 2015:134). There seems no reason to doubt that any future theory of

quantum gravity could be interpreted within a framework of absolute time.

Empirically, physics can deal only with relative motion and position. This always leaves one free to choose an absolute frame of reference based on metaphysical or theological considerations. Thus, for example, there can be no scientific objection to choosing, say, the earth as an absolute frame of reference and earth time as universal time, if one so wished.

More generally, we must be wary of extracting metaphysical conclusions from any physical theory. Often these merely reflect the metaphysical assumptions upon which the theory is based.

Finally, scientific theories, even if they could be proven to be true for the entire observed physical universe, do not extend to the unseen heavenly realm, with its own laws. Hence, human science, when unaided by divine revelation, is incapable of discovering the true spatial and temporal nature of the entire cosmos.

3. The Cosmological Principle

A basic observational fact in cosmology is that, as seen from the Earth, on a large scale, the universe is roughly *isotropic*: it is the same in all directions.

Such isotropy would be expected if the Earth were near the center of a spherically symmetric universe. Some mathematical models for such Earth-centered cosmologies have been constructed. They are called Lemaître -Tolman - Bondi (LTB) models. However, they were never very popular. Indeed, such a solution is distasteful to modern cosmologists. As cosmologist George Ellis remarks:

> *In ages by, the assumption that the Earth was at the center of the universe was taken for granted. As we know, the pendulum has now swung to the opposite extreme; this is a concept that is anathema to almost all thinking men...It is due to the Copernican-Darwin revolution in our understanding of the nature of man and his position in the universe. He has been dethroned from the exalted position he was once considered to hold." (Ellis 1975:250)*

Most cosmologists reject such models because of the ***Copernican Principle*****,** which assumes that the earth is *not* in a special position in the universe. If the Earth is not in a privileged position, then the same isotropy seen from the Earth should be seen from many locations in the universe. This can readily be extended to the ***Cosmological Principle***, which assumes that *all* hypothetical observers throughout the universe would, at the same cosmic time, see the universe to be isotropic.

One consequence of the Cosmological Principle is that a universe that is isotropic from all locations must be the same everywhere (*homogeneous*). In a *homogeneous universe* matter is spread out uniformly over large distances, while in an *inhomogeneous universe* matter distribution varies from place to place (see Figure 4.1).

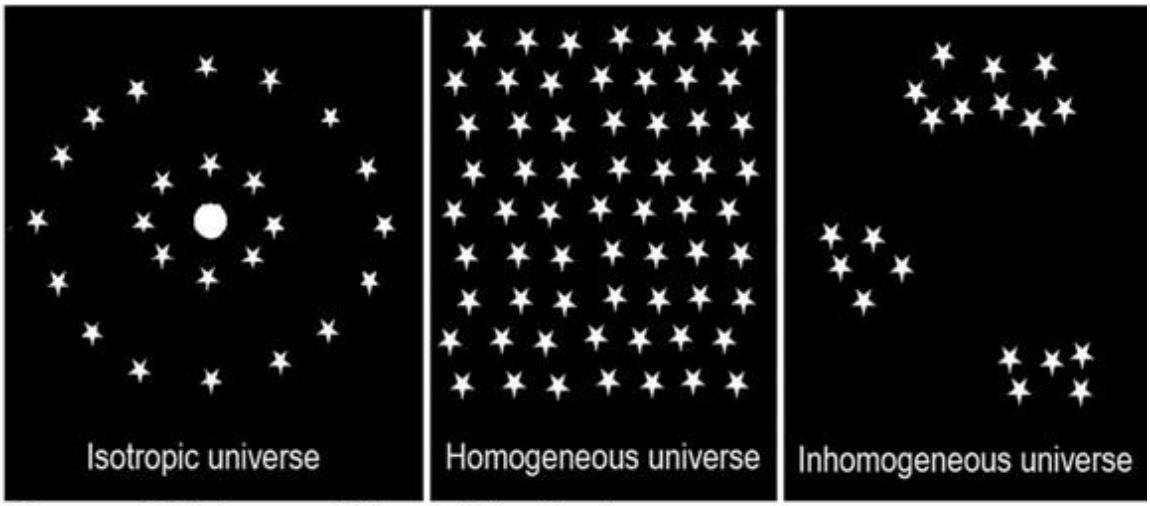


Figure 4.1. Types of Matter Distribution.

Further, if there were an edge, an observer near the edge would see no galaxies in the direction towards the edge, and hence he would not see the universe to be the same in all directions. Hence the Cosmological Principle entails that the universe has no edges. Since the universe is assumed to be homogeneous, it follows that any part of space is uniformly filled with matter. There is no space without matter.

The Cosmological Principle is a useful simplifying assumption that leads to a convenient set of cosmological equations (the Friedmann equations) describing the dynamic development of the physical universe. Cosmological models based on these equations are called

Friedmann–Lemaître–Robertson–Walker (FLRW) or, more simply, Friedmann-Walker (FW) models.

Unhappily, simplicity and utility don't guarantee truth. Is the Cosmological Principle a realistic assumption? Is the universe edgeless and homogeneous, as assumed? Whether the observable universe is homogeneous is, as we shall see, open to some doubt.

Indeed, one might well ask, why should the universe be edgeless? Most astronomical objects, such as stars, galaxies, clusters of galaxies, and so on, have edges. So, why not the physical universe as a whole? A better principle might be what we could call the *quasi-Cosmological Principle*: the universe looks the same from *almost* all positions, all but those near the edge.

A more realistic assumption might be that the universe is like finite ball of matter surrounded by infinite empty space. The observed isotropy could be accounted for if the universe was spherically symmetric about a point near the earth or our Milky Way Galaxy, such as with the Lemaître–Tolman - Bondi (LTB) models mentioned earlier.

If we assume further that the universe is homogeneous up to its edge, then such models are observationally equivalent to the edgeless FW models. However, LT models can drop the homogeneity assumption, making them more flexible than FW models.

Expanding Space or Exploding Matter?

It is commonly said that in Big Bang cosmology the galaxies taking part in the cosmic expansion are at rest with respect to space, but the space between galaxies is expanding. In this view, the creation of matter at the time of the Big Bang resulted also in the creation of space and time, these two being intertwined in space-time. In this view, space and time did not exist before the appearance of the physical universe.

This view is a natural consequence of FW models that assume that there is no space beyond the physical universe. Since space is co-extensive with matter, expanding matter is equivalent to expanding space. In that case space cannot exist before the material universe.

Yet, as we saw, one could as readily apply an LT model, treating the universe as an exploding ball of matter in infinite stationary space. In such models, a Big Bang event could occur within a pre-existing space and time. The observations can be explained equally well whether one considers galaxies as embedded within expanding space or as moving through a fixed space (Pössel 2020).

A Brief History of the Big Bang

At the time, Poe's model did not attract many scientists. Most continued to believe in some form of infinite, dynamically static, Newtonian universe.

Modern cosmology really began in 1917, when Einstein first applied his newly devised general relativity to the entire universe. Einstein assumed the universe was *homogeneous* and that the *cosmological principle* applied. The cosmological principle, we saw, implies that the universe has no edges since, if there were an edge, an observer near the edge would have a special vantage point. Until then the only way to avoid edges was to have an infinite universe. Now another possibility was now offered by relativity: the *curvature* of space. Einstein's theory postulated that the gravitational effect of matter would cause space to be *curved*. If there was enough matter the resultant gravitational field would be strong enough to cause space to curve in on itself, thus creating a finite universe with no edges. Such a finite, yet unbounded, universe is called a *closed* universe.

A less dense universe that is not closed is *open*. In an open universe the cosmological principle can hold only if the universe is infinite in size. The different geometries of space are compared in Figure 4.2.

In *Euclidean (flat) geometry* the sum of the angles of a triangle is always 180 degrees, in *Spherical (closed) geometry* their sum is always greater than 180 degrees, and in *Hyperbolic (open) geometry* their sum is always less than 180 degrees.

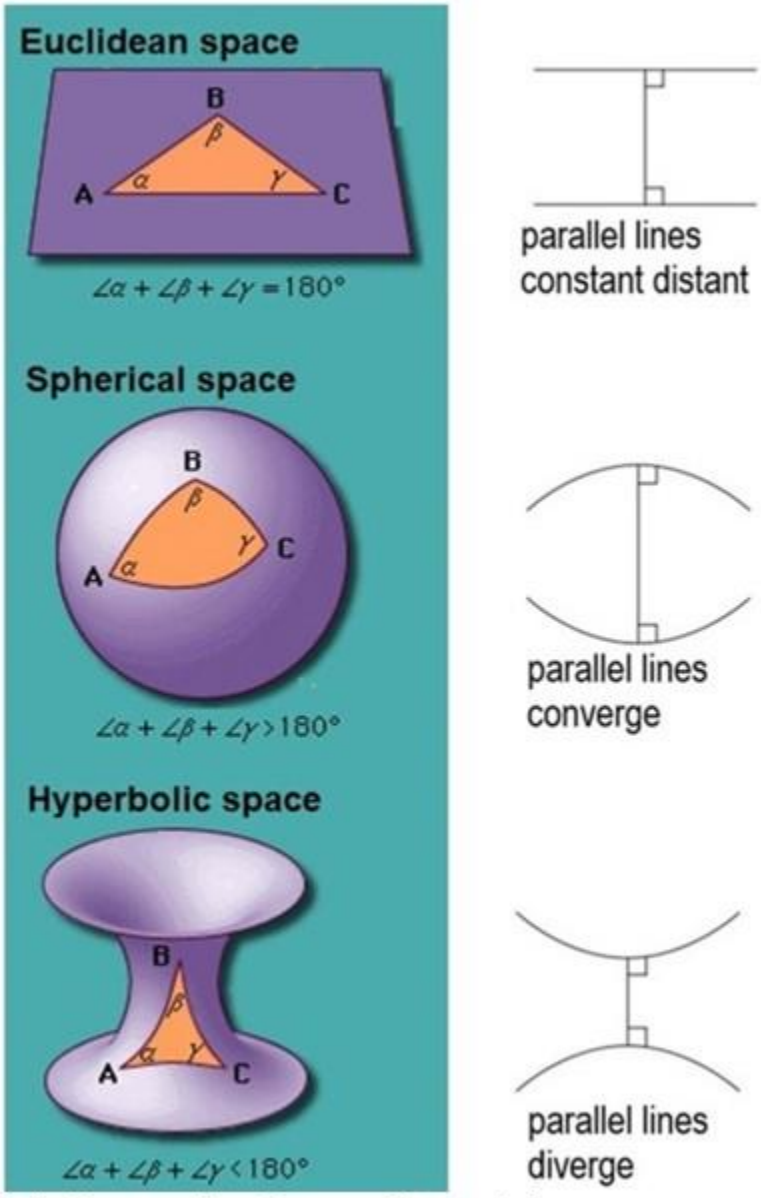


Figure 4.2. Comparing Space Geometries.

To visualize a closed universe directly is difficult, as it really involves four-dimensional geometry. Let’s consider a two-dimensional analogy. Picture a small piece of (one-dimensional) wire. It will have two ends or "edges". Place it on a (two-dimensional) table and bend it into a closed circle. We now have a finite one-dimensional length with no "edges", embedded in a two-dimensional surface.

Or imagine a bug crawling along the surface of a soccer ball. It never reaches an edge and will eventually cross its own path. The surface of the ball is finite even though it has no edges. The ball is a two-dimensional surface, embedded in a three-dimensional space.

Likewise, going up one more dimension, our universe could be imagined to be a finite three dimensional hyper-sphere, with no edges, embedded within a higher-dimensional space. Thus, with advent of relativity, it was possible to return to a finite universe and still hold on to the cosmological principle of uniformity.

Currently, the observational limits on the space curvature suggest that a closed universe must be at least 250 times wider than the observable universe, which is estimated to be about 46 billion light-years across. Hence, no matter how far out we look, we can never be sure that the universe is homogeneous beyond our observational horizon. In short, the Cosmological Principle is an unprovable metaphysical assumption.

There was one further difficulty. Einstein felt that the universe should be static, staying the same over time. Since the gravitational field of a finite universe would cause it to collapse, Einstein added a repulsive force to his cosmological model to prevent such an inward motion. This term, called "*the cosmological constant*", or "*Lambda*", would counterbalance the attractive force of gravity. The force was postulated to increase with distance so that its local contribution would be too small to be detected. Only on a cosmological scale, when the contribution from the most distant galaxies became significant, would this force become important.

Modern Big Bang cosmology is based on three observational pillars.

1. Galactic Redshifts

The first of these is the discovery, in the late 1920's by the American astronomer Edwin Hubble, that light from distant galaxies was shifted towards the red (low frequency) end of the spectrum. A similar lowering of pitch can be noted when, for example, a police siren moves past us. As the siren moves away the sound waves it emits are stretched by the motion of the siren itself, causing us to hear the noise at a lower frequency. This is called the Doppler effect. Hence, a simple explanation of the galactic redshifts is that the galaxies are receding from us.

Hubble found that the redshift was roughly proportional to the distance to the galaxy. This relationship, which became known as Hubble's law, suggested the galaxies had initially been close together.

This led, in 1929, to the resurrection of the Big Bang theory, in modern form, by the Belgian cosmologist and priest, Georges-Henri Lemaitre. Applying Einstein’s general relativity, Lemaitre conjectured that the universe originally started off as an explosion of the "*primeval atom*", an initially very dense concentration of matter.

The redshift z is defined as the fractional amount the observed light has been stretched since its emission. In Big Bang cosmology, the redshift can be thought to be caused by an expansion of *space itself*. As space expands the wavelength of light photons likewise expands.

Hence z reflects the fractional change in size of the universe at emission compared to now, so that the light was emitted when the universe was 1 / (z + 1) its current size. For example, light with z = 10 left its galaxy when the universe was 1/11 its present size, or, assuming uniform expansion, when the universe was 1/11 its present age.

It should be noted that Hubble himself was never quite convinced that the redshifts were caused by motion. He was open to alternative explanations, some of which we shall discuss later.

2. Abundances of Elements

Lemaitre's model found very few supporters. However, Big Bang cosmology received boost in 1946 from the Russian-American physicist George Gamow. He calculated that, if the Big Bang were a huge nuclear explosion, it could generate the observed proportions of light elements such as hydrogen, helium, and lithium. Shortly afterward, the British astronomer Fred Hoyle showed that nuclear processes in stars could produce the heavy elements in the observed abundances.

3. The Cosmic Microwave Background Radiation

Gamow had deduced also that the initial fireball should have left behind radiation in the form of radio waves. His calculations predicted that this radiation should by now have cooled to a temperature of about 30

degrees Kelvin (zero degrees Kelvin corresponds to absolute zero, the lowest possible temperature, which is at -273 degrees Centigrade). This radiation was predicted to be *isotropic*, that is, uniformly distributed in all directions.

In 1965 such radiation was indeed discovered, although at only 3 degrees Kelvin. Its near uniformity in all directions ("isotropy") was taken as compelling evidence of the radiation's primeval origin. This is sometimes referred to as the Big Bang's "afterglow" or "smoking gun". Hence it is called the “cosmic microwave background radiation” (CMBR). The discovery of the CMBR convinced most cosmologists of Big Bang cosmology.

Basic Big Bang Cosmology

According to the basic Big Bang model, the universe originated about fourteen million years ago as an explosion of energy. Initially it was compressed inside a space smaller than a pinhead (called a “singularity”). It started off very hot, very dense, and in a sudden state of very rapid expansion.

As it expanded it cooled. Within minutes, the photons of energy produced paired particles of matter and anti-matter. Particles of matter and anti-matter would destroy each other when they collided, transforming them back into energy. However, some isolated bits of matter and anti-matter would survive. These included stable particles such as protons, neutrons, and electrons.

After about 380,000 years, when the temperature had dropped to about 3000 K, sub-atomic particles fused together, forming light elements that were mostly hydrogen (75%), and helium (25%), with small traces of lithium and beryllium. Also, at that time, the CMBR was formed. This radiation has since cooled to the 3-degree Kelvin radiation that we now see.

As time went on, clumps of matter contracted, due to gravity, to form galaxies. Inside the galaxies, smaller clumps contracted to form stars. As the stars contracted gravitational energy was converted into heat. Eventually the temperatures inside the stars became high enough to

generate nuclear reactions, from which carbon, oxygen, and other heavy elements were formed.

Later, as stars evolved, they ejected matter into interstellar space. From this interstellar matter, second-generation stars were formed, having higher amounts of heavier elements than the first batch . Some of these stars had planets. On at least one planet (*i.e*., the Earth) random interactions of molecules produced a primitive form of life. Eventually more complicated plants and animals evolved, culminating in the appearance of man.

Thus far the creation story according to standard cosmology. It is a very comprehensive theory that strives to explain all physical reality in terms of a dynamic evolving universe that can be traced back to the initial singularity. General relativity is applied to a universe that is assumed to be everywhere spatially homogeneous and isotropic, following the cosmological principle.

The Inflation Fix

Although at first successful, by 1980 Big Bang cosmology had run into several perplexing theoretical problems.

First there was the problem of galaxy formation. The uniformity of the background radiation implied that, shortly after the Big Bang, the energy-matter was very smoothly distributed. How could this result in the galaxies, and even much larger structures, that we see today? There must have been some original clumpiness to provide seeds from which galaxies could form.

Next there was the "horizon" problem. The uniformity of the background radiation means that widely separated regions of space are at the same temperature. This implies that these regions were once close enough to exchange energy to even out the temperature. Yet, in Big Bang cosmology, these regions are too far apart for light, or any other information, to have had enough time to travel between them.

How, then, can they share the same properties, such as temperature and energy density?

Another puzzle was the "flatness" problem. At present the universe seems to be “flat”, its density being at the boundary between a closed universe and an open one (see Figure 4.3).

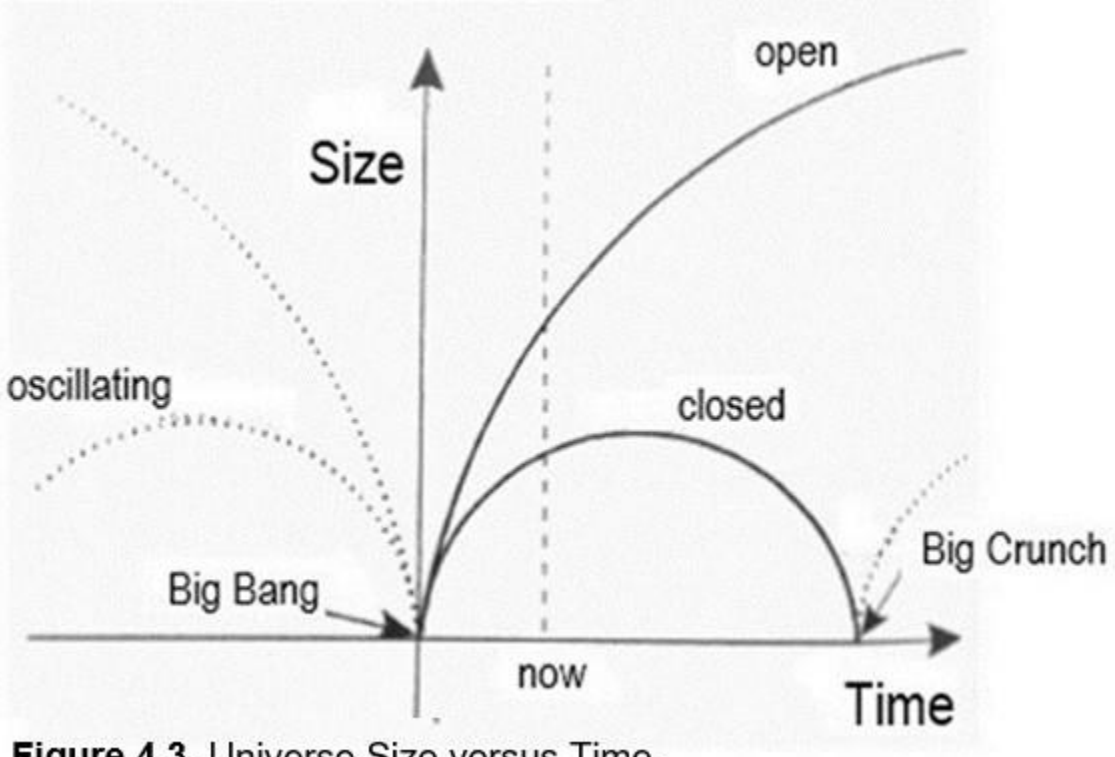


Figure 4.3. Universe Size versus Time.

After the Big Bang, an open universe will expand forever; a closed universe will eventually contract into a Big Crunch, from which it may rebound as an oscillating universe. In either case, an earlier contraction may have preceded the Big Bang.

If the density were just a little more than the critical amount, then the universe would have collapsed again long ago; if it were just a bit less, then it would have dispersed too quickly for stars to form. According to Jayant Narilkar (1989), the density near the singularity could not have differed from the critical amount by more than 1 part in 10^55. How does one explain this extraordinary coincidence?

To solve these problems, the concept of *inflation* was invented in 1979 by the American cosmologist Alan Guth. He postulated that, at very high temperatures, gravity became repulsive rather than attractive.

Sufficiently hot temperatures would prevail for the first 10^-35 seconds[1] after the Big Bang. This would cause a brief period of very rapid expansion (or *inflation*), at speeds much greater than the speed of light.[2] One such region, which started off as a tiny region much smaller than an atom and ended up being the size of a grapefruit an instant later, supposedly became our universe. According to this view, our observable universe is just a tiny bubble in a vastly greater cosmos.

Inflation explained the formation of galaxies. According to quantum physics, any energy field constantly fluctuates in intensity at the subatomic level, like waves on the surface of a lake. Inflation would make these fluctuations large enough to serve as seeds for stars and galaxies.

The very rapid expansion due to inflation also seemed to solve the "horizon" problem. According to inflation, the region from which the observable universe appeared was so small that energy exchanges would have already made it homogeneous.

Further, inflation also solved the "flatness" problem. Like blowing up a beachball to a thousand times its size would make its surface appear flatter to a nearby observer, so inflation would flatten out our region of the universe, yielding a density very close to the critical value.

Inflation thus made Big Bang cosmology more plausible, and soon became an integral part of Big Bang cosmology. Yet, some cosmologists had lingering doubts about its viability. Inflation involved several speculative assumptions about repulsive gravity, huge expansion speeds, unobserved, hypothetical particles called *inflatons*,

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[1] Recall that 10^x stands for 1 followed by x zeros, and that 10^-x is shorthand for 1 shifted x places to the right of the decimal point. Thus 10^-35 = .00000000000000000000000000000001 (*i.e*., 1 shifted 35 places to the right of the decimal point).

[2] Recall that special and general relativity do not forbid such high speeds; they just stipulates that any two objects passing each other must have a relative speed less than the speed of light.

and the like. It was a purely *ad hoc* secondary theory devised solely to save Big Bang cosmology.

The Dark Matter Fix

The early density fluctuations arising through inflation, and from which future galaxies were to form, should have left an imprint on the CMB radiation.

Much excitement was therefore generated on April 23, 1992, when, after a lengthy search, American astronomers announced that they had detected small variations in the CMBR. These were interpreted as relics of lumpy structures that existed shortly after the birth of the universe. This discovery was hailed as a decisive confirmation of the Big Bang theory of the origin of the universe, the discovery of the century.

Yet, despite such euphoria, difficulties remained. For one, the observed ripples were much smaller than originally predicted (Rees 1992). For such tiny seeds to grow into galaxies would require much more time than Big Bang cosmology allowed.

To speed up galaxy formation, it was postulated that there must be vast amounts of invisible “dark” matter, which had left no CMBR imprint. If, in the early universe, such dark matter was highly clumped, it could supply centers of strong gravitational attraction without disturbing the uniformity of the CMBR. It was thought that every galaxy is centered on a huge blob of dark matter many times more massive than the observable part of the galaxy.

There was further evidence for such invisible mass. For example, the high orbital motion of stars around galaxies suggested the existence of unseen dark matter greatly outweighing the visible matter (Coles:1998). Moreover, inflation predicted that the universe’s density should be near the critical value needed to “close” the universe, while the total observable mass in the universe is only about one percent of the critical mass.

So, it was postulated that most of the matter in the universe was invisible dark matter.

At first it was thought the missing dark matter might consist of ordinary matter in the form of dust, black holes, and dim celestial objects (*e.g.*, comets, planets, stars, and galaxies). However, Big Bang element-formation calculations showed that ordinary matter, consisting of baryons (mainly neutrons and protons) cannot exceed ten percent of the critical density. More baryons would have resulted in the formation of more helium than is seen (Horgan 1990).

Thus, the dark matter must be non-baryonic. A leading non-baryonic contender was the fast-moving ("hot") neutrino. Although such particles are known to exist, they interact very weakly with normal matter, making them very difficult to detect. However, neutrino-dominated models have their own problems. The main one is that the fast-moving neutrinos would have taken too long to settle down into galaxies.

Hence, theorists have concentrated on slowly moving ("cold"), dark ("hard to observe"), types of strange, non-baryonic matter. The standard Big Bang model thus came to be called the CDM (Cold Dark Matter) model.

The Dark Energy Fix

As the universe expands, the pull of gravity should function as a brake, slowing down the expansion. Therefore, since the light we now receive from distant galaxies corresponds to an earlier epoch, it should show a higher rate of expansion. In 1998 astronomers were shocked to discover that, on the contrary, that the universe seemed to be accelerating (Coles 1998).

This led to the re-introduction of a "cosmological constant" (also called "Lambda"), which corresponds to a repulsive force that counteracts gravity. This repulsive force, called “dark energy,” acts like matter, but matter with very strange properties. On the one hand, it corresponds to a uniform energy density that bends space in the same way matter does. Yet it also has a negative pressure which, unlike gravity, tends to expand the universe and to cause the cosmic acceleration. This

energy density is caused not by matter or radiation but by a mysterious hypothetical property of "empty" space.

Since dark energy acts like matter, it causes an increase in the density of the universe. Many cosmologists prefer a model where the total density is precisely the critical value. This makes space flat, thus satisfying the prediction of inflation.

The current standard cosmological model is known as the Lambda-Cold-Dark-Matter model (LCDM). The LCDM model has been accepted by most cosmologists since 1998.

It assumes that the universe is homogeneous and isotropic (the Cosmological Principle), and that general relativity applies, so that the Robertson-Walker equations hold. It assumes further that inflation has occurred and that both dark matter and dark energy exist.

Further, the standard model assumes that the CMBR is global and was produced when light first separated from matter. Tiny temperature fluctuations in the CMBR are assumed to reflect initial density fluctuations that have since developed into galaxies. Close examination of the CMBR temperature fluctuations at different levels of detail (*scales*) enables one to make precise very estimates of various cosmological parameters.

The latest estimates from data collected by the Planck satellite (2009-13) yielded the following results. To a high precision of less than 1 percent, the Big Bang occurred 13.80 billion years ago; the CMBR originated 380,000 years afterwards. The universe is flat (omega = 1.00, consisting of 4.8% baryonic matter (stars, galaxies, gas), 26.8% dark matter and 68.5 % dark energy (Turner 2018). The Hubble constant is calculated to be 67.3 km/sec/megaparsec, where a *megaparsec*, a common unit of length in astronomy, is about 3 million light-years.

Problems with the Standard Model

How well founded is the Big Bang model? Despite its current popularity, and the precision with which its parameters are given, the LCDM standard model suffers from several observational and theoretical shortcomings, raising the question of its actual validity.

1. Hubble Trouble

How fast is the universe expanding? According to the CMBR data, analyzed assuming the standard model, the expansion rate H (called Hubble's constant) is 67.3 (+/- 0.7) km/sec/megaparsec.

However, when measured directly, from galaxies with known distances and redshifts, H is found to be about 75 km/sec/megaparsec (Schombert 2020). This corresponds to a lower supposed age of the universe of about 12.6 billion years rather than the 13.8 billion years of the standard model.

Both methods should yield the same value of H. So, why the big difference? Something must be seriously wrong with the distance calculations, the velocity interpretation of the redshifts, or with the standard model itself.

2. Abundances of Elements

How well can the standard model account for the observed abundances of the various elements in the universe? The material in the universe is found to be mostly hydrogen-1 (75%) and helium-4 (about 25%), with small traces of the heavier elements.

Big Bang nucleosynthesis produces mostly light elements such as hydrogen-1, hydrogen-2 (deuterium), helium-3, lithium-7, lithium-6,

and beryllium.[3] Nuclear reactions in stars can produce heavier elements, as well as some of the lighter elements.

However, the precise predictions of Big Bang nucleosynthesis depend strongly on the density of baryons, and the ratio of photons to baryons. Neither of these are known accurately. Hence, in practice, these are free parameters (or "fudge factors") which are adjusted to match the theoretical predictions with the observed abundances for one or two elements.

The initial abundances, set shortly after the Big Bang, are estimated observationally by measuring the elemental abundances in very old stars. One difficulty is to subtract the effects of stellar elemental production from the observed densities, so that the initial abundances can be determined. Ideally, one would like to measure the abundances of low-density gas at a very early phase (*i.e.*, with a high redshift) before it would become contaminated with debris from exploding stars.

Lithium abundances are a major problem. The standard model predicts an abundance of Lithium-7, the main lithium isotope, three or four times greater than that seen in old stars. Also, such stars have more Lithium-6 than can be accounted for. In a recent paper exploring a possible solution the researchers conclude,

> *The scientific community has a challenge that will require additional efforts to resolve, and this will involve the fields of nuclear astrophysics, astronomic observations, non-standard cosmology, and even new physics beyond the Standard Model of particle physics (Damone 2018).*

A further difficulty concerns the elemental abundances of many high redshift objects that should reflect primordial conditions. For example, a measure of the beryllium abundance in a metal-poor star, which

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[3] Element-n refers to the form (*isotope*) of the element having n nucleons, where a nucleon is a proton or neutron. Thus helium-4 is the isotope of helium having 4 nucleons (2 protons and 2 neutrons).

should reflect the abundances of primordial matter, yielded a beryllium abundance about a thousand times greater than that predicted by Big Bang cosmology (Gilmore 1991). Also, low density regions at redshift z = 3 have been found to have much higher concentrations of heavy elements than expected via Big Bang cosmology (Shull 1999).

A "quasar" (short for "quasi-stellar object") is a star-like object emitting enormous amounts of energy at radio frequencies. Very remote quasars, thought to correspond to a time when the universe was less than a billion years old, have been found to have more iron than the Sun. Most iron is believed to come from supernovas in which one star in a binary pair explodes. However, the binaries need at least a billion years to evolve to this stage (Hecht 1994). How, then, could quasars have gotten so much iron within a billion years of the Big Bang?

Big Bang models have difficulty accounting for the depletion of lithium and beryllium, extra sources of iron, the missing mass content of the universe, and so on, without resorting to special, artificially contrived scenarios.

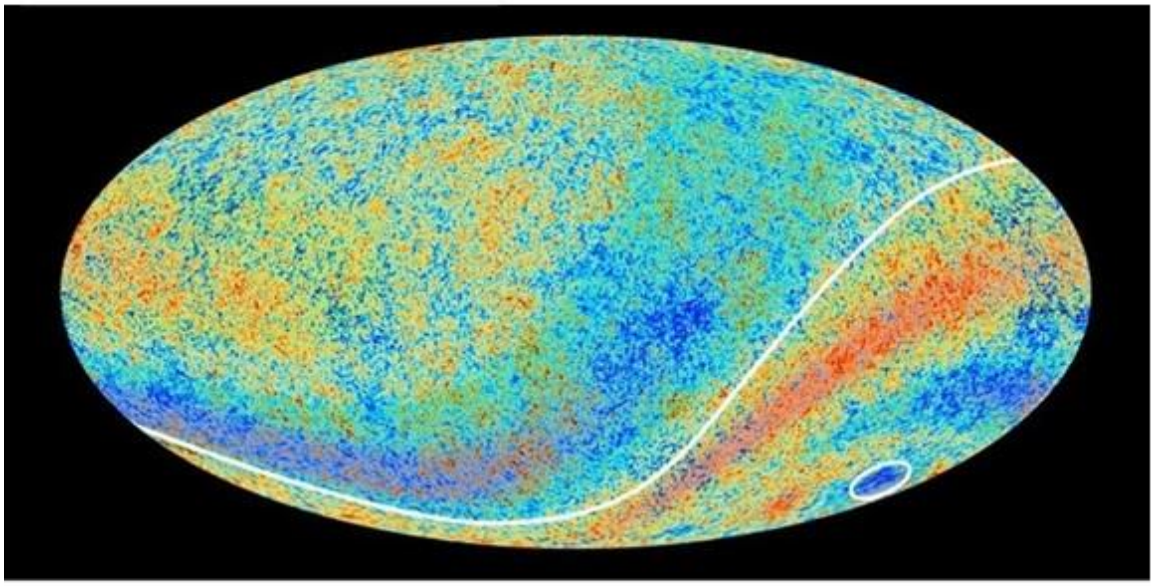
3. Cosmic Microwave Background Problems

Figure 4.4 shows a map of the CMBR, from the Planck satellite data (2013). The colors on the map represent different temperatures; red for warmer, blue for cooler. The temperature differences are only about 1/100 millionth (10^-8) of a degree. This map is thought to give us the earliest possible snapshot of the universe, when light first separated from matter, about 380,000 years after the Big Bang.

The analysis of the Planck CMBR data shows many features consistent with the predictions of standard cosmology. But there are also some puzzling anomalies. First, there is the so-called “axis of evil”: the CMBR has features that seem to be aligned with the plane of the orbit of the earth about the Sun, shown in the figure by the white line. The CMBR temperature is slightly colder (blue) north of this line, slightly warmer (red) south of it. One possibility explanation of this is that local solar system effects strongly influence the CMBR data.

Astronomer Lawrence Krauss comments,

But when you look at CMB map, you also see that the structure that is observed is in fact, in a weird way, correlated with the plane of the earth around the sun. Is this Copernicus coming back to haunt us? That's crazy. We're looking out at the whole universe. There's no way there should be a correlation of structure with our motion of the earth around the sun – the plane of the earth around the sun – the ecliptic. That would say we are truly the center of the universe (Krauss 2006).



Credit: European Space Agency Planck Collaboration

Figure 4.4. The Cosmic Microwave Background Radiation Map.

A second anomaly is a large Cold Spot (inside the white circle), which is much larger than expected by chance. It seems to be related to the huge super-void in the constellation Eridanus, nearly a half a billion light-years across, which is largely devoid of galaxies, stars, gas, and other normal matter. Cosmologist Laura Mersini-Houghton speculates that the CMB Cold Spot could be evidence of another universe interacting with our universe (Powell 2014).

4. Homogeneity Problems

Whatever the explanation, the existence of the large Cold Spot void shows that the universe is not smoothly homogeneous at large scales, as assumed, but clumpy.

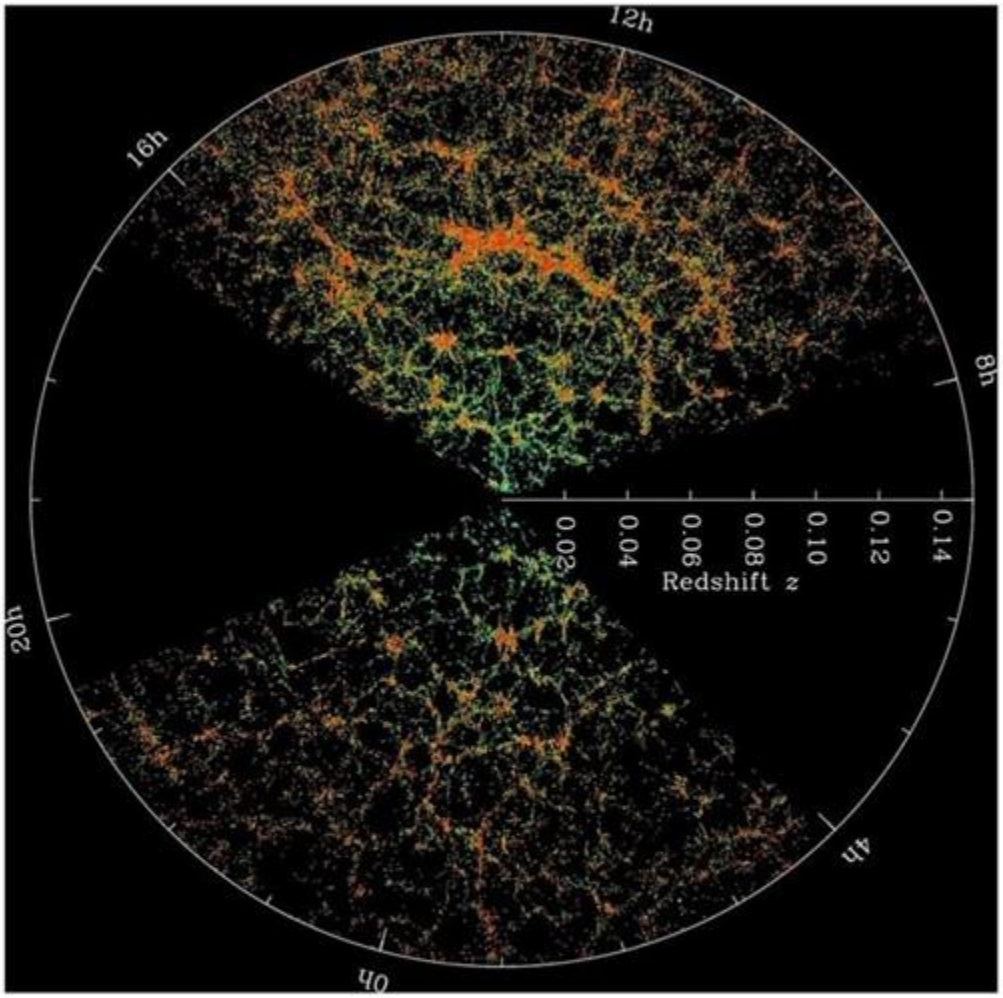
The assumption of homogeneity is further eroded by the discovery that galaxies are grouped in huge wall-like structures and voids, some of them more than a billion light-years across. Figure 4.5 shows the result of the Sloan Digital Sky Survey, which mapped more than 600,000 galaxies by 2005. The largest structure found so far (in June 2021) is called the Giant Arc. It consists of galaxies, galactic clusters, and lots of gas and dust. It spans 3.3 billion light-years, stretching across a 15th of the observable universe (Lopez 2021).

Further, there is a puzzle about the motion of the Sun with respect to the universe. As measured by the Planck satellite, the Sun is moving with respect to the CMBR at 370 km/sec towards the constellation of Crater (at galactic longitude 264 degrees and latitude 48 degrees). However, examining the motions of our Local Group of galaxies, this entails that the local group is moving at 620 km/sec with respect to the CMBR. We would expect that, at large distances, the average motion of galaxies would coincide with the CMBR. Yet, this bulk flow persists beyond a billion light-years, requiring an even bigger inhomogeneity to drive it.

This has led some astronomers to question whether the CMBR really does supply a cosmic rest frame. Cosmologist Subir Sarkar (2022) finds that the cosmic rest frame of matter traced by the CMBR differs also from that based on quasars. He concludes that this calls into question the standard model's assumption of homogeneity and the Cosmological principle.

5. Inflation Problems

Although inflation has long been a central part of the standard model, it soon became clear that inflation had several shortcomings (Earman & Mosterin 1999). For example, inflation predicted the matter-energy density of the universe to be precisely at the critical level, while observations showed a much smaller value.



A Slice of the universe. Each dot is a galaxy. Note the large-scale structure. The Earth is at the center and the outer circle at a distance of 2 billion light years.

Credit: M. Blanton and Sloan Digital Sky Survey, www.sdss.org

Figure 4.5. Map of Galaxies in the Universe.

Further, many different inflationary scenarios could be devised, contrived to fit changing observational data. In fact, there were so many adjustable parameters that inflation could explain almost any given set of observations. Worse, inflation goes on eternally, producing infinitely many outcomes, so that the theory makes no firm observational predictions.

Even Paul Steinhardt (2011), one of the original creators of the theory of cosmic inflation, came to have serious doubts about its viability. He found that the right kind of inflation required initial conditions that were even more improbable than those needed to generate a flat, uniform universe, which inflation was supposed to explain.

6. What is Dark Matter?

Then there is the problem of dark matter. No stable cold dark matter particles have ever been detected. Therefore, a host of esoteric hypothetical particles have been invented. These include such exotic concoctions as gravitons, photinos, axions, and WIMPS (for Weakly Interacting Massive Particles). Whether any of these actually exist, and in the needed proportions, remains to be seen. So far, none of these have turned up in any experiments, not even those involving the largest particle accelerators.

Cosmologist Joseph Silk notes that cosmology is now at an impasse, and that scientists are not hopeful of a breakthrough in the near future soon. He opines,

> *If dark matter particles are still not detected within the next decade, we should be prepared for a serious re-evaluation of our options (Silk 2018:1305).*

Also, there have been observations contradicting the dark matter galaxy formation model. A larger galaxy is thought to be constructed by combining many smaller “dwarf” galaxies. Yet, while 500 dwarf galaxies have been predicted to exist in the halo of our own Galaxy, only 11 have been observed (Klypin 1999). Moreover, while it is assumed that every dwarf galaxy forms about a much larger mass of “dark matter”, a team of astronomers (Guo 2020) recently found 19 dwarf galaxies that seemed to have no dark matter at all.

7. Acceleration – Dark Energy

Unfortunately, the existence of a Lambda of the required size is not explicable in terms of current particle physics. Calculations in particle physics of the vacuum energy produced as the universe cools predict a Lambda about 10^120 times greater than that required by the

standard model (Coles 1998). According to Noble laureate Steven Weinberg (1992:225):

> *This must be the worst failure of an order-of-magnitude estimate in the history of science.*

Many cosmologists worry about this huge discrepancy. A recent reviewer comments,

> *This problem is widely regarded as one of the major obstacles to further progress in fundamental physics [...] Its importance has been emphasized by various authors from different aspects. For example, it has been described as a "veritable crisis" [...] and even "the mother of all physics problems" [...] While it might be possible that people working on a particular problem tend to emphasize or even exaggerate its importance, those authors all agree that this is a problem that needs to be solved, although there is little agreement on what is the right direction to find the solution (Wang 2017).*

8. Where Is All the Anti-matter?

The everyday things around us are all made of matter. Matter consists of smaller particles, such as protons, electrons, and neutrinos. It has been discovered, in high-energy experiments, that each particle has a corresponding "anti-particle". When particles are produced from energy, they always come in particle-antiparticle pairs. When a particle meets its corresponding anti-particle, they destroy each, resulting in a flash of energy.

During the first fraction of a second after the alleged Big Bang, the universe consisted of high energy radiation that produced many particle-antiparticle pairs popping in and out of existence. This should have resulted in equal amounts of matter and anti-matter. Yet, today, our observable universe seems to have mostly matter. What happened to the anti-matter? This is one of the biggest problems in cosmology.

Several theories have been proposed to explain this, but none has gained wide acceptance. The authors of a recent review remarks, *"The*

origin of matter remains one of the great mysteries in physics." (Canetti & Shaposhnikov 2012).

9. The First Stars and Galaxies Look Old

Where are the first stars?

The first stars (known as Population 3 stars) were thought to have formed from the primordial material that appeared from the Big Bang, consisting of hydrogen, helium, and lithium. Deep inside the core of a star, nuclear reactions will generate heavier elements, such as oxygen, carbon, and iron. The atmosphere of a star should, however, have only the initial material. Thus, Population 3 stars should have no heavy elements in their atmosphere. Since all stars so far examined have heavy metals in their atmospheres, no Population 3 stars have ever been seen.

Recently, a European team of astronomers found no evidence of Population 3 stars as far back as when the Universe was supposedly just 500 million years old. All the stars at that time already had heavier elements in their atmospheres, making them at least second-generation stars. This leaves very little time for the first stars to be generated, destroyed, and regenerated into a second generation of stars. The authors comment,

> *These results have profound astrophysical consequences as they show that galaxies must have formed much earlier than we thought.(EVA/Hubble Information Centre 2020)*

Current theories of galaxy formation are further challenged by the observation of a massive rotating disk galaxy only 1.5 billion years after the Big Bang, much earlier than predicted (Neeleman 2020). Even more puzzling is the recent discovery by the new Webb telescope of six very massive and mature-looking galaxies from only 600 million years after the Big Bang (Labbe 2023), some even older galaxies appear only 300 million years after the Big Bang. Stars and galaxies seem to form much faster after the Big Bang than can plausibly be explained in terms of the standard cosmology.

Assessing Big Bang Cosmology

Astrophysicist Michael J. Disney criticizes the Big Bang model for having more free parameters (fudge factors) than certain observations, so that it is always possible to fit new observations by tweaking the parameters. He found this "negative significance" to be alarming. Disney writes,

> *In its original form, an expanding Einstein model had an attractive, economic elegance. Alas, it has since run into serious difficulties, which have been cured only by sticking on some ugly bandages: inflation to cover horizon and flatness problems; overwhelming amounts of dark matter to provide internal structure; and dark energy, whatever that might be, to explain the seemingly recent acceleration. A skeptic is entitled to feel that a negative significance, after so much time, effort, and trimming, is nothing more than one would expect of a folktale constantly re-edited to fit inconvenient new observations (Disney 2007:383).*

Is the Big Bang in crisis? That is the title of a 2020 review by cosmologist Dan Hooper. He writes,

> *But lately, it seems the more we study the universe, the less we understand it. Despite decades of effort, the nature of dark matter remains unknown, and the problem of dark energy seems nearly intractable. We do not know how the particles that make up the atoms in our universe managed to survive the first moments of the Big Bang, and we still know little about cosmic inflation, how it played out, or how it came to an end — assuming that something like inflation happened at all.*
>
> *It is from this perspective that I sometimes find myself considering whether these mysteries might represent something greater than a few open and unrelated questions. Perhaps they are telling us that the earliest moments of our universe were far different from what we long imagined them to be. Perhaps these problems represent the beginning of a revolution for the science of cosmology (Hooper 2020)*

The Problem of Verification

We saw earlier that some of the most basic assumptions in cosmology are unverifiable. Verification is a problem also for more specific aspects of cosmological models.

Robert Oldershaw (1988) distinguishes between two types of untestability:

1. *Untestability of the First Kind*: a theory that is untestable because it cannot generate definitive testable predictions or whose predictions are impossible to test is *inherently* untestable.

2. *Untestability of the Second Kind*: a theory that has many adjustable parameters or is on general modifiable in an *ad hoc* manner is *effectively* untestable.

Many of the basic features of the standard model are inherently untestable. The most critical events supposedly occurred within 10^-25 seconds after the Big Bang. Yet, in principle we can't obtain direct information on the state of the universe prior to the decoupling of radiation and matter, about 380,000 years after the Big Bang, when the CMBR was formed.

The latest inflationary Big Bang models are heavily dependent upon particle physics, which in turn involves more unverifiable theoretical entities. Many theories of the new physics require extra dimensions: 5 to 26 dimensions is typical, and about 950 dimensions is the latest record. Yet there is no known way to test empirically for the existence of these extra dimensions.

A further difficulty is that conditions in the early universe (tremendously high temperatures and pressures) are such that they cannot be reproduced elsewhere. Hence the particle physics being used cannot be tested independently.

Astronomer Burbidge comments,

> *But since there is no way of testing the inflation hypothesis by direct observation, it has always seemed to me that it also is an idea with only a metaphysical basis (Burbidge 1988).*

There are also many cases involving untestability of the second kind. Particle physics has been applied to overcome various observational shortcomings of Big Bang cosmology. However, most of the proposed scenarios are decidedly *ad hoc*.

The standard model of particle physics has more than 20 parameters (such as particle masses and coupling strengths of the forces) that cannot be uniquely derived and are thus freely adjustable. There are currently at least half a dozen superstring theories. Many of the problems in particle physics are "solved" by inventing new concepts, such as the "Higgs mechanism", renormalization, and "color" (see Oldershaw 1988).

The cosmologist P.J.E. Peebles (1987) wryly remarked:

> *The big news so far is that particle physicists seem to be able to provide initial conditions for cosmology that meet what astronomers generally think they want without undue forcing of the particle physicist's theory. Indeed, I sometimes have the feeling of taking part in a vaudeville skit: "you want a tuck in the waist? We'll take a tuck. You want a massive weakly interacting particle? We have a full rack...This is a lot of activity to be fed by the thin gruel of theory and negative observational results, with no prediction and experimental verification of the sort that, according to the usual rules of physics, would lead us to think that we are on the right track...*

More than three decades later, Peebles' assessment still holds.

Also in cosmology proper, *ad hoc* proposals abound. For example, at least three elaborate theories have been constructed to explain the observed large-scale structure in the universe: superconducting cosmic strings, biased galaxy formation in a WIMP-dominated universe, and "double" inflation. Similarly, many ingenious proposals purport to account for the vast amounts of alleged "missing mass" in the universe.

Alternative Cosmologies

Given the shortcomings of the standard LCDM cosmology, is it possible to develop other, perhaps more viable cosmologies? Many alternative cosmologies have been proposed, as discussed by Lopez-Corredoira & Marmot (2022). Let's briefly examine several alternatives.

Big Bang Variations

Many of the alternative models involve just minor modifications of the standard models concerning the types of dark matter, dark energy, or inflation. More major variations keep the major features of the standard model but with significant changes.

1. Inhomogeneous Models

The standard model assumes the Cosmological Principle, which entails homogeneity. Yet, as we saw, there are large astronomical structures showing that the actual universe is not homogeneous. Why, then, not drop the homogeneity assumption?

One could construct a Big Bang model that is spherically symmetric about a point near the earth, so that the universe appears isotropic to us, but is inhomogeneous in the radial direction. These are the Lemaître –Tolman – Bondi (LTB) models discussed before. They are more complex but can fit the observations at least as well as the standard model.

Indeed, if we are near the center of a relatively low-density volume, then this can account for the apparent acceleration of distant supernovae without resorting to mysterious dark energy (Sarkar 2022). Dark energy is implied by the observations only if the Cosmological Principle is true. Philosopher Jeremy Butterfield (2014) notes,

> *"But now the cat is out of the bag! The point here is that the LCDM model being the best fit of the standard model does not imply, of course, that it is the unique best fit model. And there is considerable evidence that the observations we have made so far can be equally well fitted by Lemaitre–Tolman–Bondi [LTB] spherically symmetric inhomogeneous models—without, one*

might add, the all-too-conjectural dark energy of the ΛCDM model."

2. Changing Physical Constants

Several astronomers, including Barrow (1999), Albrecht (1999), and Köhn (2017), have postulated that the speed of light was much greater in the distant past. They show that this, too, can explain the apparent acceleration of supernovae without having to resort to dark energy. Moreover, this can also solve the horizon and flatness problems without appealing to inflation (Sanejouand 2009). A cosmological model has also been proposed where the speed of light, gravitational constant, and cosmological constant all vary with time. The fit to observations is claimed to be better than for the standard model (Gupta 2020).

3. Modifying Gravity

Several models replace general relativity with an alternative gravity law. Most popular is the Modified Newtonian Dynamics (MOND), which changes the Newtonian law for small accelerations (see Merritt 2020). It aims to account for galactic rotation curves, and cosmology in general, without resorting to dark matter.

4. Cyclical Models

Various cyclical models have been proposed where the universe has cycles through a series of expansion and contraction phases. One such cyclic cosmology has been proposed by Paul Steinhardt (2008), an early proponent of inflation who later rejected it. In his model the smoothing of the universe occurs during the contraction phase, doing away with the need for inflation. Another proposal, called "the Dynamic Universe" (Suntola 2020), has one or more cycles from past infinity to future infinity. It aims to avoid the need for both inflation and dark energy.

Steady-state Cosmologies

Steady-state cosmology was developed by Fred Hoyle, Herman Bondi, and Thomas Gold in 1948. It was based on the *perfect cosmological principle*, which assumed the universe was the same everywhere and always. As the universe expanded, matter was continually created, so that the density of the universe stayed constant.

Although steady-state cosmology had enjoyed some popularity for a few decades, particularly among British cosmologists, the 1965 discovery of the background radiation caused most cosmologists to favor the Big Bang theory. Whereas this radiation arises naturally in the Big Bang model, steady-state models had a harder time explaining its detailed structure, though several possible explanations were proposed.

In later versions, now renamed “quasi-steady state cosmology”, the perfect cosmological principle was dropped. The universe was now to undergo an infinite series of oscillations between minimum and maximum sizes, but with no singularities (Burbidge, Hoyle, & Narlikar 1999).

Since it avoided the Big Bang singularity, it needed to explain the observed abundances of elements, as well as the cosmic background radiation (CMBR). George Burbidge and Fred Hoyle (1998) showed that the observed abundance of helium and the other light elements could all be generated from hydrogen in stars, via nuclear processes in stellar cores. Also, they found that if all the helium observed in the universe were made in stars, the starlight so generated would have the same energy density as the background radiation.

Indian astrophysicist Jayant Narlikar (1989) had noted earlier that several astrophysical processes could produce energy densities of the right size: the galactic magnetic field, cosmic rays, and starlight. Moreover, it was suggested by Narlikar (2007) and others that long slender grains of graphite, or microscopic bacteria, in interstellar space could alter this light so that its spectrum would be like that of the observed background radiation.

Plasma Cosmology

Plasma cosmology assumes that electromagnetic forces play a huge role in controlling the mass of the universe. A plasma is a gas consisting of charged particles: ions (*i.e.,* atoms that have lost an electron) and free electrons. Electromagnetic forces work on the cosmic plasma to create filaments, from which stars and galaxies are formed. It assumes the universe has always existed, always evolves, and always continues to exist.

It has been promoted by Nobel prize physicist Hannes Alfven. Eric Lerner (1988) constructed several scenarios wherein the observed abundances are formed through nucleosynthesis in cycles of stellar formation and explosion. Although deuterium and lithium are not produced by normal stars, they could be created through interactions of matter with cosmic rays. Lerner explains the CMBR in terms of absorption and re-emission of stellar radiation thermalized (*i.e.*, made like a blackbody) by interacting with electrons in space (Lerner 1994). These explanations of the elements and CMBR are like those given by proponents of stead-state cosmology.

Initially, plasma cosmology explained the Hubble expansion in terms of the repulsion between matter and anti-matter. More recently, however, Lerner (2006) contends that the universe is static. He explains the redshifts in terms of a tired light effect caused by the interaction of photons with electrons in the plasma.

Static Models

Galactic redshifts, we saw, are assumed to be caused by motion. Yet, no galaxy has ever actually been directly observed to move further away from us. Might the redshift have some other, non-motion cause, so that the universe is static?

Many alternative explanations of the redshifts have been proposed. Often, the energy loss of light is postulated to be caused either by movement through a resisting medium, referred to as "tired light", or by climbing out of a strong gravitational field, referred to as a

"gravitational redshift". Numerous static-universe cosmologies, based on such non-velocity views of the redshift, have been devised.

1. Tired Light

The motion interpretation of the redshifts was questioned almost from the start. Already in 1929, the astronomer Fritz Zwicky proposed that the redshift was caused by energy loss of light during its journey through space. One advantage of tired-light theories is that they naturally predict a redshift proportional to the distance travelled, following Hubble's law. Hubble himself, throughout his life, strongly favored the tired-light theory over the expansion view, but he could offer no plausible physical mechanism generating such an effect.

The trick is for light photons to lose energy without significant scattering, otherwise the galactic images should be fuzzier than they are.

In tired-light theories for the redshift it is generally postulated that the energy lost by the light is re-radiated at low-temperature energy, thereby accounting also for the microwave background radiation.

Many tired-light theories have been published. Redshifts have been proposed to be caused by, for example, the interaction of light with the intergalactic plasma (Kierein 1988), inelastic collisions of photons with molecules (Marmet & Reber 1989) , photon energy loss to the gravitational field (Fischer 1993), or due to interaction with a medium of gravitons moving much faster than light (Van Flandern 1993).

More recently, David Crawford (2006) developed a theory where the redshift is caused by the interaction of photons with curved spacetime. This effect results in a static universe that is statistically the same at all places and times. It is beginningless and endless. Crawford (2011) contends that his model, which has no need for dark matter or dark energy, offers a better fit with observations than does standard cosmology.

A static model by Dean Mamas (2010) views the photon as an electromagnetic wave whose field part causes oscillations in free electrons in deep space, which then re-radiate energy from the photon, causing a redshift. This allegedly avoids blurring the image.

2. Gravitational Redshift

G.F.R. Ellis (1978) has shown that the redshifted galaxies and the microwave background radiation can be explained by a static, spherically symmetric universe with two centers, with our Milky Way Galaxy being near one of the centers. The systematic redshifts of the galaxies are then interpreted as cosmological gravitational redshifts, while the background radiation originates from a hot gas surrounding a singularity situated at the second center of the universe. Ellis asserts that, while he does not claim the universe to be like this model, there exist no overwhelming arguments to show that such a model could not reproduce all the current observations.

A somewhat similar static model, but having only one center, has been developed by Rao & Annapurna (1991). Another model, using both gravitational and Doppler redshifts, has been proposed by Robert Gentry (1997). To explain the background radiation, Gentry appeals to a shell of hot hydrogen gas enclosing the galaxies of the visible universe,

3. Changing Constants

Another static universe model has been constructed by the Russian V.S. Troitskii (1987) who interprets the redshift as being due to a decrease in the speed of light. Such a mechanism would also produce the observed background radiation.

In 1931, Sir James Jeans advanced a model in which the size of atoms decreases in time. In a static universe, this would cause the universe to appear to expand, while in fact everything in it, including us, is shrinking. This idea was later re-introduced by Fred Hoyle (1975b:661), who claims that this model is indistinguishable from that of the expanding universe. The shrinkage occurs if the masses of all the elementary particles increase, while the electric charge stays constant. As atoms become less tightly bound about their nucleus, emitted radiation is redshifted. Halton Arp (1998), in a similar vein, proposes that the mass of elementary particles increases with age, speeding up the rate of atomic time, and resulting in a decreasing redshift with age.

Summary

Alternative models aimed to overcome perceived deficiencies in the standard model, such as, for example, the *ad hoc* nature of inflation, dark matter, and dark energy. Yet, although many alternatives have been proposed, they all suffer from shortcomings of their own.

Jean-Marc Bonnet-Bidaud, after examining various alternate proposals for producing the CMBR, concludes,

> *…most of these works are currently too underdeveloped, particularly with regard to the details of small inhomogeneities of the background radiation. But they illustrate the fact that there are multiple paths that can be followed to interpret this mysterious 3K radiation.(Bonnet-Bidaud 2017)*

Likewise, most of the alternative explanations for the redshift are rather speculative and still have serious problems to overcome.

Nevertheless, they illustrate that the redshifts and the CMBR can be interpreted within a variety of theoretical models, and thus do not supply unambiguous evidence for Big Bang cosmology.

Thus far there exists no cosmological model that satisfactorily explains all the astronomical observations without special pleading and dubious *ad hoc* devices.

Cosmology and Sociology

In an interesting paper entitled “Non-standard models and the sociology of cosmology” astronomer Martin Lopez-Corredoira, after reviewing various alternative cosmologies, remarks,

> *The development of modern cosmology is somewhat similar to the development of the Ptolemaic epicyclic theory. However, in this race to build more and more epicycles the Big Bang model is allowed to make ad hoc corrections and add more and more free parameters to the theory to solve the problems which it finds in its way, but the alternative models are rejected when gaps or inconsistencies arise, and most cosmologists do not*

> *heed their ad hoc corrections. Why are the different theories accepted/rejected with different criteria? (2014:14)*

He believes that alternative models are not developed to their full potential, and rejected unfairly, because almost all cosmologists are devoted to refining the standard cosmology.

Current research methods discourage the exploration of new ideas. Whereas new ideas and revolutions usually came from younger scientists, younger astronomers are now expected to support the standard model. There is pressure to conform in choosing a safe Ph. D. topic, obtaining a secure academic position, tenure, research funding, and usage of major telescopes. This is particularly so when ever more research is done in large research groups.

There is also a feedback effect, in that the more successful standard cosmology is, the more scientific work and funds are devoted to it, and thus the more it can explain, with more *ad hoc* parameters added as needed.

Summary

Several important conclusions can be drawn from our survey of modern cosmology.

1. Deficiencies in Big Bang Cosmology

First, Big Bang cosmology, even though it is currently by far the most popular cosmology and even though it is often presented as undoubtedly true, is beset with several serious observational and theoretical difficulties.

On the observational side, we recall such observational puzzles as the discrepancies in the value of Hubble’s constant, difficulties in accounting for the observed elemental abundances, the existence of huge structures of galaxies and other inhomogeneities, the large drift of galaxies with respect to the background radiation, the apparent acceleration of galaxies, and the existence of mature galaxies shortly after the alleged Big Bang.

On the theoretical side, we recall the problem of the hypothetical inflation mechanism, the alleged existence of huge amounts of strange, invisible dark matter, the problem of the cosmological constant, Lambda, the problem of the formation of galaxies and huge structures of galaxies, and so on. Many proposed theoretical explanations are inherently unverifiable.

It is not clear how these problems can all be satisfactorily resolved. Moreover, we have not yet addressed further fundamental problems associated with the alleged Big Bang singularity, a subject to be discussed in the next chapter. In short, both empirically and theoretically, Big Bang cosmology lacks cohesion and plausibility.

Of course, this does not mean that Big Bang cosmology can't be saved. In principle, it is always possible to salvage a favored cosmological model. One can always devise suitable *ad hoc* modifications to the theoretical model to make it conform to the observational data.

Thus, for example, Big Bang cosmology was saved from falsification by inventing inflation, which involved very contrived scenarios based on a very hypothetical Higgs field. Predictions of inflation for an Omega of 1 were saved by inventing huge amounts of missing mass. When it was shown that this missing mass can't be ordinary matter, a whole host of esoteric particles were invented, none of which have yet been observed, and so on.

One is reminded of Ptolemy's epicycles, and later tries in medieval cosmology to better explain the observations by postulating epicycles upon epicycles. Given the number of free parameters in particle physics and the fertile imagination of cosmologists, the future may well yield a Big Bang cosmological model that will surmount all the current difficulties. In practice, moreover, a favored cosmological model is not readily discarded, even if currently falsified by data, until a more acceptable alternative is found.

2. The Possibility of Alternative Cosmologies

This brings us to our second conclusion, the possibility of alternative cosmologies. As we saw, all the observational features have multiple theoretical interpretations. This has led to a host of alternative

cosmologies. In the later chapter we shall examine a few creationist cosmologies.

We highlighted the shortcomings of Big Bang cosmology only because it is currently the majority choice. All alternative cosmologies currently have serious problems of their own to overcome. For example, most of the alternative interpretations of the redshifts are highly speculative. And most alternative explanations for the observed abundances and background radiation seem to involve at least as much fudging and special pleading as does Big Bang cosmology.

Yet these cosmologies can't simply be rejected as false. Here, too, one cannot rule out future improvements. Indeed, one suspects that, were alternative cosmologies to be the recipients of as much ingenuity and research funding as has gone into Big Bang cosmology, they could likewise be suitably changed to "save the phenomena".

Currently there is no cosmological model that offers a simple explanation, in terms of well-established physical laws, of all the observational data. With the advent of the Hubble Space Telescope, and other remarkable advances in electronic instrumentation and computing, in the last few decades, we entered a new era in astronomy. There has been a proliferation of recent data on distant parts of the universe. This will increase even more as new instruments are applied, such as the recently launched (2021) Webb space telescope.

No doubt future observations will resolve some current problems while at the same time raising new ones, leading to the development of new cosmological models that might differ significantly from current Big Bang cosmology. It is therefore prudent not to equate any current cosmology with the actual history of the cosmos.

Nevertheless, the intrinsic, unavoidable epistemic gap between actual observations and the hypothetical cosmological models trying to explain these will ensure that there will continue to be a variety of cosmological models.

3. The Necessity of Presuppositions

How are we to choose among competing cosmologies? Our third conclusion is that any cosmological model must necessarily rest on various assumptions that are essentially unverifiable. The justification of these basic presuppositions must thus come from subjective, extra-scientific considerations. As we noted in the first chapter, scientific theorizing is guided largely by our prior philosophical and religious beliefs. Particularly in cosmology, where we try to explain literally everything, we construct theoretical models that are consistent with our most basic convictions.

It is therefore crucial that we be aware of the underlying philosophical presuppositions involved in the construction, assessment, and selection of cosmological models.

5. Cosmology, Life, and the Future

What does modern cosmology have to tell us about the future? In the immediate future, one of the hopes of today's society is to set up contact with advanced extra-terrestrial civilizations. How likely is that? And with what implications? Another concern lies in the more distant future. Can we expect human life, or life in any form, to continue to exist indefinitely? Finally, there is the all-important question of our own personal immortality. Does science offer us any hope for life after death?

Life in the Universe

Many people believe that life is not limited to the earth but is widespread throughout the universe. In 1992 the US space agency NASA launched a major project to search for extra-terrestrial intelligence. This project, called SETI (short for: Search for Extra-Terrestrial Intelligence) uses radio telescopes around the world to examine distant stars for signals that might be of artificial origin. So far, the results have been completely negative. Nevertheless, we shall examine the case for extra-terrestrial life and intelligence, from both scientific and theological angles.

A Brief History of ETI

Speculations about the possibility of extra-terrestrial life (ETL) and intelligence (ETI) have a long history. They can be traced back to at least the Greek philosopher Democritus (ca.460-370 B.C.), who believed that there were an infinite number of worlds, each with a central, inhabited planet. He was convinced that the Moon was also populated. Yet, belief in ETI was generally not popular in ancient times; nor, for that matter, in the medieval world, whose finite, hierarchical cosmology had no place for other inhabited planets. However, the existence of legions of angels - and demons - was acknowledged.

The big boost for ETI came with the Copernican revolution in the 16th century. With the demotion of the earth to just another planet, there was no longer any reason to believe that it was unique in either

composition or function. Hence the astronomer Johannes Kepler, among many others, thought that the Sun, the planets, and particularly the Moon, were all populated with a variety of creatures.

By the end of the 18th century belief in ETI was very common in the scientific community. By then, after it had been shown that the Moon had no atmosphere, the possibility of lunar intelligence had been ruled out. But this merely transported the presumed presence of ETI to other celestial objects. The influential German philosopher Immanuel Kant (1755) wrote a treatise describing in detail the various life forms allegedly inhabiting the planets in our solar system.

For a long time, Mars was the prime candidate for ETI. Interest peaked in the early 20th century when American businessman and amateur astronomer Percival Lowell announced that he had seen canals on Mars. However, such extravagant claims were soon discounted by most professional astronomers, who did not see these alleged features. The search for ETI then shifted to nearby stars. Today it is still widely hoped that more sensitive radio telescopes will soon detect evidence of advanced alien civilizations.

The Scientific Case for ETI

How strong is the scientific case for ETI? Estimates vary considerably. During the last few years, there has been a lively debate between those scientists who believe the existence of ETI to be widespread and those who think it to be very rare, perhaps even non-existent.

The optimists assert that many stars have planets, that a good fraction of those planets are suitable for life, that life will in fact develop on a sizeable proportion of such inhabitable planets, and, finally, that a significant number of these life-bearing planets will produce intelligent societies. Even if the fraction in each of the four steps is, say, only one percent, the huge number of stars in our Milky Way Galaxy alone (about 400 billion) would still leave us with potentially about 4000 intelligent civilizations in our Milky Way Galaxy. Many of these would very likely be much more advanced than we are.

On the other hand, the pessimists point out that all the above factors are highly uncertain, that attaching numbers to the steps amounts to

no more than guessing, and that, based on current science, some of the required steps in the chain are extremely unlikely.

Let's examine some of the most important links in the chain.

1. Habitable Planets

Recent observations of nearby stars suggest that most stars have planets. Planets beyond our solar system are called “exoplanets.” How many of these could support life? All known life needs liquid water. Hence, a habitable exoplanet must be rocky (like Mars), rather than gaseous (like Jupiter). Also, the planet must be in the “habitable zone”: its distance from its star must be such that its temperature supports liquid water. According to Kunimoto & Matthews (2020), the 400 billion stars in our Milky Way Galaxy are estimated to yield about 6 billion rocky planets in the habitable zone. Thus, within 100 light-years we might expect to find about 170 “habitable” exoplanets.

To sustain life, much more is needed than a rocky surface and the right temperature. For example, the radiation received from the parent star must be the right amount, at the right wavelength, to enable photosynthesis. A recent study by Giovanni Covone (2020) found that out of about 5000 observed exoplanets, only one (Kepler 442b, about 1100 light-years away) came close to receiving enough sunshine to sustain a large biosphere. This suggests only a few planets in our Milky Way Galaxy have the right temperature and radiation conditions for merely plant life.

The chances that a “habitable” planet exoplanet actually has liquid water, along with a suitable atmosphere, the chemicals needed for life, and so on, are very much slimmer. It thus seems likely that all the proper conditions needed to sustain life are to be found only on earth, out of all the planets in our Milky Way Galaxy, if not the universe.

2. Life by Chance

It is still a huge step from a habitable planet with the proper conditions for life to the actual formation of life on that planet. No form of life has yet been found by any space probes to the planets in our solar system.

Until recently it was widely believed that Mars might harbor, if not canal-builders, at least some primitive form of life. This hope was ruled out by tests by the Viking spacecraft, which landed on Mars in 1976, although some scientists still insist that those results were inconclusive. Moon rocks returned by the Apollo astronauts also yielded no evidence for life.

There was much excitement in August of 1996 when NASA scientists announced the discovery of what they believed was evidence for primitive life on Mars (MacKay 1996). A meteorite, found in Antarctica and thought to have come from Mars, held microscopic carbonate globules that resembled bacteria found on earth. It was thought that an asteroid striking Mars could displace material into space, some of which, like the meteor in question, might fall on earth. Unfortunately, it has since been determined that these globules were likely due to inanimate causes.

Even if definite signs of life had been found, and even if it could be shown that these were on the meteor before it reached the earth, the result would still be inconclusive. If life could be transplanted from Mars to Earth via an asteroid impact, the same mechanism could have brought life from Earth to Mars. Hence an independent source of life on Mars would still be unproven.

How likely is it, from a naturalist, evolutionary perspective, for life to evolve from non-life? Many complicated molecules have been seen in interstellar space. These include water, methane, ammonia, methyl and ethyl alcohol, and formic acid. Exposing a mixture of water vapor, methane and ammonia to ultra-violet light can lead to the formation of some amino acids. Since traces of amino acids have been found in some meteorites, it is likely that amino acids are common throughout the universe.

Yet this is just a tiny step towards even the simplest living cell. Terrestrial organisms consist of two types of molecules, whose interaction results in life. The first are proteins, which make up the organism. The second are nucleic acids, such as DNA (**D**eoxyribo**n**ucleic **a**cid), which supply information for the structure of the organism and the means to pass on this genetic information in reproduction. Proteins consist of amino acids; DNA consists of very long strands of bases, which are molecules that interact with acids.

Proteins and nucleic acids are both composed of very intricate combinations of carbon, hydrogen, oxygen, nitrogen, and a few other common elements.

Even if we have all the necessary amino acids and bases, it is extremely unlikely for these to combine randomly in just the right manner to form a complete cell.

How complex is the simplest cell? The simplest cell consists of hundreds of proteins, each of which in turn consist of hundreds of smaller units, called amino acids, attached to each other in long chains. Assuming a prebiotic soup full of amino acids, the odds of randomly assembling one functional protein have been estimated to be less than 1 chance in 10^164. According to Stephen Meyer (2009:213), the simplest cell needs at least 250 proteins consisting of, an average, 150 amino acids. Meyer estimates the probability of assembling all the necessary proteins to make the simplest cell as 1 out of (10^164) ^250, or 1 out of 10^41,000 (*i.e.*, 10 followed by 41,000 zeroes)!

Even if our universe has 10^80 elementary particles, interacting 10^43 times per second for 10^17 seconds (30 billion years), this yields only 10^140 possible events since the origin of the universe. Hence Meyer (2009:216-9) estimates the event of one workable cell forming by chance, over the history of the universe, to have a probability of 10^140 divided by 10^41,000, which is 1 out of 10^40,860. This is so small as to be virtually impossible. It has the same chance as tossing a fair coin and getting heads 135,000 times in a row. At that rate, during fourteen billion years, we wouldn't expect to find another living cell in the observable universe.

3. Higher Forms of Life

The next hurdle is for single-celled organisms to evolve to more advanced forms of life. According to Ian Crawford (1997:19), single-cell organisms first appeared about one billion years after the earth was formed, while multi-cellular animal life appeared more than three billion years later. Furthermore, the evolution of multi-cellular animals from single-celled organisms allegedly occurred only once in history.

Crawford concludes that the evolution of complex life is therefore much more difficult than the first development of life itself.

4. Civilization

A further concern raised by Crawford is the emergence of intelligence. Many thousands of species, supposedly evolving over many millions of years, yielded only one species sufficiently intelligent to develop technology and culture. Thus, even given the existence of multi-cellular life, the evolutionary emergence of civilization is very unlikely.

Optimists, such as biologist Jack Cohen and mathematician Ian Stewart (2002) argue that life may take on many different forms beyond our imagination. Perhaps. However, given the above immense odds against the chance emergence of intelligent life, such considerations seem unlikely to reduce the odds sufficiently to favor the existence of aliens.

Physicist Marcelo Gleiser (2023) contends that we are the only intelligent beings in our Milky Way Galaxy, and perhaps in the universe. Since human life is fundamentally unique in the Universe, we should treat Earth as a precious, sacred realm deserving respect and veneration. Gleiser concludes that we should embrace a biocentric view that life must be protected as something unique and endangered. Yet, since he is an agnostic, his spirituality is not directed towards the supernatural, but towards earthly nature itself. Gleiser supports a naturalistic form of paganism.

5. Self-Organizing Matter

Such pessimistic estimates have in turn been challenged by the optimists, who claim that our present grasp of the evolutionary mechanism is incomplete. They hope that further developments will show that the evolution of life is much more probable than currently believed. After all, they ask if: life has evolved here, on this insignificant planet, why not elsewhere as well?

Paul Davies (1995) argues that the origin of life was not a miracle, nor a stupendously improbable accident, but rather the inevitable outworking of certain "self-organizing" properties of matter. Davies considers both life and consciousness to be fundamental “emergent”

properties of nature. He views them as natural consequences of the laws of physics, appearing in a physical system once it reaches a certain level of complexity. As such, he believes that life should be plentiful throughout the universe.

Unfortunately, Davies gives no details of how the necessary complexity can be reached, what the actual conditions are for life and consciousness to “emerge”, or what the physical laws are that make such emergence inevitable. Merely to affirm that life must emerge, without supplying any specifics, does not solve this profound problem.

A further weakness of Davies’ position is the lack of supportive scientific evidence. Why have such "self-organizing" properties not been found in any of the many scientific experiments that have tried to synthesize life? Why, in the evolutionary view, did life on Earth apparently originate only once? Davies' mysterious "emergent properties" seem highly magical: stupendous miracles that are even more inexplicable in that they allegedly occur purely by themselves, without any need for a divine intervention. Like magic without a magician. This is little more than wishful thinking.

6. Where Are They?

If ETI were common in our Milky Way Galaxy, it might be expected that at least one of the more advanced civilizations would have explored and colonized the entire Galaxy by now. Since we don't see ETs, and since there is no evidence that they have ever visited us, it seems that ETI must be rare. Very few astronomers believe that UFOs are ET visitors! Optimists respond that perhaps these civilizations have no desire to colonize, or that perhaps they are keeping the earth as a nature preserve, a sort of cosmic zoo. Pessimists reject such options as implausible.

Motivation For Belief in ETI

Given the lack of scientific evidence for ETI, belief in ETI must clearly rest on other, more philosophical considerations. Frank Tipler, who believes that we are alone in the universe, sees a strong similarity between belief in ETI and belief in UFOs:

> *In fact, I suspect the psychological motivation of both beliefs to be the same, namely, the expectation that we are going to be saved from ourselves by some miraculous interstellar intervention...(Tipler 1980:278).*

He supports this conclusion by citations from many prominent supporters of ETI. Typical is the following statement from Carl Sagan:

> *The translation of a radio message from the depths of space...holds the greatest promise of both practical and philosophical benefits. In particular, it is possible that among the first contents of such a message may be detailed descriptions for the avoidance of technological disaster, for a passage through adolescence to maturity...(Sagan 1979:276).*

In a similar vein, Harvard astrophysicist A.G.W. Cameron writes:

> *If we can...communicate with some of these (advanced ET) societies, then we can expect to obtain an enormous enrichment of all phases of our sciences and arts. Perhaps we shall also receive valuable lessons in the techniques of stable world government (Cameron 1963:1).*

Paul Davies comments:

> *The interest in SETI among the general public stems in part, I maintain, from the need to find a wider context to their lives than this earthly existence provides. In an era when conventional religion is in sharp decline, the belief in super-advanced aliens...can provide some measure of comfort and inspiration...This sense of a religious quest may well extend to the scientists themselves, even though most of them are self-professed atheists (Davies 1995:136).*

It is ironic that man, even after having rejected God, still searches the heavens for his salvation.

Theological Considerations

The above arguments are all based upon the premise that man, and life in general, have an evolutionary origin. Before Darwin, however,

most of the ETI proponents were Christians. Should Christians expect aliens to exist?

It is certainly possible that God directly created intelligent beings on other planets. In the 17th century the newly invented telescope revealed many hitherto invisible stars. These could hardly serve as light-bearers for man. So what was their purpose? Many contended that those distant stars functioned as suns for other intelligent beings, placed there by God. Furthermore, it was argued that, since two universes are better than one, and since the wise Creator always chose the best, there should be an infinite number of inhabited worlds. Anything less was considered unworthy of an infinite Creator.

Note that the lack-of-colonization objection to ETI no longer applies if God created the universe recently. Then ETs would have had too little time to develop and apply their exploration potential. On the other hand, the same consideration makes it extremely unlikely that, if civilizations like our own do exist, we would be able to see them, let alone interact with them, any time soon.

1. The Absence of Biblical Evidence for ETI

Several theological objections have been raised against the belief in ETI. First, if ETs exist, why are they not mentioned in Scripture? The Lutheran theologian Philip Melanchthon (1497-1560) noted that after God had created the earth, sun, moon, and stars of our cosmos, he rested and created nothing more, least of all another cosmos. The only extra-terrestrial creatures found in Scripture are the angels.

To this one might counter that the biblical account is directed towards man and his relationship to God. Perhaps God created other beings the existence of which he did not consider it necessary to inform us.

2. Christ's Incarnation and ETI

The foremost theological objection to ETI has, however, always been centered on the uniqueness of Christ's incarnation. This dates back to at least the Church Father Augustine (354-430). Augustine was concerned with the notion, popular at that time, that history repeats

itself in an endless cycle. Based on biblical texts such as "*for Christ also suffered once for sins*" (I Peter 3:18) and "*Christ being raised from the dead will never die again...he died to sin, once for all*" (Romans 6:9-10), Augustine (*The City of God*) concluded that the historical process of creation, fall, and redemption could occur only once.

This argument was extended by Albertus Magnus (1206-1280) to also refute the idea of a multitude of worlds in space, rather than time. Melanchthon, too, in his rejection of ETI, contended that Christ could die only once and that ET creatures, if they existed, could be saved only through knowledge of Christ.

The question of the uniqueness of Christ's sacrifice doesn't appear to bother most modern liberal theologians who discuss ETI. The acceptance of an evolutionary origin of man, and the corresponding rejection of the historicity of Adam and his fall, opens the possibility that human history could well be repeated elsewhere. The liberal theologian Paul Tillich and the Anglican Dean Wiiliam Inge, for example, both suggest that the incarnation of Christ is not unique and could re-occur on other planets.

The British cosmologist E.A. Milne (1952) resolved the paradox between the uniqueness of Christ and the plurality of worlds by proposing that knowledge of the incarnation on earth could be transmitted to other planets via radio signals. On this he was criticized by the Anglican theologian E .L. Mascall (1956), who contended that salvation is not dependent upon our knowledge of Christ's incarnation. On the other hand, Mascall doubted that Christ's earthly human nature would suffice to make him the savior also of extraterrestrial beings. Therefore, he suggested that the incarnation could be repeated on other planets.

More recently John Davis argues that Christ’s reconciliation of all things to himself (Col 1:15-20) is sufficiently vast in scope to include the redemption of fallen beings anywhere in the universe, without the need for any additional incarnations or atonements. Referring to the Westminster Confession of Faith (1647, Ch.8:v, vi), where the redemptive benefits of the death of Christ are said not to be limited by time, but apply to the elect of all ages, Davis (1997) remarks:

> *If the atonement can be understood as not being limited in time, it can just as readily be understood as not limited by space or distance. Christ assumed in the incarnation a true and complete human nature that he might represent man as the covenant head of a redeemed people. By extension, it could be postulated that the human nature of Homo Sapiens could be designated by God to represent the nature of all sentient, embodied beings.*

There is, however, a huge difference between an atonement unlimited in time (for descendants of Adam) and one unlimited in space (including those not related to Adam). Scripture stresses the close connection between the first Adam and the second Adam, Christ. For Christ's sacrifice to apply to humans, it is essential that Christ have a human nature:

> *Since therefore the children share in flesh and blood, he himself likewise partook of the same things...For surely it is not angels that he helps, but he helps the offspring of Abraham. Therefore, he had to be made like his brothers in every respect, so that he might become a merciful and faithful high priest in the service of God, to make propitiation for the sins of the people. (Hebrews 2:14-17)*

Since ETs, like the angels, are not descendants of Adam and thus share neither his nature nor guilt, Christ's sacrifice is of no avail to them. The uniqueness of Christ's incarnation implies the uniqueness also of man as the only creature to be thereby saved from the consequences of his sinfulness. Of course, this does not, by itself, imply that ETs can't exist, but only rules out any possible redemption through Christ's incarnation.

The notion of unredeemed species is not without precedent. We know that angels, the only other known species of intelligent beings, have no possible redemption through Christ. Even for fallen man, redemption is effective only for the elect minority. Why, then, should it be thought necessary that ETs be redeemed?

As to Davis's reference to Colossians1:15-20, the Bible makes clear that Christ's reconciliation of all things to himself does not imply that all creatures are to be redeemed. Rather, it concerns Christ's victory over Satan and sin, with the resultant cleansing of all creation under the dominion of Christ.

3. The Uniqueness of Man

Even if Davis's argument were valid, it would still imply that man is in a special relation to God, since, from among all possible creatures, Christ chose to take on the specific form of man. This brings us to a further argument against ETs: the special position of man in the universe. According to Genesis 1, man alone was created in the image of God, and man alone was appointed to have dominion over creation. Even stars were created primarily to serve as lights and signs for man. Finally, at the end of times, Christ returns to the *earth*, the abode of man, to judge living and dead. Man is to judge the angels (I Cor. 6:3). The New Jerusalem comes down from heaven to *earth*. All this reinforces the special place of man in God's creation.

Hence, in the extremely unlikely event that intelligent beings do exist on other planets, we can conclude, based on the biblical account of salvation, that either they have not fallen from grace or, less happily, that, like the angels, there is no redemption for those who fell.

4. Extra-terrestrial Life

What about more primitive extraterrestrial life? The amazing complexity of even the simplest life shows the need of a direct creative act to get it started. God could certainly have miraculously created simple ET life. But to what purpose? On earth, plants were created to serve as food for man and beast, while animals were created to serve man (Gen. 1:26-30), who was to serve God. What would be the purpose of ET plants or animals in the absence of ET intelligent life? Since the Bible is silent on this, we can only speculate.

Detecting ETL in very distant places is much more difficult than detecting ETI, who might be sending us radio signals. Within our own solar system the most likely places have already been ruled out.

The new James Webb telescope now enables us to examine the atmospheres of exo-planets for traces of life-related chemicals. The atmosphere of exo-planet K2-18b, 120 light-years away, was found to have traces of water vapor, carbon dioxide, methane, and perhaps dimethyl sulfide. This was exciting, since on Earth dimethyl sulfide is only produced by living organisms. However, the presence of dimethyl sulfide must still be confirmed, and geological and chemical causes have not been ruled out.

If any ETL were found, it would certainly greatly bolster the naturalist case that life is widespread in the universe, greatly increasing its odds for the existence of ETI. Yet, the mere existence of ETL, without ETI, would pose no serious theological problem.

Conclusions

In conclusion we note that there is no scientific evidence in support of the belief in ETI. On the contrary, there has been no sign of life of any form on any of our planets. All searches for ETI have yielded purely negative results. Searches for interstellar life, scanning nearby stars for radio signals or noise indicative of civilization, have virtually ruled out the possibility of advanced civilized life within a hundred light-years. To span greater distances, even an extremely fast rocket travelling at a tenth of the speed of light would take longer than a millennium, and radio dialogues would have century-long gaps. Thus, for all practical purposes, communication with extra-terrestrial civilizations can be ruled out.

From an evolutionary perspective, the odds are so heavily stacked against the chance occurrence of life, particularly intelligent life, that the existence of ETI must be considered virtually impossible.

Creationist arguments for ETI depend strongly upon how we view the nature of God and his relation to his cosmos. Theological considerations based on biblical revelation weigh very heavily against the presence of ETI, but not conclusively so. In a young universe, it is very improbable that ETI, even if it existed, would be detected soon.

The case against more primitive forms of extra-terrestrial life is much weaker. Arguing against the existence of ETL are its absence in the biblical creation account and the question as to what purpose the creation of ETL would serve, given the non-existence of ETI. But, again, these considerations do not rule out ETL.

The Future of Life in the Universe

What lies ahead for the universe? Most cosmologists are optimistic about the near future - that is, the next few billion years. If man and society have arisen purely through evolution, then it is not unreasonable to posit further evolutionary advances.

By modern cosmological standards humans are present in the universe at a very early time in its history and, hence, we must therefore expect our species to be replaced by more advanced forms of life in the future. A few million years down the road intelligent life may be as far removed from us as we presently are from the apes.

According to Frank Tipler, this has important implications for religion:

> *Traditional religion must come to grips with the fleeting existence of our species in universal history. It is our relative insignificance in time, not space, which is the real challenge posed by modern cosmology for traditional religion (Tipler 1988:313).*

Tipler emphasizes that the universe will continue to exist for at least 5 billion years:

> *Almost all Christian theologians adopt a much shorter temporal perspective. This is as great an error - and as great a misunderstanding of mankind's place in nature - as believing that the universe was created a few thousand years ago (Tipler 1988:316).*

Presumably Tipler believes that Christianity will no longer apply to the advanced species of the future. To this it must be pointed out that improved intelligence and technology will do little to eradicate man's main deficiency: a sinful heart. The need for a savior would remain. However, Tipler does make the valid point that the future as depicted

by the Big Bang universe is as much at odds with that of traditional Christianity as is its description of origins.

While the relatively near future may seem rather secure for civilization, in the long run the picture is far from rosy. Several factors point to a gloomy fate for civilization and even life itself.

In about five billion years the Sun is predicted to expand, becoming a huge red giant, and killing all life on earth. By then, earth civilization may have migrated to a more habitable planet, orbiting some other distant star.

Eventually, however, according to Big Bang cosmology, all life in the universe will be extinguished. If the density of the universe is greater than a critical amount, its expansion will gradually slow down, change into a contraction, and finally end in a Big Crunch. The universe may still bounce back, but all life would have been destroyed.

On the other hand, if the cosmic density is less than the critical amount - and this seems to be the case - then the universe is predicted to continue to expand forever. As available energy is irretrievably lost and the temperature drops, the universe approaches its inevitable heat death. Again, life would eventually disappear.

Another possibility is that the mysterious dark energy becomes more powerful over time, tearing apart first clusters of galaxies, then galaxies, stars, and eventually even single atoms. This is death by the Big Rip. Katie Mack (2020) lists other possible future scenarios, almost all leading to the same gloomy fate for life.

Given such approaching doom, Steven Weinberg concludes:

> *The more the universe seems comprehensible, the more it also appears pointless. But if there is no solace in the fruits of the research, there is at least some consolation in the research itself...The effort to understand the universe is one of the very few things that lifts human life a little above the level of farce and gives it some of the grace of tragedy (Weinberg 1979:144).*

Most cosmologists share such a pessimistic outlook for the possibility of the long-term survival of life. However, such a gloomy forecast has been challenged by a few optimists who envision at least a possibility that life may survive. Let's examine a few of these alternatives.

Future Life in a Closed Universe

Among Big Bang cosmologists, Frank Tipler and Freeman Dyson are two exceptions who paint a rosier picture for life in the distant future. They differ, however, in their assessment as to whether a closed or an open universe will be more hospitable for life. Whereas Dyson favors an open universe, Tipler (1994) believes that only a closed universe will do.

Tipler defines life in terms of information processing. A *living being* is any entity that codes information, with the information coded being preserved through natural selection. With this definition even cars and computers can be considered as forms of life. Tipler asserts that man is a purely physical object that can be regarded as a type of computer. The human mind - or soul - is just a specific computer program run on a computer called the brain. Man has arrived rather early in the evolution of the universe; it must be expected that he will eventually be replaced by more advanced forms of life. The next stage of intelligent life might well be quite literally information processing machines.

According to Tipler, the laws of thermodynamics allow an infinite amount of information processing in the future, provided there is sufficient available energy at all future times. The available energy depends on the temperature. Since, in an open universe the temperature eventually becomes too low to support life, Tipler turns to a closed universe. In a closed universe the present expansion will eventually turn into a contraction, at which point the temperature will again increase, approaching infinity as the singularity draws near. As the Big Crunch is approached, life will engulf the entire universe, will be unified into an immense computer that will store an infinite amount of information, and will eventually control all matter and energy sources. This event, which Tipler calls the "Omega Point", is the culmination of life. Since the Omega Point is omniscient, omnipresent, and omnipotent, Tipler equates it with God.

The Big Crunch, which will be reached in a finite time, will spell an end to life. How, then, does Tipler rescue the immortality of life? According to Tipler the metabolism of life speeds up with the temperature increase, so that an infinite amount of *subjective* time - time as experienced by living beings - will elapse before the singularity is reached.

Although Tipler argues that the Omega Point necessarily exists, few cosmologists agree with him. Indeed, his scenario sounds more like far-out science fiction than factual science. A detailed critique of Tipler's ideas has been made by Ellis & Coule (1994). Among other things, they find Tipler's definition of life to be absurdly simplistic, as contrasted with the incredible complexity of biological life, particularly its intricate control mechanisms for cellular and bodily functions. They conclude that no physically plausible mechanisms exist that would allow life to occur under the extreme conditions Tipler envisions. Any possible physically based computing machine, let alone living systems, would be destroyed well before the final crunch.

In any event, Tipler makes six testable predictions, of which at least two are currently falsified. Tipler predicts that the universe is closed and that Hubble's constant - the present rate of expansion - is at most 45 km/sec/megaparsec. Current observations, at least as interpreted by Big Bang astronomers, show that the universe is open, and that Hubble's constant is at least 67 km/sec/megaparsec.

Future Life in an Open Universe

How about the possibility of life in an open universe? Dyson, contrary to Tipler, sees no future for life if the universe is finite and closed. In that case the universe will eventually contract, the sky will grow hotter and hotter until it finally falls in on us as we approach a space-time singularity at infinite temperature. No life could survive such a fate. Dyson (1988:107-15) concludes that life would barely be able to spread around the cosmos before it meets its demise.

On the other hand, Dyson finds more hope in a the universe that is open and infinite. In that case, the universe will expand forever, growing ever colder. Life now faces the prospect of slow freezing rather

than quick frying. However, Dyson believes that it is easier for life to adapt to cold than to heat.

Dyson, like Tipler, assumes that the essence of life is in *organization* rather than in *substance*. The basis of life is *structure*, in the way molecules are organized, rather than in the substance of the molecules themselves. If this assumption is true, then one can imagine life detached from flesh and blood and embodied in such complex entities as networks of superconducting circuitry or even in interstellar dust clouds.

The complexity of life can be measured in terms of bits of information. For information processing the main consideration is not an abundant energy supply, but rather a good signal-to-noise ratio. The colder the environment, the quieter the background noise, and thus the thriftier life can be in its use of energy. As the universe gets colder the pulse of life will slow down but will never stop. As in Tipler's scheme, man is destined to become extinct, but the torch of life will continually be passed on to ever more hardly forms of life.

One prediction of particle physics is that all matter may be unstable. Theory predicts that after 10^33 years the nuclei of all atoms will have decayed into positrons, photons, and neutrons. This may pose a severe test for life, but Dyson is confident that life will again adapt to the new circumstances. According to Dyson, the total energy reserve contained in the Sun could support forever a society with a complexity 10 trillion times greater than our own. This energy would also suffice to keep open forever as many communication channels as would be needed to keep us talking with every star in the visible part of the universe.

No matter how far into the future we go, there will always be new things happening: new information coming in and new worlds to explore. Life and intelligence are potentially immortal, with resources of knowledge and memory constantly growing as the temperature of the universe decreases and the reserves of free energy dwindle.

Nevertheless, as Dyson himself is the first to admit, this sketch of the future is highly speculative, based more on a highly fertile and optimistic imagination than on hard scientific knowledge.

Future Life in a Plasma Cosmology

A further possibility for future life has been presented by Eric Lerner (1991), who rejects Big Bang cosmology. Lerner promotes a plasma cosmology that postulates the universe to be infinite in both space and time. According to him, the pessimistic conclusions of conventional cosmology are false. Thermodynamics does not *demand* that the universe wind down. Lerner assures us that we need not worry about a heat death, for there can be ever-increasing orders of complexity, with increasing energy flows. The heat death can be indefinitely postponed as technology devises ever more efficient machines. This would prevent both an end to life and an end to the growth of life.

Lerner believes that there is a strong correlation between society and cosmology. The current pessimistic, finite Big Bang model is mirrored by a pessimistic spirit in toda y's society. According to Lerner, "*When society retreats, when progress is halted, rationality is discredited and many turn to the supernatural*". He argues that the universe is not doomed. We need not despair because our present actions can permanently change the cosmos and will be echoed through a limitless future, even though there is no hope for individual immortality.

One major drawback with this model is its denial, not only of Big Bang cosmology, but, more fundamentally, also that of the validity of the second law of thermodynamics as applied to the universe as a whole. Another is its postulation of a hypothetical ever-increasing complexity. Here, too, we have a very speculative sketch of the future that has attracted few supporters.

Conclusions

In summary, although a few optimistic scenarios of a rosy future have been concocted, it appears extremely unlikely that, in a naturalistic universe, life can survive indefinitely long. Modern cosmology offers little hope for the distant future: not for individuals, not for humanity, nor even for the survival of life as such.

6. Cosmology and God's Existence

Does the cosmos tell us anything about God? Can we prove it was created? Or designed? If Big Bang cosmology were true, would it entail the existence of God?

Various theological implications have been drawn from modern cosmology. Foremost among these are proofs for the existence of God.

Rational proofs for the existence of God date back to at least the time of Plato. These proofs can be grouped into four basic types:

1. The *ontological argument* (from the Greek *ontos*, “being”) is based on the notion that the very concept of a perfect Being demands that such a Being exists.
2. The *moral argument* asserts that the existence of a moral law implies the existence of a moral law Giver.
3. The *cosmological argument* (from the Greek *cosmos*, “world”) asserts that the existence of the universe implies the existence of a prior Cause of the universe.
4. The *teleological argument* (from the Greek *telos*, “design” or purpose) contends that the apparent design within the world points to an intelligent Designer.

Virtually all the major philosophers have discussed at least some of these proofs. The proofs can involve many philosophical subtleties, but we shall concentrate on the part played by cosmological factors. Thus, we shall consider pertinent aspects of only the latter two proofs: the cosmological argument, based on evidence pointing towards a beginning of the universe, and the teleological argument, based on evidence for design within the universe.

The Cosmological Argument

The cosmological argument is probably the most popular theological existence proof. According to Norman Geisler and Winfried Corduan (1988:150), only the cosmological argument offers any hope for a theistic proof. Much of their philosophy of religion rests upon its presumed validity.

Over the years many different versions of it have been presented. Our focus will be on the *Kalam* Cosmological Argument, which aims to prove that the universe was created a finite time ago by a personal creator.

The argument is grounded upon the supposed impossibility of an actual infinity of past events. Many of the arguments against an actual infinity can be traced back to Aristotle, although the Christian philosopher John Philoponus seems to have been the first to apply them, in AD 529, to a demonstration of the finite age of the universe (Sorabji 1983:198). Philoponus' proofs for creation were taken up and further developed in the 9th and 10th centuries by several Islamic philosophers of the Kalam school, becoming thus known as the *Kalam* cosmological argument.

More recently it has been defended by several Christian apologists, including William Craig (1979) and J.P. Moreland (1994). It boils down to the following reasoning:

(1) Whatever begins to exist has a cause for its existence.

(2) The universe began to exist.

(3) Therefore the universe has a cause of its existence.

(4) That cause must have been personal.

In short, the finite past of the universe implies its *ex nihilo* creation by a personal creator.

The second step is crucial. Can it be proven that the universe had a beginning? There is certainly biblical proof for this, as we found earlier. However, this is relevant only to those who already believe in God. Can we prove the universe’s finite past without appealing to the Bible?

The Big Bang Singularity

Earlier, we contended that there are no compelling logical or mathematical grounds against an infinite past. Can cosmology prove the universe had a finite past? The main efforts to this effect rely on

the alleged Big Bang singularity. In Big Bang cosmology the time t = 0 corresponds to a state of infinite density, which is commonly taken as the beginning of the universe.

In a famous statement in 1951 Pope Pius XII referred to the Big Bang theory as testifying to a beginning of the cosmos, thus confirming the need for a creator (McMullin 1981:30). Nor was Pius XII alone here; many Christians concur in taking the Big Bang singularity as a proof for the existence of a creator.

The theistic implication of the Big Bang singularity has been drawn also by atheistic scientists. Thus, for example, Hannes Alfven, who won the Nobel prize in physics in 1970, wrote that "*the state of the singular point necessarily presupposes a divine creation*" (Alfven 1974:7, 12). This, apparently, was the main reason why Alfven rejected the Big Bang. Similarly, the prominent astronomer Fred Hoyle (1977) objected to the Big Bang theory, not just on scientific grounds, but because an eternal universe fit in better with his atheistic beliefs. Strong opposition to the Big Bang model also came from Soviet cosmologists, who asserted that the notion of an absolute beginning was fundamentally incompatible with the Marxist-Leninist principles of dialectical materialism (McMullin 1981:36-7).

On the other hand, many cosmologists and theologians deny any such close connection between Big Bang cosmology and theism. So how compelling is the Big Bang evidence? Does it really prove that the physical universe began a finite time ago? And, if so, does this necessarily have theistic implications?

1. The Accuracy of the Big Bang Model

Earlier, we found that the standard (Big Bang) model, despite its current scientific popularity, suffered from several observational and theoretical deficiencies. Many of its theoretical assumptions were inherently unverifiable. Moreover, the observational evidence might well be explicable in terms of alternative cosmologies lacking a past singularity.

The argument for a singularity must, therefore, first show the superiority of the Big Bang model over its challengers. This will involve the establishment and justification of specific criteria for theory choice,

as well as proof that the Big Bang cosmology best fulfils these standards.

Supporters of Big Bang cosmology tend to minimize the problems for the Big Bang and to give undue weight to the difficulties faced by rival theories. Indeed, they often affirm that the Big Bang has been proven beyond reasonable doubt, and that all alternatives have been conclusively ruled out. Detractors of the Big Bang, of course, tend to do the opposite. Assessing cosmological models can be a very subjective exercise.

Nevertheless, at the present time a large majority of cosmologists do favor Big Bang cosmology. While this does not prove it to be true, it has swayed popular opinion to accept Big Bang cosmology. This first step in the theistic proof may therefore be acceptable to most people.

2. Limits of the Big Bang Model

The standard LDCM Big Bang model concerns only what happened *after* the first fraction of a second. Going back in time, as one approaches the singularity, things become ever more uncertain. The pressure and temperature were then much greater than what can be generated in any laboratory. Whether current theories of matter will then still apply, or how these should be changed, is necessarily conjectural and unverifiable.

a. Singularity Proofs

Despite such uncertainty, several theorems have been constructed claiming to prove that the present universe must have originated from a past singularity.

However, all such singularity proofs rely on simplifying assumptions that seriously restrict their power. For example, an early proof by Stephen Hawking and George Ellis assumed a homogenous universe. They note that, because of local irregularities, it is quite possible that only part of the universe originated from a single singularity:

> *One might suggest therefore that prior to the present expansion there was a collapsing phase. In this, local inhomogeneities*

> *grew large and isolated singularities occurred. Most of the matter avoided the singularities and re-expanded to give the presently observed Universe (Hawking & Ellis 1967:32).*

A somewhat later proof by Hawking and Roger Penrose (1970) assumed there was no positive cosmological constant acting as a repulsive force counteracting gravity. This condition is contradicted by recent observations suggesting the existence of a large positive cosmological constant, which is now part of the LCDM model.

A detailed examination of assumptions made in the singularity proofs found many possible general relativistic cosmologies where the universe did not begin in a Big Bang singularity (Senovilla 1998).

More recently, a result by Borde, Guth, & Vilenkin (2003), the BGV theorem, proves a finite past for any region of space that has on average been expanding throughout its history. This theorem is often cited as a proof for the beginning of the universe. Yet, both Guth and Vilenkin have explicitly said that the theorem proved a beginning for *inflation*, but not for the universe (Harper 2021).

Though simple and powerful, this theorem does not rule out, for example, a universe that initially contracted over an infinite time to a minimum size and then bounced back into its present expanding state. Hence the singularity proofs, even within the confines of general relativity, fall short of proving a finite past for the universe.

b. Unknown Physics

Moreover, near the singularity, before the so-called Planck time (10^-43 seconds)[4] after the Big Bang), the density would have been so huge that quantum effects dominate. General relativity must then be replaced by a suitable theory of quantum gravity. Unfortunately, no viable model for quantum gravity has yet been found. Thus what happens before the Planck time is anyone's guess.

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[4]Recall that 10^- 43 is shorthand for 1 shifted 43 places to the right of the decimal point.

Most models of quantum gravity are based on string theory or loop quantum gravity. According to string theory, all matter is made up of tiny strings that can loop, vibrate, stretch, join, or split. String theory is a “theory of everything” aiming to explain all the laws of physics, including general relativity and quantum mechanics, through the interactions of strings.

Because the strings have a minimum length near the Planck length (about 10^- 35 m), no particle can be compressed below this length, ruling out the existence of singularities. So the universe can never be smaller than some minimal radius, with a corresponding limit to the maximum energy density. As applied to cosmology, string theory regards the Big Bang not as a singularity marking the beginning of everything (including space-time) but only as a transition (or bounce) from an earlier cosmological regime (Gasperini & Veneziano 2015).

According to loop quantum gravity (LQG), the structure of space and time is not continuous but is composed of finite loops woven into an extremely fine fabric or network. The size of the loops is about a Planck length. As with string theory, singularities are ruled out, since the nothing can be smaller than a Planck length. Applied to cosmology, LQG predicts the Big Bang was preceded by a period of contraction (the Big Crunch), making the Big Bang more of a Big Bounce (Edward Wilson-Ewing 2013).

Interestingly, Einstein himself never accepted the existence of the alleged singularity. Shortly before his death Einstein commented:

> *The present relativistic theory of gravitation is based on a separation of the concepts of "gravitational field" and of "matter." It may be plausible that the theory is for this reason inadequate for a very high density of matter. It may well be the case that for a unified theory there would arise no singularity...(Einstein 1956:124, 129).*

For large densities of field and of matter, the field equations and their variables may have no real significance. One may not therefore assume the validity of the field equations near the singularity. Hence, one may not conclude that the "beginning of the expansion" must mean

a singularity in the mathematical sense. It may just mean that the equations cannot be continued over such regions.

Thus, theologically significant questions arise just beyond the limits of the Big Bang model. As we go back into the last, the model becomes increasingly more speculative as we approach the alleged Big Bang, with a corresponding rapid loss in scientific consensus.

c. The Beginning of Time and Space

In the standard model the universe is assumed to be homogeneous, so that every point of space is filled with matter. Hence, going backward in time, when all matter is condensed into a disappearing point, space also disappears. Since in general relativity space and time are inseparably connected into space-time, the disappearance of space entails also the disappearance of time. Therefore, the origin of matter and energy in the Big Bang is accompanied by the simultaneous origin of space and time.

The first premise in the Kalam Cosmological Argument was that whatever began to exist must have a cause. This fits in with our experience that nothing jumps, uncaused, into being. God, who has always existed, needs no cause.

For something to begin to exist implies that there was a time when it did not exist. Yet, if there was no time before the singularity, then there never was a time when the universe did not exist. Hence, if time came into existence along with the universe, it cannot be said that the universe ever began to exist. In that case the rule that whatever began to exist must have a cause does not apply to the universe.

3. Beginningless Possibilities

Not all cosmologists agree that time began with the Big Bang. Many have objected to the notion that the universe has existed for only a finite time. Recall, for example, the variety of static cosmological models discussed earlier. Even within Big Bang cosmology it is not necessary that the universe began at a singularity. Various Big Bang models have been constructed that avoid a beginning in time.

a. Oscillating Universes

The earliest eternal Big Bang alternative was based on the notion that the Big Bang expansion could have been preceded by a contraction, by a Big Crunch. The Big Crunch would have destroyed any evidence of earlier cycles, except, possibly, for some very general parameters such as the energy and entropy.

Such an eternal, oscillating universe has been advocated by several modern cosmologists, starting with the Dutch astronomer Willem de Sitter (1931). It soon became clear, however, that such models had serious shortcomings. It was calculated, for example, that each new cycle would yield an increase in the maximum size of the universe, with an accompanying increase in the time needed to complete a cycle. Extrapolating back into the past, the cycles approached zero size in a finite time. Note that, since the universe increases in size with each cycle, it is, on the average expanding. Thus, according to the BGV theorem, a finite past is assured.

Each cycle also produces more radiation. If radiation is passed on to the next cycle, then the accumulated radiation currently seen allows for no more than about 100 earlier cycles (Smith 1988).

A similar result is obtained from thermodynamics. If an infinite number of earlier cycles have elapsed, each with increasing entropy (*i.e.*, the amount of disorder), then the present cycle would be in a state of maximum entropy. But in fact it is now in a state of relatively low entropy (i.e., there is a lot of orderly structure). Thus even an oscillating universe, while allowing an infinite future, seemed to point towards a beginning some finite time in the past.

To evade a finite past, physicist John Wheeler suggested that, at the end of each contracting phase, all the constants and laws of that cycle disappear, and the universe is reprocessed, getting new constants and laws for the next cycle. No information is passed on to the next cycle. In that case no inference to a finite past can be made based on the observations, laws, and constants of the present cycle.

In response, Quentin Smith (1988:43) has objected that, while this may be logically possible, yet, since the new laws and constants cannot be predicted, it is preferable to follow the principle that physical laws and constants set up for one domain should, in the absence of evidence to the contrary, be applied to other domains. While there may be some merit in Smith's criterion, it is again one of philosophical expediency rather than rational proof.

The Russian physicist Moisey Markov (1983) contends that the universe would transform into a vacuum when it comes close to the singularity. There would then be no particles and entropy would not be definable. Thus the universe could oscillate forever, with each new cycle starting fresh.

One further difficulty with an oscillating universe is that it requires that the universe be closed. The universe must be sufficiently dense so that gravitational attraction will eventually halt each expansion phase and turn it into a contraction. As we noted earlier, present observational evidence favors an open universe rather than a closed one. In an open universe matter will continue expanding forever.

An open universe does allow for another possibility for evading a beginning in time. George Gamow (1954) suggested that the Big Bang singularity was preceded by a corresponding eternal contraction. The universe existed from eternity, collapsing from a state when it was vanishingly sparse until it became immensely dense at the Big Bang singularity. Then it rebounded, the contraction turning into the present expansion. Gamow's proposal avoided the drawbacks of the oscillatory universe, since now there was no problem with accumulated radiation or entropy.

How does one account for the "bounce" from contraction to expansion? It seems natural that a contracting universe would, once it reached the state of maximum compression, bounce back into an expanding phase rather than staying at the singularity. Quite general considerations based on the conservation of energy and momentum point in that direction.

Roger Penrose (2010) developed a Conformal Cyclic Cosmology where the universe goes through an endless sequence of cycles. Each starts off with a Big Bang. Material structures are formed but, due to

decaying matter and evaporating black holes, eventually these all end being transformed back into radiation. Eventually nothing in the universe any longer has any time or distance scale associated with it. That condition is like the Big Bang starting point, and a new cycle is started. This avoids a beginning to the universe while also explaining the low entropy (amount of disorder) of the universe. Of course, much of this is highly speculative.

After reviewing several beginningless models, cosmologist Alexander Vilenkin (2015) concludes that the universe had a beginning. However, he suggests this could be due to a quantum fluctuation in a pre-existing void.

b. Vacuum Fluctuation Models

The notion that the present universe appeared spontaneously from a pre-existent vacuum was first proposed by Edward Tryon (1973). This model is based on the *uncertainty principle* of quantum mechanics, which says that at any time we can accurately measure either the position or the motion of a small particle, but not both at once. According to this principle, particles can be spontaneously generated in a vacuum by random fluctuations of energy. The smaller the energy of the particle, the longer the particle can exist before disappearing again into the void.

Tryon proposed that, in the universe as a whole, the positive energy of matter is cancelled exactly by the negative energy of gravity, so that the total energy of the universe is zero. According to the uncertainty principle, a particle of zero energy can exist forever. Hence, according to Tryon, the universe, being of zero energy, can last indefinitely long, a colossal free lunch.

The Russian cosmologist Iosif Rozental (1988) developed this into an eternal, infinite cosmology. The universe is seen as an infinite vacuum in a large space, boiling with energy fluctuations. Our present universe is just one of the larger fluctuations to appear from the vacuum; in time it will again dissolve back into the vacuum. Recently, the American physicist Lawrence Krauss (2012) promoted the same idea.

According to cosmologist Andrei Linde (1985), the only verifiable prediction, in principle, of the vacuum fluctuation models is that the universe must be closed. If the universe were created by a vacuum fluctuation, then it cannot be infinitely large, as would be the case for an open universe, at least as predicted by the usual Big Bang models. This is consistent with the inflationary Big Bang model but in conflict with the present observational evidence, which shows that the density of matter in the universe is too small to close it. Unobservable missing matter, or energy, must therefore be postulated to make up for the difference.

c. Eternal Chaotic Cosmology

Several scenarios have been postulated by Markov (1989) and Linde (1994) in which our present universe was created out of a "mother" universe, and so on from past eternity. These models are admittedly very speculative, but so are all models concerned with the early universe. Given the inflationary Big Bang framework, it does not appear to be unduly implausible to conjecture that, if a universe can be created via a quantum fluctuation in empty space, further universes could be similarly created within the energy-filled space of a previously existing universe.

We conclude that, although Big Bang cosmology is often interpreted as implying that the physical universe has a finite past, a closer examination reveals a rather more ambiguous situation. The argument for a finite past is based on one interpretation of a dubious extrapolation beyond the known physical laws, to the exclusion of various beginningless alternatives that seem no less plausible. In short, even within Big Bang cosmology an eternal universe cannot be conclusively ruled out.

The Second Law of Thermodynamics

The second law of thermodynamics asserts that a closed system continually increases its amount of disorder, called *entropy*, accompanied by a corresponding reduction in useful energy. Applied to the universe this predicts a future “heat death” when all life dies due to lack of available energy. It implies also that the world was initially wound up in a more orderly state.

Many theists have used this as evidence for a divine beginning of the physical world a finite time ago. Were the past infinite, they contend, our universe would have already reached its heat death. Moreover, they add, God is needed also to endow the universe with its initial order.

Arguments for the finite past of the universe based on the alleged Big Bang singularity relied upon several speculative cosmological assumptions. The second law, on the other hand, is one of the most basic laws of all science. Few scientists would question its universal validity.

Nevertheless, there are doubters. Not everyone believes the second law applies to the universe as a whole. For example, the Dutch philosopher Willem Drees (1989) contends that an expanding universe is not really closed since entropy is carried away into expanding space by the background radiation. The expansion works as if there were an environment, although there is none.

To this it may be replied that Big Bang models assume the universe to be the same everywhere, so that as much radiation leaves each region (which may have expanding dimensions having a fixed mass-energy) as enters it. For each such region a net entropy gain is thus to be expected.

Drees asserts that there exists no clear concept of entropy in relation to gravity, hence the application of the concept of entropy to the whole universe is questionable. Nevertheless, while the relation of entropy to gravity may not be quite as clear cut as the situation in statistical non-gravitational systems, there is no reason for thinking that such a fundamental law as entropy gain should not apply. Roger Penrose (1989), for example, has argued that entropy can be quite reasonably applied to gravitational structures.

Eric Lerner, too, in advocating an infinite universe of ever-increasing complexity, denies the cosmic applicability of the second law. He claims that contrary to the second law, the cosmos involves from chaos to order:

> *conventional physics views any change as a necessary regression, as devolution toward equilibrium. Yet if we look at the long-term tendency of evolution, reality is just the opposite - the universe winds up, not down...The universe we observe we observe is simply not decaying; the generalization of "the law of increasing disorder" to the entire cosmos is unsupported by observation...If there is no tendency toward evolution or progress in nature, then human existence itself is nothing but a meaningless accident...in a timeless or a decaying cosmos there is no room for anything that has value for humanity ,no room for consciousness, joy, sadness, or hope (Lerner 1991:287-91).*

Consequently, he contends that the second law holds only in systems that are already very close to equilibrium, where each part in the system has almost the same temperature and there is little useful energy left. If, however, the system was already far from equilibrium, with significant flows of energy through it then , Lerner affirms, it would not tend to return toward equilibrium but would move away from it, creating order and structure in the process.

Lerner's proposed mechanism is the growth of fluctuations through instability. For example, in a heated pot of water, instability creates order by "capturing" the flow of heat energy from the stove to the water, resulting in the growth of convection patterns.

The trouble with this example is that an external energy flow, which is itself ordered, is needed to set off the growth of order in the heated water. Lerner has not shown that the total order of the entire system (water, pot, flame) has in fact increased. Thus, he has not proven that the universe as a whole can escape the consequences of the second law.

Since there is, of course, no conclusive proof either way, a word of caution might be in order about drawing universal conclusions from the second law. Yet, if one follows the plausible principle that known physical laws should be followed as much as possible, rather than postulating new ones, then the evidence currently favors the universal applicability of second law.

Even so, it may still be possible to avoid a finite beginning or a heat death future. It was suggested by the Austrian physicist Ludwig Boltzmann in the late 19th century that the order we see may be due just to random fluctuations. In a very large universe, even if it were in a state of thermal equilibrium, random motions would still produce small, highly ordered regions of lower entropy. If such regions are large enough and last long enough, then life might originate.

Is this feasible? Appreciable entropy fluctuations are very rare in any volume having more than just a few particles. Yet the entire visible universe seems to be in a state of low entropy. Can we really consider the entire visible universe as a random fluctuation? This implies not only that the universe must be vastly larger than the region now observable, but also that the unobserved part of the universe, which is presumably in a chaotic state of high entropy, must be drastically different from the orderly universe we see. This contradicts the usual assumption of uniformity.

Again, we conclude that the evidence favors the universe winding down from an initial state of high order. Yet, this initial state need not have occurred a *finite* time ago. In principle the entropy could have increased from a minimum value in the *infinite* past. This would be the case in a cosmological model such as Gamow's infinitely old contraction-expansion universe, described above.

To sum up, the scientific arguments for a beginning to the universe are not foolproof. The argument from the supposed Big Bang singularity relies too much on a specific cosmological model and on speculative extrapolations beyond the model's range of validity. Although the case based on thermodynamics avoids these shortcomings, it, too, falls short of decisively proving that the universe began a finite time ago.

This is not to deny that cosmological evidence for a beginning seems plausible. But plausibility falls short of proof and, as we saw, those who wish to deny a beginning can construct beginningless alternatives which, in their eyes, may seem more credible, based on the same observational data.

Of course, under theistic assumptions, the alleged scientific evidence for a beginning is limited by its uniformity assumptions. For all we know, God could have added energy and order to the universe, or changed its laws, from eternity. For example, we noted in an earlier chapter that the second law of thermodynamics might not fully apply before the Fall or after the eschaton. Therefore, we can know for sure that the universe was created a finite time past only because God has revealed that to us.

The Argument from Design

Although the second law of thermodynamics may fall short in proving the beginning of the universe a finite time ago it may still point to the Creator. For, if the universe has been steadily unwinding, how did it come to be wound up in the first place? Where did the initial order come from? Such questions lead us to a second popular proof for the existence of God: the argument from design.

The argument from design was strongly promoted by William Paley in his book *Natural Theology* (1802). He argued that, like the detailed mechanism of a watch reflected the purposeful craftsmanship of a watchmaker, so the intricate organization of the world pointed to the existence of an intelligent Creator.

Does the observed complexity of the universe necessarily involve a creator? Or could that complexity perhaps be explained as the result of purely natural processes?

The amazing characteristics of biological organisms and ecological systems were often taken as the most persuasive evidence for a divine designer. Yet this interpretation was challenged by Charles Darwin's *The Origin of the Species* (1857), wherein he conjectured that the observed biological diversity was caused solely by random mutations and natural selection.

A Fine-Tuned Universe

Design seems clear also in cosmology. From various cosmological considerations, the universe appears to be remarkably fine-tuned. Had

the physical laws and initial conditions been only slightly different then, it seems, the universe would have been unable to sustain life. Spectacular fine-tuning of the universe is needed for human life. Let's consider a few main factors.

1. Entropy

If entropy, the amount of disorder of the universe, is always increasing, then the universe must initially have been created in an orderly condition, as we just discussed. According to Paul Davies (1983:168):

> *If the universe is simply an accident, the odds against it containing any appreciable order are ludicrously small. If the Big Bang was just a random event, then the probability seems overwhelming (a colossal understatement) that the emerging cosmic material would be in thermodynamic equilibrium at maximum entropy with zero order. As this was clearly not the case, it appears hard to escape the conclusion that the actual state of the universe had been 'chosen' or selected somehow from the huge number of available states, all but an infinitesimal fraction of which are totally disordered. And if such an exceedingly improbable initial state was selected, there surely had to be a selector or designer to 'choose' it?*

The physicist Roger Penrose (2004:764) estimates that the odds of the initial low entropy state of our universe occurring by chance alone are on the order of 1 in 10ˆ(10^123), an incredibly tiny number!

2. The Expansion Rate

In the standard Big Bang model, the expansion rate of the universe appears to be very critically balanced. Had it been a fraction less it would have re-collapsed within seconds; had it been a fraction more, galaxy formation would have been impossible. To avoid these disasters the expansion rate during the early instants had to be fine-tuned to about one part in 10^55, according to philosopher John Leslie (1989:3).

The expansion rate can be accounted for by inflation, but this itself requires fine-tuning: two components of an expansion-driven cosmological constant cancel each other to an accuracy of one part in 10^50. Leslie estimates that a change by one part in 10^100 in the present strengths of either the nuclear weak force or gravity might end in disaster.

3. The Elements

Hydrogen and carbon are essential for life, at least as we know it. Had the nuclear weak force been a little stronger, the Big Bang would have burned all hydrogen to helium; had it been a little weaker, the neutrons formed at early times would not have decayed into protons, and again there would be no hydrogen. Leslie (1989:4) notes that, for carbon to be created in quantity inside stars the strong nuclear force had to have its present value to within one percent either way.

4. Life

Fine-tuning is needed not only in the initial conditions and in the physical forces, but also in the generation of complexity, in particular life. In the previous chapter we discussed how immensely unlikely it was that even one simple cell could be assembled by chance, even if all the needed materials and conditions were present.

Astronomer Guillermo Gonzalez and theologian Jay Richards, in their book *The Privileged Planet* (2004), list many very special features of our Earth that make it uniquely suitable for sustaining intelligent life and for enabling the scientific study of the universe.

A host of Christians, including John Leslie, Richard Swinburne, and Hugh Ross, have based their case for the existence of God upon such cosmological evidence of design. They are not alone. Many non-Christian scientists, too, have been struck by the spectacular fine-tuning of the universe. Thus, Stephen Hawking writes,

> *the odds against a universe like our emerging out of something like the Big Bang are enormous. I think there are clearly religious implications (Boslough 1985:121).*

Freeman Dyson, in a similar vein, writes:

> *numerous accidents that seem to conspire to make our universe habitable...The more I examine the universe and the details of its architecture, the more evidence I find that the universe in some sense must have known we were coming (Dyson 1979:250).*

And Paul Davies (1983:189) also concludes:

> *It is hard to resist the impression that the present structure of the universe, apparently so sensitive to minor alterations in the numbers, has been rather carefully thought out.*

He finds that "the impression of design is overwhelming" (Davies 1988: 203).

Alternatives to Design

Yet such conclusions are by no means unanimous. Various alternative explanations of such fine-tuning have been proposed. Let’s consider these.

The Multiverse

Are there other physical universes beyond our observable world? Many scientists believe so. They speculate that infinitely many other universes exist parallel to ours. The entire complex of universes is called the *multiverse*.

From a naturalist perspective, the notion of parallel universes has some plausibility. If our universe were indeed started by a quantum fluctuation that developed into a Big Bang, why should such a physical process not generate other universes?

Moreover, the multiverse hypothesis offers a simple naturalist explanation of the fact that our universe seems to be remarkably fine-tuned for the existence of life. If there were an infinite number of universes then, it us argued, life must evolve on some of these, no matter how small the probability. Clearly, humans will exist only in

those universes that are just right for intelligent life. Hence, we will naturally find our own universe to be fine-tuned.

Cosmologist Max Tegmark (2003) distinguishes between four levels of multiverses:

Level 1. Universes far away in space. Cosmic inflation predicts an infinite universe having infinitely many Big Bangs. These universes have the same physical constants and laws of physics. Most universes will differ from ours. However, since there are infinitely many, a certain fraction of these will be identical to ours.

Level 2. Universes with different physical constants. In the eternal inflation theory, space is forever stretching but some regions stop stretching and form distinct bubbles. These become level I multiverses. Different bubbles experience spontaneous symmetry breaking, which results in different properties, including different physical constants.

Level 3. Parallel quantum worlds. In a quantum event, we cannot predict the outcome but can only give a range of possibilities. In the Many-Worlds Interpretation (MWI) of quantum mechanics each possibility corresponds to a different universe. Thus, at each quantum event the universe splits into many worlds, which cannot interact. This produces the same type of worlds as levels 1 and 2, but in an infinite-dimensional space.

Level 4. The Ultimate Ensemble. Universes with all possible mathematical structures.

Since parallel universes do not interact with our own, their existence cannot be proven. Many cosmologists believe in the existence of other Level 1 universes. On the other hand, Levels 2 and 4 are much more speculative. Level 3 depends on one particular interpretation of quantum mechanics.

Although the multiverse hypothesis might seem to undercut the notion that our universe is designed, it still does not resolve ultimate issues. We are still left with many profound questions. Did the multiverse always exist? Why does it have the properties it has? Is its existence due to necessity, chance, or purpose? The question of design has simply been shoved to a higher level.

In any one of these schemes the presence of our universe, with its relative hospitality towards life, is explained as a chance occurrence, a rare phenomenon in the virtually infinite set of universes, the vast majority of which have been barren.

Richard Swinburne (1990:167) contends that the many-worlds view goes against normal scientific method. We extrapolate to distant parts of the universe by assuming that the present laws will hold. All the evidence points to the constancy of these laws. The most striking evidence of this comes from the observed isotropy of the universe. There may be states of affairs (*e.g.*, at a singularity) where some of the laws won't hold, but there is no evidence suggesting that in general the laws were different. In all regions of the space and time that are spatially and temporally related to our own, we have no reason to doubt that the physical laws and boundary conditions were quantitatively the same as our own; we have no reason to doubt the universal application of induction.

In the many-worlds quantum theory there are an infinity of universes, none of which will ever produce any observable effect on our universe. Swinburne (1990:170) reasons that it would be much simpler to interpret quantum mechanics as only describing physical probabilities of the behavior of the real constituents of the universe.

According to Swinburne (1990:171),

> *it is a crucial tenet of the scientific method that entities are not to be postulated beyond necessity....to postulate infinitely many worlds in order to save a preferred interpretation of a formula, which is in no way obviously simpler than the alternative explanation, and to avoid having to postulate a very narrow range of boundary conditions, seems crazy.*

He concludes that it is much simpler to explain our tailor-made universe by specifying just one entity of a simple kind: God. The existence of God is much more likely on the evidence of our life-producing world than the existence of many worlds.

John Leslie, too, has argued that the God hypothesis is simpler and more plausible as an explanation of the fine-tuning than these multiverse hypotheses. According to Leslie (1985), the latter are all very artificial and unsupported by any independent evidence, while there exists other evidence in favor of belief in God. John Polkinghorne, too, argues for the superiority of the theistic option:

> *A possible explanation of equal intellectual respectability - and to my mind greater economy and elegance - would be that this one world is the way it is because it is the creation of the will of a Creator who purposes that it should be so (Polkinghorne 1986:80).*

On the other hand, Drees doubts that simplicity favors design over multiple worlds. Simplicity, he argues, has to do with the *structure* of a theory, not the number of *entities* it predicts (Drees 1989:68).

Baptizing the Multiverse

Many Christians support the notion of a multiverse. For example, Ian Barbour thinks that one could interpret multiverse hypotheses theistically; God and chance need not be mutually exclusive. He suggests the possibility that:

> *God created many universes in order that life and thought would occur in this one. Admittedly, this gives chance an inordinately large role, and it involves a colossal waste and inefficiency if there are many lifeless universes. But then again, one might reply that for God neither space nor time is in short supply, so that efficiency is a dubious criterion (Barbour 1990:138).*

To this one might respond that, surely, an omniscient God has no need of chance. Indeed, to him there is no such thing as chance. Since he knows what initial conditions will generate a favorable universe, why should he create countless many just to generate ours?

Evangelical cosmologist Don Page (2008) offers a different theological argument for a Level 3 (MWI) universe. Page assumes that God values elegant laws of physics. God loathes to violate these, even to reduce human suffering. Although our universe might seem to have a

large degree of unnecessary evil, Page believes that God has created the multiverse as the best possible *total* world.

In a Level 3 universe, with each quantum event (occurring everywhere, every second), the world splits into many worlds, one for each possible outcome. Each of these worlds is at that time identical, except for the one different outcome. Thereafter, they develop independently, continually splitting as more quantum events occur.

For example, there are many copies of myself, in other worlds, that have split off from me since my conception. Since no communication is possible between the various worlds, each copy of myself believes he is the real me.

Left to itself, everything that is possible in the multiverse will happen in some world. Since there might be some worlds where Christ did not arise from the dead, Page suggests that on special occasions, such as the Resurrection of Jesus Christ (and perhaps some other miracles) God intervenes so that there is only one outcome.

What are we to make of Page's theistic multiverse? It suffers from several shortcomings.

1. First, it depends on a particular *interpretation* of quantum mechanics. There are other interpretations, equally well satisfying the observational data, that do not involve world splits.

2. Second, it assumes that everything in the universe is entirely material and, further, that all material properties can be completely expressed in terms of quantum mechanics. Such reductive materialism has no place for a conscious mind, nor a human soul. Nor is there any room for angels or demons. This restricted, materialist view of reality contradicts both common sense and Scripture.

3. Third, it entails multiple human incarnations of Jesus Christ. It is already difficult for us to conceive of Christ having two natures, human and divine. Yet Christ must now encompass many human natures, each having a separate consciousness.

Moreover, heaven is surely not ruled by quantum mechanics. Hence it should experience no quantum splits. We can thus expect that there is only one heaven, with only one great white throne (Rev.20), and only one Lamb. Yet, if there are multiple Christs, with multiple incarnations, resurrections, and ascensions, then there should be many resurrected bodies of Christ in heaven. Which of these corresponds to the Lamb? The Bible clearly says that Christ's Incarnation was unique, having cosmic significance (Col.1:19-20).

4. Fourth, the Bible relates that God did not create all possible worlds, nor even a small number of worlds. Rather, God created one world according to one comprehensive plan (Eph. 1:10-11).

In sum, from a Christian perspective, I see little merit in Dr. Page's theistic MWI (Level 3) multiverse proposal.

What about the other levels of multiverses? As I noted above, the naturalist may find these convenient to explain the origin and design of our universe. Christians, however, believe that God created this universe through supernatural means, following a specific design. We therefore have rather less incentive for believing in the existence of a multiverse.

Finally, even if such parallel universes existed, they could not interact with ours. So, we could never know anything about them. Hence, the question of their possible existence is largely academic and extra-scientific.

Anthropic Principles

A naturalist explanation of fine-tuning requires not just a multiplicity of universes but also a workable selection effect. How is it that we just happen to be in a universe favorable to life? One obvious answer is that, if the universe had been different, we would not be there to see it. Hence the physical properties we see are the result of an all-embracing selection effect. To quote Barrow & Tipler (1986:2):

> *...any observed properties of the universe that may initially appear astonishingly improbable, can only be seen in their true perspective after we have accounted for the fact that certain*

> *properties of the universe are necessary prerequisites for the evolution and existence of observers at all.*

Such an explanation makes use of what is called the *anthropic principle*. The anthropic principle is used in various forms:

a. The Weak Anthropic Principle (WAP).

This is the weakest, most basic version of the anthropic principle. It refers primarily to the self-selection principle: what we see must be compatible with our existence. The definition given by Barrow & Tipler (1986:16) is:

> *the observed values of all physical constants...take on values restricted by the requirement that there exist sites where carbon-based life can evolve and by the requirement that the universe be old enough for it to have already done so.*

In short, our observations must be biased in favor of scenarios in which we exist.

b. The Strong Anthropic Principle (SAP).

This is more stringent and much more speculative. Barrow & Tipler (1986:21) define it as the concept that "*the universe must have those properties which allow life to develop within it at some stage in its history*". It is often tied in with the multiverse view: that all possibilities must occur, including a few where life arises.

Whereas the weak form states that the universe to be such that life *can* occur, the strong form specifies that life *must* occur. SAP specifies that life must arise not just in our universe, but in all possible universes. Swinburne (1990:165) notes that WAP is just a trivial truth: any theory must be compatible with the observations. It must be kept in mind that WAP is not a causal explanation: we cannot say that the initial conditions and laws are the consequence of our existence. Rather, it is the other way around. As to SAP, with its claim that the laws of nature must be such that life can exist, this has no evidence to support it. According to current knowledge, the opposite seems to be true. The universe was very much more likely *not* to produce life.

Heinz Pagels (1990) asserts that the anthropic principle is much ado about nothing, being deeply flawed and having no place in cosmology. He complains that it is entirely *ad hoc*, predicts nothing, and is immune to experimental falsification. It has been more fruitful, he argues, to search for explanations in terms of the laws of nature than to point to an alleged selection effect. The question boils down to whether the initial conditions of the universe were arbitrary or necessary. Only in the former case does it make sense to appeal to a selection effect such as the anthropic principle. Until the origin of the universe is better understood, it is premature to invoke the anthropic principle. The anthropic principle, Pagels contends, detracts from real science; those who use it have in effect given up on the attempt to find a truly fundamental explanation for the nature of things.

Pagels notes that the anthropic principle is in direct competition with the theistic principle: that the universe seems fine-tuned for our existence because it was fine-tuned for our existence by God. His assessment of those upholding the anthropic principle:

> *Of course, some scientists, believing science and religion mutually exclusive, find this idea unattractive. Faced with questions that do not neatly fit into the framework of science, they are loath to resort to religious explanation; yet their curiosity will not let them leave matters unaddressed. Hence, the anthropic principle. It is the closest that some atheists can get to God (Pagels 1990:175).*

WAP may explain something if combined with a multiple universe theory. But it does not explain why we have precisely this universe and not one, say, slightly less isotropic. If this universe is the way it is only for the purpose of creating life, then its arrangement could have been much less precise.

The Theory of Everything

The above comments by Pagels raise a third possibility: that the apparently arbitrary values of the physical constants are in fact dictated by a more basic law. It may be that a more fundamental theory will show that the constants *must* have the values that they have. In that case coincidences such as thus listed above will turn out to be necessities.

Recently efforts have been made to construct a Grand Unified Theory, which would unite the nuclear and electromagnetic forces into a single theory. Much work has also gone into trying to combine general relativity and quantum mechanics into a unified theory of quantum gravity. Such a theory is needed in situations where the matter-energy density is extremely high, such as is envisioned shortly after the Big Bang. The latest theories, involving multi-dimensional "super-strings", try to fuse all these forces into a single theory, a Theory of Everything (TOE). It is called a theory of *everything* because it is thought that everything in the universe could be logically deduced from such a theory.

A successful TOE theory might seem to undermine the argument of design. However, according to Barbour (1990:139), such a theory would be welcomed by the theist as part of God's design. While such a theory might show that only one universe is possible and that the characteristics of our universe are necessary rather than accidental, it would still leave unexplained why or how it came to be instantiated in the real world.

However, even a TOE would not totally explain fine-tuning. To derive conclusions about particulars we need not only universal laws, but also proper boundary conditions. As Barbour (1990:139) asserts: "*evolution must be described by a historical account of events and not by predictive laws alone*". Thus we would still be left with the question as to why the boundary conditions were as they were.

Further, for a TOE to explain literally everything, including the features of every individual of every species, clearly requires an extremely detailed knowledge of the boundary conditions that is beyond human capacity.

Stephen Hawking has also considered the possibility of a TOE. He finds that even if such a theory could be found, it would still leave unanswered questions:

> *Even if there is only one possible unified theory, it is just a set of rules and equations. What is it that breathes fire into the equations and makes a universe for them to describe? The*

> *usual approach of science of constructing a mathematical model cannot answer the questions of why there should be a universe for the model to describe (Hawking 1988:174).*

Nevertheless, Hawking is optimistic:

> *However, if we discover a complete theory, it should in time be understandable...by everyone...Then we shall all...be able to take part in the discussion of why it is that we and the universe exist. If we find the answer to that, it would be the ultimate triumph of human reason - for then we would know the mind of God (Hawking 1988:175).*

Hawking overestimates the value of a TOE, while underestimating the content of God's mind.

To summarize, even if a TOE could be found, the question of design remains. One still needs to explain the boundary conditions, the existence of the TOE, and the existence of the universe itself. All of this assumes, of course, that everything in the universe is the result of normal, physical laws. Allowance for spiritual influences and miracles diminishes even further the significance of a TOE.

A Naturally Selected Universe

The American astronomer Edward Harrison (1995) has proposed that our universe was made by highly intelligent forms of life living in another universe and that the fine-tuning in our universe has been naturally selected.

Harrison contends that it may be possible to create a universe, under controlled laboratory conditions, by forming a small (10 kg), black hole from high-energy particles. The physical constants in the offspring universe would probably be much the same as the values in the parent universe.

Highly intelligent beings could then create new universes that would be hospitable for intelligent life. Only universes having intelligent beings are likely to reproduce.

He assumes that, initially, there was a set of universes, with differing fundamental constants, having at least one universe where intelligent

life occurred. Thereafter, by reproduction, intelligent universes dominate the set. Universes most hospitable to intelligent life are naturally selected by their ability to reproduce.

Harrison argues that belief in a supernatural creator stops scientific inquiry, while the anthropic principle implies a vast wasteland of mostly barren universes. His choice, on the other hand, has life itself taking over the creation business, which then drops out of the religious sphere and becomes open to scientific investigation.

It is clear, however, that this proposal has several weaknesses. First, the proposed scenario of universe creation is, to say the least, highly speculative, based on cosmological conceptions and particle physics theories that have not been empirically tested. To the extent that it postulates a parent universe no longer spatially or causally connected to our own, it is inherently unverifiable.

Second, natural selection, as an explanation of complexity, generally involves an evolution in the direction of increased complexity. Here, however, the direction is reversed: our universe is postulated to have been created by superior, rather than inferior, beings. This is much like, using Paley's analogy, finding a watch, and inferring from it, not a watch maker, but a sophisticated watch-making machine. It explains the original problem at the high expense of replacing it with a much more difficult one. We are still left with the question as to what created the first set of universes, particularly the one having the superior intelligent beings. This brings us back to many-world theories and anthropic principles.

In short, the proposal that our universe was created by intelligent beings in a parent universe is not a plausible explanation of the origin of our universe. The natural selection scenario is contrived, unverifiable, and ultimately reduces merely to an unnecessarily more elaborate version of the theistic or anthropic principles. It seems more rational to consider our universe as the first one to have created intelligent beings.

Summing up, the observed features of the universe seem to be much more plausibly explained through Divine design than by the alternative

explanations of many-world theories, anthropic principles, theories of everything, or natural selection. Nevertheless, it must be granted that the argument lacks compulsion. In judging scientific theories, criteria such as simplicity and plausibility are often in the eye of the beholder, a beholder whose assessment is shaped by his deepest religious convictions.

Design and Evolution

If the universe did in fact have just the right parameters needed to evolve to its present state, with all its detailed structure and diverse forms of life, this might be seen as strong evidence for evolution. After all, in a universe created instantaneously, in mature form, the critical cosmological parameters, such as the density and the expansion rate, could conceivably have been much different. It may seem that, from a creationist perspective, the fine-tuning is merely coincidental.

In response, we note first that much of the fine-tuning allegedly needed for life to evolve is needed also to sustain life. Life, as we know it, depends critically on the unique properties of the elements carbon, nitrogen, hydrogen, and oxygen. The necessary life-sustaining properties would no longer exist if, for example, the nuclear or electron-magnetic forces were only slightly different, or if the relative masses of electrons and neutrons were in slightly different proportions. Thus also a recently created universe would require a considerable degree of fine-tuning of physical constants and laws.

Second, many of so-called anthropic coincidences are based more on theoretical speculation than on observational fact. Take, for example, the high precision required of the early expansion rate, as listed above. Such high precision is certainly not observed, since the present expansion rate is known to a precision of no better than a few percent. Rather, it is inferred purely based on theoretical calculations. As such, the hypothetical fine-tuning could be viewed as a measure of the implausibility of Big Bang cosmology. It can explain the present universe only based on a conjectured past expansion rate which was extremely improbable.

Conclusions

Winding up our discussion of the proofs for the existence of God, I stress the following points:

1. Limitations of the Proofs

Although the cosmological evidence makes it plausible that the universe began a finite time ago, it is by no means conclusive. The limited nature of the data and the speculative nature of the theories leave open the possibility of a beginningless universe. Similarly, much of the seemingly striking evidence of design could conceivably be explained without resorting to a Designer.

Nevertheless, while such arguments are not compelling, they clearly do have some persuasive force. Indeed, several astronomers have drawn theistic implications from Big Bang cosmology. This has led some to reject Big Bang cosmology. Others have accepted some form of a Creator or Designer.

Few, however, seem to have thereby been converted to orthodox Christianity. Why is this the case? Possibly because the cosmological argument leads to only a prime mover, an eternal being who starts the universe. The teleological argument gets us little further. John Leslie (1990:186), an advocate of the argument from design, contends that God need not be a person at all, but merely a "creatively effective ethical requirement for the existence of a (good) universe or universes". These gods, as impersonal abstractions, are hardly objects inspiring or requiring our worship. At most this brings us to only a deistic God: the plausibility of providence, supernatural revelation and miracles must still be shown. Clearly, a huge step is still needed to move beyond the Prime Mover or Designer to the living God of the Bible.

2. Commitment to the Big Bang

A further problem in arguing from the Big Bang to the biblical God is the commitment to Big Bang cosmology that it entails. Tying a theistic

proof too closely to a particular model invites theological disaster should that model be dethroned. Even more important, the biblical view of reality is quite different from that of Big Bang cosmology, as we shall show in a later chapter. These differences involve matters concerning not only origins and eschatology but also the present structure of the universe. For example, Big Bang cosmology has no place for a transcendent God, for supernatural causes, or for an immortal soul.

Thus, in constructing a Christian view of reality, Big Bang cosmology must ultimately be replaced by cosmological concepts that are more in accord with biblical givens. It follows that the argumentation of such apologists as Craig and Ross has limited value to bolster the faith of Christians. Indeed, their endorsement of Big Bang cosmology ushers in a new epistemology that gives much too high a weight to speculative theorizing, under the guise of general revelation. This will inevitably have grave implications for traditional views of biblical authority and hermeneutics.

Once we allow for a supernatural God, the case for a Big Bang singularity is considerably weakened, since other plausible options are now possible. If God could create the entire universe *ex nihilo* at the singularity, it is not unreasonable to conjecture that, for example, he formed this universe out of an earlier universe, or that he created the entire universe *ex nihilo* in the more recent past. The question now becomes a theological one and can be answered only through what God has revealed to us in his written word.

3. God Revealed Through Nature

To what extent can one construct a natural theology, relying only on reason and science, from cosmological evidence? The Bible itself proclaims:

> *The heavens declare the glory of God… (Psa. 19:1)*
>
> *For his invisible attributes, namely, his eternal power and divine nature, have been clearly perceived, ever since the creation of the world, in the things that have been made. So, they are without excuse. (Rom.1:20)*

This shows that at least some characteristics of God can be clearly perceived through nature: his glory, eternal power, and deity.

God reveals himself through nature in such a way that everyone is fully aware of God’s existence. This knowledge does not depend upon logical proof or scientific argumentation. It is much more direct. Look at the majesty, beauty, goodness, and order around us: at the stars, flowers and so on. Is it not obvious that they must have been created by a great God? Even pre-scientific man could discern the order, beauty, vastness, and harmony of the creation.

Man, made in the image of God, cannot look upon the things of nature without at once perceiving them as the work of God. It seems that God has created us with the innate sense of clearly discerning him in nature, the *sensus divinitatis* referred to by John Calvin (1559).

This is clear in the nature psalms (*e.g.*, Psalms 8, 19, 29, 65, 104), which reveal the insight of faith into the work of God's hands. The nature-psalms deal not with *abstract* aspects of cosmic reality but rather with common, everyday experiences. Moreover, these psalms are set amid God’s people. The psalmist never views nature as revelation apart from God's word: God's law is never far from his thoughts. Hence, as noted by Stephen Spencer (1988), the nature Psalms supply a theology of nature rather than a *natural theology*. God's natural revelation is interpreted within the framework of his word rather than independent of it. We must view nature through the eyes of faith informed by Scripture.

Yet while the divinity of God is clearly revealed through nature, fallen man distorts and suppresses this knowledge and rejects God. Therefore God gives him up to dishonorable passions and a darkened mind chasing futile thoughts (see Rom.1:18, 21-32).

Only through the preaching of the Gospel and the operation of the Holy Spirit that man can now come to a proper knowledge of God. Fallen man needs Scripture to interpret nature correctly. Thus, while there is a natural revelation, this does not lead to a natural theology: without Scripture to guide us man loses himself in futile speculations. To use the analogy of John Calvin (15 59), man's eyes are too dim to properly

read the book of nature; he needs the spectacles of Scripture to dispel the darkness and give him a clear view of the true God, thus correcting his distorted notions of Deity.

The knowledge God reveals through nature concerns only his attributes. Moreover, this knowledge is acquired through faith, rather than scientific investigation. God's general revelation certainly does not include Big Bang cosmology, which is not a revealed truth. It is mere speculation and as such does not count as valid evidence for God. Nor is it needed: man’s experience with nature already leaves him without excuse.

In short, cosmology tells us very little about God. Through a study of the structure and properties of the universe we may gain a better understanding of God's handiwork, but not a great deal about the Creator. The scope of natural theology - the study of God via nature and human reason, as opposed to revelation - is extremely limited.

What is left, then, of the apologetic status of these theistic proofs? Although they fall short of proving the existence of the biblical God, their prime value consists in showing that the naturalism inherent in modern science cannot consistently be kept. Ultimately, naturalism does not give satisfactory explanations for the full richness of our experienced reality and gives little insight into the deeper questions of origins, purpose, and destiny. Naturalism, consistently applied, inevitably undermines itself.

7. Strange Modern Gods

Two chief concerns of religion are the nature of God and what happens after we die. In an earlier chapter we discussed the implications drawn from modern cosmology concerning the existence of God. There we noted that, at best, the evidence can suggest only a Prime Mover or Designer, a deistic being that falls far short of the living God of the Bible. We shall now examine a selection of gods that have been constructed to fit into various cosmological models. To what extent can these be reconciled with traditional Christianity? We shall be concerned with comparing the modern gods to the biblical God and investigating what kind of hope they offer about individual immortality.

The Evolving God of Natural Theology

Basic to modern cosmology is the notion of evolution: that the entire universe and its contents has developed naturalistically from the initial singularity. If God is a natural being, living entirely within the confines of the physical universe, then it follows that God, too, must be evolving. Thus the God of modern cosmology is generally conceived, if at all, as an evolving God.

The notion of an evolving God can be traced back to the German idealist philosopher Friedrich Schelling (1775-1854). In 1810, he introduced a radical evolutionism into metaphysics and theology. According to Schelling, God is subject to suffering and change, and will only become perfect in the distant future, at the final state of the universe. God is identified with the evolutionary process, or, at least, with the not yet realized end product of the process.

These revolutionary ideas were taken up and reworked by the French philosopher Henri Bergson (1859-1941) in his book *Creative Evolution*, published in 1907. He believed that, metaphysically, *becoming* was more basic than *being*. Evolution was seen as a creative force, in the sense that it always engendered something wholly new, something unexpected. Nature was viewed as an organic whole, ultimately purposeful because it is driven by a non-physical, impersonal Life

Force, whose future and goals are ultimately unknowable.[5] Although Bergson was aware of the inevitable thermodynamic Heat Death, he suggested that life may be able to take a form in which the heat death was delayed indefinitely. Bergson was to have a great influence on another Frenchman, the Jesuit Teilhard de Chardin, to be discussed shortly.

A decade later another version of an evolving God was developed, this time in England by Samuel Alexander (1859-1938). Alexander's fundamental entity was Space-Time. This generates first matter, then life, and finally mind. Beyond mind there is yet a further, much superior, stage, which Alexander termed "deity". As mind can exist in a living being, so deity can exist in mind. However, just as most living beings do not have mind, so also most minds will not have deity. The purpose of the universe is to bring deity into being. Beings with finite deity are finite gods. God includes the whole universe, although his deity is lodged in only a part of it. According to Alexander, such an evolving God does not yet exist but will appear at some future time.

Natural Evolving Gods

Several more recent authors have also promoted the notion of an evolving god. First, we shall examine several proposals from scientists who have no sympathy with Christianity. Their gods are purely natural, purportedly involving only natural cause and effects. Later, we shall investigate various proposals by theologians as to how to incorporate some form of Christian God into an evolving cosmos.

1. The God of Paul Davies

First, we consider the natural god proposed by physicist Paul Davies in his 1983 book *God and the New Physics*. Davies writes, "it may seem bizarre, but in my opinion, science offers a surer path to God than religion". He is convinced that the scientific evidence favors the

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[5.] See the analysis by Barrow & Tipler 1986:90. Throughout this section I am much indebted to their treatment.

existence of a God. What has convinced Davies that God must exist? He cites several factors:

> *It is clear that no order at all could exist unless the universe as a whole started out with a considerable stock of negative entropy. If total disorder always increases, in accordance with the second law, then the universe must, it seems, have been created in an orderly condition. Does this not provide strong evidence in favor of a creator-designer? ...If the universe is simply an accident, the odds against it containing an appreciable order are ludicrously small (Davies 1983:166-7).*

He finds that there are many mysteries about the natural world that would readily be explained by postulating a natural God. Davies is quite impressed by the apparent fine-tuning of the universe. He writes:

> *It is hard to resist the impression that the present structure of the universe, apparently so sensitive to minor alterations in the numbers (of the fundamental physical constants), has been rather carefully thought out (Davies 1983:189).*

He notes the puzzles of the origin of galaxies and of life.

Nevertheless, Davies is careful to avoid the "*god of the gaps trap*". He argues,

> *"To invoke God as a blanket explanation of the unexplained is to invite eventual falsification, and to make God the friend of ignorance" (Davies 1983:209).*

Although Davies is convinced that there must be a God, he objects to a supernatural God. He insists that miracles, being repugnant to scientists, are to be avoided. A natural God, Davies believes, is more plausible than a supernatural one:

> *The hypothesis that a natural God created life, within the laws of physics, is at least known to be possible and consistent with our scientific understanding of the physical world...(Davies 1983:209).*

Davies suggests that:

> *...it is possible to imagine a super-mind existing since the creation, encompassing all the fundamental fields of nature, and taking upon itself the task of converting an incoherent Big Bang into the complex and orderly we now observe; all accomplished entirely within the framework of the laws of physics. This would not be a God who created everything by supernatural means, but a directing, controlling, universal mind pervading the cosmos and operating the laws of nature to achieve some specific purpose...Nature is a product of its own technology, and that universe is a mind: a self-observing as well as self-organizing system (Davies 1983:210).*

He suggests such a mind can "*load the quantum dice*", thereby controlling everything that happens, and can thus escape our attention. This God would be the creator of everything we see, having made matter from pre-existing energy, and set up the necessary conditions for life, but he would not be capable of creation out of nothing, as Christian doctrine requires. Davies is of the opinion that "*such a picture of God might well be enough to satisfy most believers*".

Several questions come to mind. For one, how can a purely natural being "*load the quantum dice*", as Davies puts it? To invoke such a concept, going beyond known physics, smacks of the "*god of the gaps*" thinking that Davies expressly wishes to avoid. A further major deficiency is that Davies does not explain how such a natural God could arise in the first place. To explain the order in the universe Davies invokes a Designer. But if this designer itself is the result of purely natural forces, as Davies contends, its origin is even more in need of explanation. Davies tries to explain one mystery by appealing to an immensely greater one. Since he limits himself to purely natural explanations, his solution seems highly implausible. Only a supernatural creator can do the job Davies needs from him.

Further, the power of Davies' God is very limited. Controlling only quantum states, it is still bound by the laws of physics. It can do no miracles. Consequently, if offers man no hope for a life hereafter. Indeed, the divine mind itself, being purely natural, cannot hope to escape eventual destruction, whether via the heat death or Big Crunch.

In short, this is not a God that demands worship or answers prayer. Hence, contrary to Davies' optimistic expectations, this "God" is unlikely to satisfy many religious needs.

2. The God of Freeman Dyson

Another attempt to create a natural god has been made by physicist Freeman Dyson in his1988 book *Infinite in All Directions*. We have already considered Dyson's optimistic view of the future. As the reader may recall, Dyson argues for the eternal survival of life in the universe.

To Dyson the most astounding fact of the universe is the power of mind that drives our bodies. Mind, through biological evolution, has made itself a driving force in our little corner of the universe. The tendency of mind to infiltrate and control matter is a fundamental law of nature. Dyson writes:

> *Mind is patient. Mind has waited for 3 billion years on this planet before composing its first string quartet. It may have to wait for another 3 billion years before it spreads all over the galaxy (Dyson 1988:118).*

When mind has further expanded its organization by many orders of magnitude beyond the human scale then we can no more expect to understand its thoughts than a butterfly can understand ours. At that stage it may be called "*God*".

Dyson considers God to be either a world-soul or a collection of world-souls. At the present stage of development, we may be the chief inlets of God on this planet. Dyson's god is neither omniscient nor omnipotent, but one who learns and grows as the universe unfolds. As such, the universe is not deterministic but open. Chance is part of God's plan; chance exists because God shares our ignorance. Dyson considers this god to be close to the one of process theology, which will be discussed later.

The universe, according to Dyson, has a deep purpose. He asserts:

> *I believe that we are here to some purpose, that the purpose has something to do with the future, and that it transcends altogether the limits of our knowledge and understanding...If you like, you can call the transcendent purpose God. If it is God, it is a Socinian God, inherent in the universe and growing in power and knowledge as the universe unfolds. Our minds are not only expressions of its purpose but are also contributions to its growth (Dyson 1988:294).*

Dyson uses the word *Socinian* in reference to the Italian Protestant theologian Lelio Sozzini (latinized to *Socinus*) (1525-1562), who denied original sin, the deity of Christ, the Trinity, and predestination.

Regarding scientific evidence for God, Dyson writes:

> *The argument from design is a theological and not a scientific argument...I consider the argument from design to be valid in the following sense. The universe shows evidence of the operation of mind on three levels. The first level is the level of elementary physical processes in quantum mechanics. Matter in quantum mechanics is not an inert substance but an active agent, constantly making choices between alternative possibilities according to probabilistic laws...It appears that mind, as manifested by the capacity to make choices, is to some extent inherent in every electron. The second level at which we detect the operation of mind is the level of direct human experience. Our brains appear to be devices for the amplification of the mental component of the quantum choices made by the molecules inside our head. We are the second big step in the development of mind. Now comes the argument from design. there is evidence from peculiar features of the laws of nature that the universe as a whole is hospitable to the growth of mind...Therefore it is reasonable to believe in the existence of a third level of mind, a mental component of the universe. If we believe in this mental component and call it God, then we can say that we are small pieces of God's mental apparatus (Dyson 1988:297).*

To know the ultimate purpose of the universe we must read God's mind. Dyson suggests the universe is constructed according to a principle of maximum diversity, both at the physical and mental levels.

The laws of nature and initial conditions are set to make the universe as interesting as possible. As a result, life is possible but not too easy.

3. The God of Steven Dick

Astronomer-historian Steven Dick has developed a “cosmo-theology” based on six principles. These assert that humanity is not physically, biologically, cognitively, or morally central in the universe; that any concept of God must be grounded in naturalistic cosmic evolution; and that human destiny must be linked to cosmic evolution rather than supernaturalism (Dick 2020).

Dick believes that the universe contains beings that have highly evolved intelligence far beyond humanity. He envisions “God” as an evolved superintelligence that is fully natural but with many characteristics, such as supreme wisdom and power, normally associated with God. Such a purely natural god is more in line with the knowledge of modern man, he believes, than the supernatural Christian God of a pre-modern era.

Humans may interact with such a natural superintelligence in the future. Dick suggests that this natural God may even have fine-tuned the universe for life. However, how can this God, a result of fine-tuned cosmic evolution, be also the prior cause of the needed fine-tuning?

Dick conjectures,

> *We might posit that in a multiverse superintelligences create and fine tune universes such as ours. But in the end that involves an infinite regression to the first universe. This seems to be problematic, to say the least…Perhaps the universe emerged and fine-tuned itself in ways we simply do not yet understand (Dick 2023).*

The gods of Davies, Dyson, and Dick have much in common. They are all evolved super-minds. All point to the argument of design as evidence for the existence of such a god. Yet none offer an explanation as to how this super-mind, who really comes into his own in the far future, could have influenced the initial conditions and subsequent

evolution up to now. Design is explained in terms of a designer who, in turn, is supposed to be the product of a purely natural process. This merely adds to the complexity of the design problem without making any progress in explaining it.

Self-Caused Gods

The main difficulty with a natural god is accounting for its origin. Several proposals have been made to remedy this deficiency.

1. The God of Fred Hoyle

Fred Hoyle, in his 1983 book *The Intelligent Universe*, describes his perplexity with the emergence of life on earth. Based on the intricate complexity of life, he finds the transformance of non-life to life to be so improbable that he doubts it has occurred on earth. Instead, Hoyle postulates that life, in the form of bacteria, came to the earth from outer space.

Hoyle puzzles over the fact that life, and other features in cosmology, appears to work contrary to the second law of thermodynamics. Instead of disintegrating and collapsing, like other physical systems, living matter becomes more and more organized. To explain this unusual behavior, he resorts to a rather bizarre idea: that evolution is guided by information *from the future*! Hoyle believes that biological systems are somehow working backwards in time. To quote Hoyle:

> *On a cosmic scale the effect of introducing information from the future would be...far-reaching. Instead of the Universe beginning in the wound-up state of the Big Bang, degenerating ever since, an initially primitive state of affairs could wind itself up gradually as time proceeds, becoming more, not less sophisticated, from past to future. This would allow the accumulation of information - information without which the evolution of life, and of the Universe itself, makes no logical sense (Hoyle 1983:214).*

Furthermore, Hoyle believes that Darwin's theory is wrong because random variations lead nowhere. For progress to occur genetic information must come from outside the system. Furthermore:

> *We have seen that life could not have originated here on the earth. Nor does it look as though biological evolution can be explained from within an earth-bound theory of life. Genes from outside the earth are needed to drive the evolutionary process…A proper understanding of evolution requires that the environment, or the variations on which it operates, or both, be intelligently controlled (Hoyle 1983:242, 244).*

What is the source of this mysterious source of this information from the future, which controls the evolutionary process? According to Hoyle it is an intelligence, placed infinitely far in the future. Such an intelligence explains the various anthropic coincidences noted in an earlier chapter. It also explains the occurrence of geniuses such as Mozart and Shakespeare.

Hoyle stresses that this being is not an omnipotent, supernatural God:

> *The intelligence responsible for the creation of carbon-based life in the cosmic theory is firmly within the universe and is subservient to it. Because the creator of carbon-based life was not all-powerful, there is consequently no paradox in the fact that terrestrial life is far from idea (Hoyle 1983:236).*

Hoyle does not claim to know where this god is to be found, what it does, or what its physical form is. This god attains full stature only in the distant future. To influence the past and present, Hoyle resorts to the novel conception of backward causation. The intelligence works in a reversed-time sense, from future to past, by controlling individual quantum events. Only thus can it bring about its own existence:

> *The overriding intelligence of the infinite future, which masterminds the development of intelligence in our present time, must exercise its controlling influence simply in order to exist (Hoyle 1983:248).*

Hoyle claims that it is illogical for God to influence the universe and yet not be affected by it, as he claims is the case for a Christian God. This, he asserts, is avoided by his "*God*", who exists only by virtue of the support received from the universe. Hoyle complains that the idea of a "normal cause and effect" intelligence, such as he advocates, is not well received in the contemporary western world because, in conformity with Christian tradition, it is the wish of western astronomers to invoke supernatural ultimate causes from outside the Universe.

It should be noted that Hoyle, in this book, rejects both the Big Bang and steady state theories. Instead, he opts for an eternal universe of many little bangs. Thus, he is not faced with the problem of the creation of the entire universe in time.

What are we to make of this? To explain the design in the universe Hoyle points to a Designer. But if this intelligence is to be natural then it must have evolved, so that it could not have been there in any effective form near the beginning. Yet the major anthropic coincidences that must be explained, such as the expansion rate and the value of the physical constants, must presumably be set at a very early stage in the development of the cosmos. Hence, if there is a Designer, he must have been designing from the beginning, implying a supernatural being who existed before the creation of the cosmos.

Scoffing at those who wish to invoke such a supernatural cause, Hoyle resorts to the doubtful alternative of backward causation. But this is hardly "*normal cause and effect*"; this is no less than miraculous. Hoyle's God is really one with supernatural powers, albeit of a limited kind. Again, there is no hope for an afterlife. Nothing in Hoyle's God that instills our fear or love.

2. The God of Frank Tipler

A much more ambitious model for an evolving god has been developed by Frank Tipler (1994). According to Tipler, the war between science and Christianity is over. Science had found God and theology has been reduced to a mere branch of physical cosmology. Tipler presents his Omega Point Theory as

> *a testable physical theory for an omniscient, omnipotent God who will one day resurrect every single one of us to live forever*

> *in an abode which is in all essentials the Judeo-Christian heaven (Tipler 1994:1).*

The reader may recall, from our discussion of Tipler in the previous chapter, that he assumes a closed universe, where the present expansion will eventually turn into a contraction, leading ultimately to the Big Crunch. Life is defined essentially as information processing. As the Big Crunch is approached, life will engulf the entire universe. It will become omnipresent, omnipotent, and omniscient in the sense that it will control all matter and energy sources, while storing an infinite amount of information. Tipler calls this event - the final singularity - the "*Omega Point*". Since the Omega Point is just beyond spacetime it is "*transcendent*"; since it is formally equivalent to all spacetime points it is also "immanent" in every point in spacetime.

Tipler believes that, due to its high intelligence, the Omega Point counts as a person. The Omega Point will "e*xperience*" the whole of universal history "*all at once*", like the theological notion of eternity. In Tipler's model God and the universe are two aspects of the same thing, but not quite a form of pantheism.

Although Tipler calls this god "*omnipotent*" because it controls all energy and matter, it must be kept in mind that it is still limited to natural law; and although this god is "*omniscient*", its knowledge will not be complete until the Omega Point is reached.

How can we be certain that the Omega Point will be reached? The postulate by which Tipler deduces an evolving God is fundamentally a moral one. Value is something connected to life. Thus, if value is to remain in the universe, life must persist indefinitely. The laws of physics must therefore forever allow the continued existence of life. The continued existence of life implies progressive evolution without limit in spacetime: the limit of cosmological and biological evolution is a point beyond space and time, the Omega Point. This brings the concept of purpose back into science:

> *"Teleology, although removed from terrestrial biology, reappears when biology is combined with cosmology" (Tipler 1988:315).*

To ensure that we do arrive at such an Omega Point, Tipler proposes the "*Teilhard Boundary Condition*" for the universal wave function. The "*universal wave function*", which Tipler equates with the Holy Spirit, is the set of all possible histories of the universe. Tipler's condition specifies that all possible histories of the universe end in a future Omega Point, with life coming into existence along at least one history, and thereafter continuing to the Omega point. He conjectures that this boundary condition gives a unique universal wave function.

In that case the laws of physics and every physical thing that exists would be in effect be generated by the Omega Point and its living properties. These properties determine the wave function, and the wave function determines everything else. The ultimate future guides all present states into itself. In a sense the Omega Point creates the physical universe, but in another sense the Omega Point creates itself. Tipler's universe is thus completely deterministic: nothing unexpected can happen, everything is fixed by the universal wave function.

Again, a major flaw is that some form of backward causation is necessary to have this god create itself. Everything is predetermined by the wave function, but how is this wave function set up in the first place?

As noted in an earlier chapter, present observations rule out a closed universe, which is needed in Tipler's model. Further, as pointed out by cosmologist George Ellis, in a devastating review, Tipler ignores the fact that the indefinitely rising temperature would dissociate matter into its fundamental constituents, making reliable storage and processing of information impossible. Ellis comments:

> *One cannot point out in a short review all the absurdities in this extraordinary edifice, which is the product of a fertile and creative imagination unhampered by the normal constraints of scientific or philosophical discipline. Tipler does not merely base his theory on highly improbable assumptions and make claims that cannot by any stretch of the imagination be tested by experiment or observation; he typically assigns the label 'God' to a mathematical construction that, while it might possibly be a good description of the causal boundary of the universe (it probably is not), certainly does not refer in any serious sense to*

> *what the word 'God' is normally taken to refer to (Ellis 1994:115).*

In his later book "*The Physics of Christianity*" (2007) Tipler updated his Omega Point cosmology. He contends that the Omega Point singularity is fundamentally triune in its structure. The initial singularity (*i.e.*, the Big Bang) he identifies with the Holy Spirit, the final singularity (*i.e.*, the Omega Point) with God the Father.

The initial and final singularities are beyond space and time. However, they are connected by worldlines within space-time associated with the histories of all the universes in the "multiverse" that is implied by quantum mechanics. The Father and Holy Spirit singularities are also connected by a line outside of space-time called the "All Presents Singularity." This singularity exists at all times at the edge of the multiverse. Tipler identifies the "all presents singularity" with God the Son.

Regarding the collapse of the universe to the final Omega Point, Tipler must deal with the recent evidence that the expansion of the universe is currently accelerating. If caused by a cosmological constant, the acceleration will increase with time and will make collapse impossible. Tipler, however, believes that future life will be able to alter matter throughout the universe to cancel out the cosmological constant, ensuring the universe will ultimately collapse.

In summary, these natural gods are not likely to gain many believers. Subject as they are to natural law (except for backward causation!), they can perform no miracles, answer no prayers, and have few of the characteristics generally attributed to the God of the Bible. Moreover, since they could not have existed prior to the (presumed) Big Bang singularity and will not evolve into super-minds for a long time, their past and present influence can be brought about only through such dubious ploys as backward causation, which seems to boil down to merely a special form of supernaturalism, albeit in disguise.

An Evolving God and Christianity

Several attempts have been made to construct evolving gods that are more in accord with Christianity. We shall examine the views of de Chardin and process theology, both of which have been influential.

1. The God of Teilhard de Chardin

Pierre Teilhard de Chardin (1881-1955) was a Jesuit priest as well as a paleontologist (*i.e.*, a fossil expert). He was much concerned with adapting Christianity to the modern world view, trying to demonstrate that Christianity is the religion of evolution. Forbidden by the Roman Catholic Church to publish his radical views on evolutionary Christianity during his lifetime, they became widely known only after his death. His main work was *The Phenomenon of Man* (1959). Teilhard's views have not been without influence. For example, Frank Tipler finds several facets in his model that are very similar to those of Teilhard's. Hence his referral to the "*Teilhard*" boundary condition and to Teilhard's "*Omega Point*".

Pondering over the mysterious relationship between matter and consciousness, two seemingly quite different entities, Teilhard rejected the usual notion that consciousness somehow developed from matter. Instead, Teilhard started from the hypothesis of the primacy of psychism. Self-consciousness he considered as the fundamental entity in the universe, being already present in matter from the beginning. All material things, living or not, have a psychic side, a "*within*", and a material side, a "*without*" (Teilhard 1959:59). The evolutionary process was viewed as having a dual nature: a growing outward complexity as well as a growing inward psychism, both culminating in man. The future course of evolution is contained in man. The unity being reached throughout the various arts and sciences shows the convergence of evolution in and through man.

Ultimately, when the highest possible unification and consciousness have been reached, a central point is reached, called the Omega Point. This Omega Point, the goal of creation, is identified as Christ. Christ is thus seen as the unifying principle of the cosmos since everything is ultimately held together in him. Christ is the energizing principle in the cosmos since all motion originates from the final object. Further, Christ

is also the principle of completion since everything finds its ultimate perfection in him.

But this Christocentric future is by no means certain! The completion of the world in Christ can be carried out only through the cooperation of man. Since man is free, it is within his power to make the project fail (Teilhard 1959:307). Thus, as Wildiers (1982:207) summarizes it, our main concern ought to be the further evolution of man towards greater spiritual unification. There is a mystical element in Teilhard wherein he identifies the world with God, sometimes referring to his view as a "*Christian pantheism*". He wished to stress the presence of God in all things, particularly in the evolutionary process. God has become immersed in his creation, struggling with it for its completion; God's incarnation is coextensive to the duration of the world. Thus, love of the world and love of God are combined into one. Through study and work, social and political action we unite ourselves with Christ (Wildiers 1983:210). In short, Teilhard's universe is one where God, who manifests himself in the physical universe in the person of Christ, evolves.

From a scientific perspective, Teilhard believed that his theory faced some thermodynamic difficulties. The evolution of ever more complex entities seemed to him to be contrary to the Second Law of thermodynamics, with its prediction of a general trend toward disorder, rather than order. Also, the Heat Death predicted by this law would rule out the future eternal existence of the Christic Omega Point. Eventually even Christ would die a permanent death.

To overcome these limitations Teilhard argued for the existence of another form of energy - a "*radial*" or psychic energy - in addition to the usual physical "*tangential*" energy. Since all forms of matter have some psychic substance, psychic radial energy is available in all matter. It supplies a vital force that drives the evolutionary process. Its concentration increases as evolution progresses upwards towards greater complexity.

In man, radial energy is the energy in our thoughts. Radial and tangential energy are somehow related and pass into each other. On

the one hand, *"to think, we must eat*" (Teilhard 1959:64), on the other hand, through thought and will, we can effect physical change.

According to Teilhard radial energy would oppose the degenerative effects of the second law. Since Teilhard wrote this it has been noted that his psychic, radial energy is in fact equivalent to information content, which cannot avoid the restrictions of the second law (Barrow & Tipler 1986:198). Thus, as a scientific theory, this aspect of Teilhard's view has been refuted.

Although Teilhard's universe centers about Christ, it is a much-diminished Christ who is heavily dependent upon man's efforts and evolutionary process. This is hardly the Christ of orthodox Christianity.

2. The God of Process Theology

In recent years process theology has become increasingly popular among theologians. This movement originated with the work of Alfred North Whitehead (1861-1947) who, in his earlier years, had been active in the philosophy of science and mathematics. He was much influenced by the writings of Bergson and Alexander. In his main work, *Process and Reality* (1929), he developed a metaphysical system wherein the central notions were those of *process* and *becoming*. His ideas have since been further developed by several theologians and philosophers, the foremost among his followers being Charles Hartshorne and Schubert Ogden.

Process theology rejects both the God of classical theism, where God is distinct from the world, and pantheism, which equates God with the world. Instead, it adopts a view called "*panentheism*", which means "all in God". The world is seen as the body of God, but God also has a mind which is, however, dependent upon his body. Creatures in the universe are considered as cells of God's body.

Whitehead considers God to be "*dipolar*": he has both a *primordial* nature and a *consequent* nature. Viewed as primordial, God is "*the unlimited conceptual realization of the absolute wealth of potentiality*" (Whitehead 1929:521). In this state he has no consciousness. Through this aspect God is the source of unity and order in the world. "*He is the lure for feeling, the eternal urge of desire*" (Whitehead 1929:522). In this pole God is infinite and unchanging.

But there is also another side to God. In his consequent nature God is conscious and is "*the realization of the actual world in the unity of his nature, and through the transformation of his wisdom*" (1929:524). In this pole God is finite, dependent upon the world, and in process. "*God is the great companion - the fellow sufferer who understands*" (1929:532). God is both the primordial ground of order, structuring potential forms of relationships before they are actualized, and the ground of novelty, presenting new possibilities.

Not only God - at least in his primordial nature - but also the universe is eternal. God created the world not ex nihilo, but out of pre-existing material. God is not *before* all creation but *with* all creation. Nor is our universe the only universe. Over time all logically possible universes ("cosmic epochs") will come into existence, each ultimately to be replaced by its successor; ours, too, will eventually be extinguished (1929:139, 148, 171).

In process theology God is generally thought to be omniscient with respect to all past and present events, but not with regards to the future. The future is indeterminate and not even God can know it. If the future were fixed there would be no room for free actions by man. Process theology affirms both order and openness in nature. Divine purpose is understood to have unchanging goals but not a detailed eternal plan; God responds to the unpredictable. Process thought recognizes alternative potentialities that may or may not be realized.

The God of process theology is not omnipotent. He *influences* the world (by valuing potentialities to which creatures can respond) but does not *determine* it. God always acts with and through other entities rather than by acting alone as a substitute for their actions. God's presence in the universe is thus not readily detectable. Most process theologians believe that God's acting doesn't contradict science and, hence, that God doesn't perform miracles. God's power over nature is limited. The power God exercises is that of evoking love and inspiration, rather than controlling, unilateral power. God does not compel but supplies creative power to his creatures.

It is through man that God has the greatest opportunities to influence the world. Man is considered as a free being, co-creator with God and

of God. Man creates himself through the decisions he makes. Also, on the material and biological levels "*decisions*" are made when one of many possibilities is realized. The world is a series of decisions, and in this sense, freedom forms a dimension of the universe. Not only man, but the whole world is a self-creative reality. All events that take place are mutually related. The fundamental properties of reality are creativity and relativity, with God being the supreme Creativity and the universal Relation.

The cohesion of all the individual decisions in the world is due to the influence of a supreme creativity on all events. This does not cancel their freedom but is a form of enticement. God is that ordering element whereby creativity assumes a specific character and without which no occasions of experience are possible. God is the ever-present ground of experience. Every occasion is dependent on God for its existence as well as for the order of possibilities it can actualize.

Unlike Teilhard's view of the culmination of history in an Omega Point, process theology envisions history as having no specific ultimate goal. There is only a deity growing ever more towards increasing perfection.

Ronald Nash (1983) has criticized process theology on several points. According to him, most process theologians apply a highly selective biblical hermeneutic, welcoming Scripture when it agrees with panentheistic opinion but otherwise ignoring it. Moreover, process theologians often deny basic tenets of Christianity. Schubert Ogden (1966:184-6), for example, though referring to Christ as "*God's decisive act*", holds that Christ was fully human, special only in that his words and deeds represent God's being in a normative way. Also other fundamental Christian beliefs, such as the Incarnation, the bodily Resurrection and the Atonement are questioned by some process thinkers.

The God of process theology does not measure up to the omniscient, omnipotent God of the Bible. Nor, as we shall soon see, does process theology offer much hope for Christians in a life hereafter. Since the motivation for process theology was primarily that of developing a theology more in line with modern evolutionary thought, it is perhaps not surprising that this approach leaves us with little Christian content.

Life After Death

A crucial theological question is that of life after death. As Christians we set our hope on a better life in the hereafter. Does modern cosmology have anything to offer here? We saw earlier that, if we were to rely on purely natural processes, the fate of life in the universe is rather dismal. Can any of the gods depicted above remedy this gloomy forecast?

Fred Hoyle (1983:226) suspects the conviction of individual immortality to be in error. However, he does believe that our remote descendants, through immense advances in technology, would be able to guarantee the *collective* immortality of humanity. This is, unfortunately, of little consolation to the individual, who stays merely mortal and eventually dies.

Freeman Dyson and Frank Tipler are more optimistic. Dyson (1988:289) speculates that future technology will be able to reconstruct copies of our ancestors if we could record the sequence of bases in their DNA cells. Perhaps, also, it may become possible to read memory traces in the ancestor's brain and to play these back. In this way it may be possible to "*resurrect*" ancestors.

Whether this will work is, of course, highly doubtful. First, it is feasible only for those individuals for which we have DNA samples and for which memory traces can be recorded. But, even if complete memory traces are possible, which seems most unlikely, the corresponding technology must surely by in the far distant future, when our thoughts and brains will long since have disappeared. Thus, past and present generations, including Dyson himself, do not stand to benefit from Dyson's clever scheme. Second, even if this process were possible, it would yield only *copies* of ancestors rather than the actual ancestors. There would be no actual, conscious individual continuity or immortality.

Much the same scenario is offered by Tipler. He argues that it is possible, in principle at least, for future life to reconstruct an exceedingly exact simulation of our past lives. Such a simulation of a living being would, according to Tipler, actually be alive:

> *The simulated body could be one that is vastly improved over our present one...we can call the simulated, improved, and undying body a "spiritual body" (Tipler 1989:246).*

Such simulations would be made using the past light rays of our ancestors. These light rays are not lost but will be intercepted as the singularity is approached. As we near the singularity the information extracted becomes more precise. From the information extracted from this light our ancestors will be reconstructed. Even if sufficient information can't be extracted from the past light cone, resurrection could still occur, for it would still be possible to resurrect all possible humans that could be coded in DNA, this being a finite number.

Again, this is very similar to Dyson's resurrection, except that it mentions no memory reconstruction. Much the same criticisms apply. Even if it were technically possible, this would just create a *copy* of my former self rather than being the continuation of my conscious being.

Teilhard's system, too, offers little hope for those longing for a life hereafter. When a man dies his body decomposes and turns back to ordinary, non-living matter. It follows that man's soul, being tied to his body, cannot survive as a high order of consciousness. The most that one can expect, it seems, is a great many elementary centers of consciousness, each belonging to a unit of the decomposed body, subject to the laws of statistics. Man can survive only collectively, not individually (Teilhard 1959:61). Thus, at heart, even though Teilhard brings Christ into the picture, it is a Christ who offers us no ultimate salvation.

Regarding the destiny of man, most process theologians reject the notion of an actual heaven or hell, or any individual immortality. According to Schubert Ogden (1975), man will continue to live on only in God's cosmic memory, of which we won't be conscious. A similar position is taken by Charles Hartshorne (1962:254), who considers the notion of an actual heaven and hell to be a dangerous error.

In process theology there is only a type of *objective* immortality: we may live on after death, but only through our past actions, only in the memory of God. There is no *subjective* immortality, in which our self, our consciousness, continues an experiencing existence.

According to process theologian John Cobb (1965:63-70), a major difficulty of the separation of body and soul is where to place the soul. We no longer conceive of heaven and hell as spatial places. Cobb believes that in Newtonian cosmology souls or mental substances fitted in so ill with the space-time continuum that it did not seem too strange to postulate another sphere, a spiritual realm, where human souls belonged. But in the evolutionary cosmos this distinction between mind and matter cannot be kept. If minds emerge in the physical universe, then they must belong in that universe. There seems to be no longer a "*place*" for the soul after death.

It is thus clear that the question of origins is closely related to that eternal life. The supposed evolutionary origin of man undermines the ability of his soul, physically determined as it then must be, to survive death.

If all processes in the soul are merely a different aspect of bodily processes, which are entirely governed by the laws of physics then, when the body dies, the soul will cease to exist. If the soul is necessarily tied to the body, then a past Big Bang and a future heat death (or Big Crunch) rule out the existence of consciousness in the distant past or far future. Such a view also has no room for God as a Spirit and is essentially atheistic.

Conclusions

In summary, modern cosmology cannot easily accommodate two of the most essential ingredients for true religion: a supernatural God and subjective immortality. Clearly, to preserve these fundamental features there must be a richer reality beyond that of our observed, physical three-dimensional space. There must be a spiritual realm wherein God and soul can exist. Knowledge of such a transcendent realm is necessarily beyond the scrutiny of scientists.

Thus, ultimately, those who wish to keep the basics of true religion must acknowledge the inadequacy of modern cosmology's depiction not only of the future, but also of the present structure of the universe.

8. Christianity and the Big Bang

In an earlier chapter we have noted the subjectivity of cosmological theorizing in general, various weaknesses of Big Bang cosmology, and the possibility of constructing alternative cosmological models. We have cautioned against equating Big Bang cosmology with truth, proved beyond reasonable scientific doubt.

Yet, far from seeing BBC as a threat to Christianity, apologists such as William Craig and Stephen Meyer believe it provides compelling evidence of the biblical teaching of *creatio ex nihilo*, thus offering a very useful step in proving the existence of a transcendent God. For example, Meyer concludes,

> *Taken jointly, general relativity and the Big Bang theory provide a scientific description of what Christian theologians have long described in doctrinal terms as creatio ex nihilo Creation out of nothing (again, nothing physical). These theories place a heavy demand on any proposed causal explanation of the universe, since the cause of the beginning of the universe must transcend time, space, matter, and energy (Meyer 1999:8).*

Christian apologist Gregory Koukl goes even further,

> *I know the Big Bang idea is controversial with some Christians, but I think that's because they haven't realized how well it fits the Story [the Christian worldview laid out in the Bible], which basically says the same thing (Koukl 2017:51).*

Since BBC forms an integral part of the naturalist worldview, Christians must first "baptize" Big Bang cosmology (BBC). This involves insisting that the biblical God is the creator of the universe, that BBC merely describes how God created, that God can act miraculously at times, and so on. The baptized BBC is, however, still factually identical to the naturalist version in its history of the physical universe, beyond the earth, after the supposed singularity.

How well does BBC fit the Christian worldview? Are there really no clashes? Is there no theological price to pay for embracing modern cosmology? Let us examine more closely how the Bible and BBC view the past, future, and present structure of the universe.

Conflicts About Origins

1. Astronomical evolution

Big Bang cosmology and Genesis certainly agree on a few things: the universe began a finite time ago, light was one of the first things created, and man the last.

However, they differ greatly about the *timescale* (billions of years versus thousands of years) and the *order* of events (Sun then Earth then vegetation versus Earth then vegetation then Sun). They differ also about the *mode* of creation. In BBC everything arises gradually through evolutionary processes, based solely on the operation of natural laws. According to the Bible, God acted directly at each step, bringing in something new. And this happened quickly: he spoke, and it was.

Further, they differ in that BBC assumes natural laws have never changed while, according to the Bible, rebellion against God subjected the entire creation, including astronomical objects, to distortion and decay, effecting even natural laws.

To harmonize the Bible with BBC one could simply re-interpret Genesis 1, treating the creation days as merely a literary device (*e.g.*, the framework hypothesis or analogical days) conveying theological rather than historical truths, and re-interpret those biblical texts speaking of the universal effect of sin.

This may seem like a small price to pay to harmonize the Bible with modern cosmology. The problem is that it introduces the hermeneutical principle that perceived scientific truths should guide our reading of Scripture. Once that hermeneutic is granted legitimacy, it becomes difficult to restrain.

2. Geological evolution

One could stop here, adopting an old universe/young earth position. This, however, is rarely done. Once we accept mainstream astronomy, why not likewise accept mainstream geology? Both are based on the

same naturalist presuppositions. If the scientific picture of the history of stars is considered dependable, why not also the scientific picture of the history of planet Earth?

Most BBC-accepting Christians therefore accept also mainstream geology as giving a reliable account of earth history. However, now the theological cost is much higher.

For example, mainstream geology claims fossil evidence for pain, suffering, predation, disease, earthquakes, and the like, millions of years before man. Such natural evil could then not be due to Adam's Fall but must be part of God's initial "very good" creation.

Much else in Genesis is challenged. William Craig (2021a:101, 105) considers Genesis 1-11 to be "mytho-history", having "fantastic elements" that are "palpably false" if taken to be literally true, including the ideas that God created the world in six days, that the first humans were vegetarian, that there was a snake that could talk, that there were actual cherubim with a flaming sword, that the antediluvian patriarchs lived long ages, that Noah's flood was global, that linguistic diversity can be traced back to the Tower of Babel, and that the earth is only a few thousand years old.

Ironically, Craig's stress on God's transcendence, needed for his cosmological argument, aids his mythologizing of Genesis:

> *If Genesis 1–11 functions as mytho-history, then these chapters need not be read literally. The accounts of the origin and Fall of man are clearly metaphorical or figurative in nature, featuring as they do an anthropomorphic deity incompatible with the transcendent God of the creation account (Craig 2021a:101).*

The greatest problem, however, is mainstream geology's placing the existence of humans, or human-look-a-likes, more than a million years ago, as primitive cave-dwellers, lacking language. This is hard to square with the biblical account of Adam and his fall into sin. The biblical Adam fits does not fit well within naturalist geology.

3. Biological Evolution

This brings us to the next logical step. Having accepted mainstream astronomy and geology, why not also mainstream biology? If mainstream science is right about the ages of things, why should it not also be right about the evolutionary origin of things?

Most Christians biologists are evolutionists. They consider the evidence for evolution overwhelming. So does theologian Bruce Waltke, who said,

> *"if the data is overwhelmingly in favor of evolution, to deny that reality will make us a cult…some odd group that is not really interacting with the world...To deny scientific reality would be to deny the truth of God in the world. For us as Christians, this would serve as our spiritual death because we would not be loving God with all of our minds. It would also be our spiritual death in witness to the world because we would not be seen as credible...".(quoted in Morris 2010:4-5)*

Where does that leave Adam? Adam has been variously considered as a neolithic farmer, a tribal chief, a representative human, the first *homo sapien*, or a member of an even earlier hominid species. He is viewed as either fully created, physically evolved with a created soul, or fully evolved. Craig takes Adam and Eve to be two evolved members of Heidelberg Man, in whom God implanted rational souls at least 750,000 years ago (Craig 2021b:47-48).

Given the difficulty of fitting the biblical Adam into mainstream science, many theologians now deny his actual existence. Theologian Peter Enns (2012) considers Adam to be merely a literary figure. So does theologian John Schneider (2010), who believes that humans were never upright, that death is not due to sin, and that Christ's atonement was not a payment for human sin. Blaming evolution (and thus God who drives evolution) for making humans selfish and sinful, he ends up with a universalism where all humans will be saved.

Few Christians may want to go that far. Yet once we start adapting the Bible to modern science the stopping point becomes arbitrary, as is reflected in the wide spectrum of views on origins among Christians.

The Big Bang and Heaven

The Bible depicts heaven as a place created directly by God, in time and space, containing angels, God's throne, Christ in his human flesh, and the departed souls of saints. Normally invisible to us, heaven seems to be a three-dimensional subspace embedded in a larger-dimensional space also containing the physical cosmos. It may well have its own natural laws. Yet heaven is closely linked to Earth, where its agents can cause physical effects.

This heaven is hard to reconcile with modern cosmology, which assumes there is no space or time beyond our physical universe. It considers the visible universe to be a closed system. It literally has no place for heaven. It is hard to imagine heaven originating from the Big Bang singularity, partaking of any expansion of space, or undergoing any sort of physical change.

Christians upholding Big Bang cosmology rarely discuss heaven or angels. When they do, they seem to think of heaven as a vague spiritual abstraction. Thus, for example, William Craig (2021c) believes that heaven is a purely spiritual realm, beyond space-time, inhabited entirely by non-physical beings, so that even Christ presently has no physical body.

The Big Bang and the Future

The contrast between Big Bang cosmology and Christianity is most stark about the future.

We saw that modern cosmology predicts the eventual extinction of all life in the universe, whether by freezing, frying, or the "big rip". Further, modern biology asserts that dead is dead; there can be no resurrection of dead individuals.

Against such despair, the central hope of Christianity is the impending return of Christ, the resurrection of the dead, the Last Judgment, and

life everlasting in a new heaven and a new earth. These essentials of Christianity cannot be compromised by any Christian worthy of the name.

Thus, many Christian believers in the mainstream science account of the past will reject Big Bang eschatology. For example, William Craig (2006), as well as physicist turned-theologians John Polkinghorne (2002) and Robert Russell (2008) all profess that Christian hope for a personal, as well as a cosmic resurrection must be grounded upon God and his mercy rather than in science.

To justify their rejection of Big Bang eschatology, they all note that God's sovereignty enables him to change natural laws or intervene whenever he wishes, invalidating scientific predictions based on uniformity assumptions. Hence, we should trust the Bible about God's future eschatological acts, rather than naturalist science.

Such a Bible-first epistemology is commendable. Yet it is highly inconsistent with their belief, following mainstream science, that Gen.1-11 is largely mythical, "palpably false", to use Craig's words. If we can trust God's word about the future, why not also about the past? If God's radical actions in nature can void scientific extrapolations into the future, why not also regarding into past?

The cosmic reconciliation will involve much *continuity,* in that the earth and heavenly bodies will not be destroyed but renewed. But also, there will be also d*iscontinuity*, the renewed cosmos shall not be subject to physical decay. Russell (2008:307-10) speculates that the natural laws may be modified, so that thermodynamics will be included only to the extent that it contributes to natural good, but not natural evil.

Russell's proposal about future thermodynamics is remarkably like the modified thermodynamics suggested by some creationists as applying to the initial "very good" creation before its distortion due to sin. Indeed, the biblical eschatological terms of "renewal", "redemption", "reconciliation" all imply a restoration back to an *original good state*. As noted by theologian Cornelis Venema (2000), the entire cosmos was adversely affected by sin, from which it will be cleansed and recreated into a new heaven and earth (*e.g.*, Rom.8:18-25, 2 Peter 3:5-13).

Also, Russell does not question that this transition will take place very rapidly, after Christ's return but before the new Jerusalem comes down from heaven. "*I saw the new heavens*…" (Rev. 21:1-2). This entails that the cosmos will be instantly transformed so that renewed galaxies billions of light-years away will be at once visible to an observer on the renewed earth. Just like in the first creation, where God spoke "*and it was so*." Thus, if distant starlight is not a problem in the renewed cosmos, why should it be a problem in the original cosmos?

Conclusion

To sum up, Christians should be wary of embracing Big Bang cosmology. Although this may at first involve only small revision of the Bible, it introduces a science-driven hermeneutic. This opens the door to acceptance also of geological and biological evolution, leading to the loss of the biblical Adam, and raising many theological problems.

It is hard to square modern cosmology with the existence of heaven as a physical place in space and time that interacts with the visible cosmos.

Most importantly, Christians must certainly break with mainstream cosmology's predictions about the future, which rule out a future restored cosmos and our bodily resurrection. Therefore, since we must ultimately place our trust in the truth of God's written Word, and in the power and faithfulness of our Lord, should we not consistently apply this same trust to other matters that God has revealed to us?

9. Biblical Cosmologies

As we saw, Big Bang cosmology is not easy to reconcile with Scripture. Is it possible - and desirable - to construct cosmological models that are more in line with the Bible? Any viable cosmology should (1) describe the universe and (2) explain the observed features of the universe.

Astronomical data can be interpreted via a wide variety of cosmological models. Our assessment and choice of cosmological models depends heavily on our prior philosophical and religious commitments. A Christian approach should therefore insist that scientific theories be consistent with *all* the data, including the biblical data.

The Bible, however, says very little about the current physical structure of the celestial universe. The biblical input to cosmology is concerned primarily with matters of the heavenly realm, origins, and the future.

Cosmology, as a science, can study only the *physical* aspect of our universe, in terms of known *physical* causes. It must thus ignore such things as the unseen heavenly realm, angelic and demonic forces, and miraculous events. Hence, any cosmological model will necessarily be spatially incomplete (omitting any specifics about the heavenly realm) and causally incomplete (omitting spiritual causes).

As to the future, heaven and earth will be renewed via supernatural means, when Christ returns. There will be only a limited natural continuity between this age and the next. Hence it is impossible to construct an adequate cosmological model for the distant future even for the physical universe . All that can be said is that any model for the present physical universe, incomplete as it is, can be valid for at most a very limited time.

A major challenge for a biblical cosmology is to explain the observed features of the universe in terms of the Genesis creation account, where the Earth is created before the stars, less than ten thousand years ago. How could stars and galaxies form within a day? How could light from galaxies billions of light-years away reach us within a few thousand years?

The Size of the Observable Universe

First, we shall consider the size of the stellar universe. Some creationists believe that the farthest galaxies are much closer than commonly believed, perhaps they are less than twenty light-years away.

How are astronomical distances calculated? For objects within the solar system, distances can reliably be calculated using radar or radio signals. Thus the Astronomical Unit (AU), the average distance from the Earth to the Sun, is easily found to be roughly 93 million miles, or about 8 light-minutes.

For larger distances, to nearby stars, we can make use of the annual motion of the Earth relative to the Sun. As seen by an observer on the Earth, a nearby star's apparent position, relative to more distant stars, changes throughout the year. From the maximum parallax angle (see Figure 9.1), the distance to the star can be calculated using simple trigonometry and the already known astronomical unit AU. Using this method the distance to the nearest star, Proxima Centauri, is found to be about 4.2 light-years. Distances found by this method are called parallax distances.

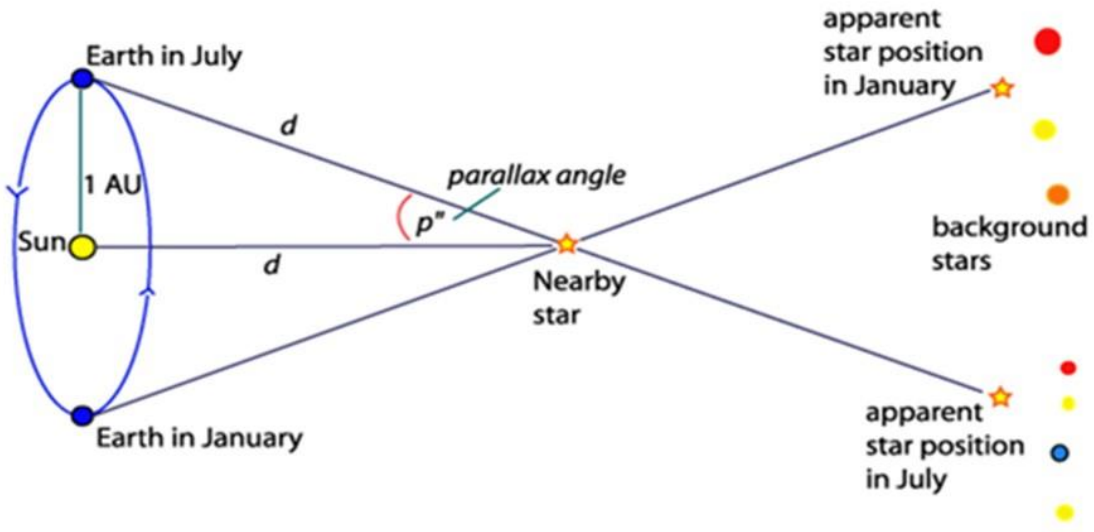


Figure 9.1. The Parallax of a Nearby Star.

Parallax distances can be found for stars up to about 10,000 light-years away. From the parallax distances of nearby stars it was found that

certain types of stars, such as Cepheid variables and Supernovae, have an intrinsic brightness related to their period or other observable characteristics. Such a star serves as a “standard candle”. From its known intrinsic brightness and measured apparent brightness, its “luminosity” distance can be calculated using the inverse square law of light. Luminosity distances can be found for many stars up to a billion light-years away. For nearby galaxies it was found that their luminosity distance was related to their redshift. Distances to further galaxies can be found using this redshift-distance relation.

How reliable are such distances? Could stars and galaxies be much closer than thus calculated?

The critical assumption is that space is the normal *flat* space of three-dimensional Euclidean geometry, where the inner angles of a triangle always add up to exactly 180 degrees. What if space is not flat, but *curved*? In a curved, or *non*-Euclidean space, the inner angles of a triangle do not add up to 180 degrees. Recalling that curved space can be either *spherical* or *hyperbolic*, as depicted in Figure 4.2 of Chapter 4.

In a spherical space the angles of a triangle sum up to more than 180 degrees (as happens when you draw a triangle on a spherical orange); in a hyperbolic space the sum is less than 180 degrees. This strongly affects distance calculations. Distances determined assuming flat space could thus be substantially incorrect if space is curved.

Some time ago Parry Moon and Domina Spencer (1953) developed a curved-space model of the universe wherein the light-travel time to distant objects is at most 15.7 years. Although this model has since been cited by some creationists, it has several serious deficiencies. First, it postulates that the curved space applies only to light; material objects still behave as if space were flat. This seems very strange. One might expect that the universe is either flat or curved, but certainly not both simultaneously. Second, this model does not solve the starlight problem since the curvature is of the wrong sort, as illustrated in Figure 9.2.

In Figure 9.2, the rays from the yellow galaxy are the actual light rays;

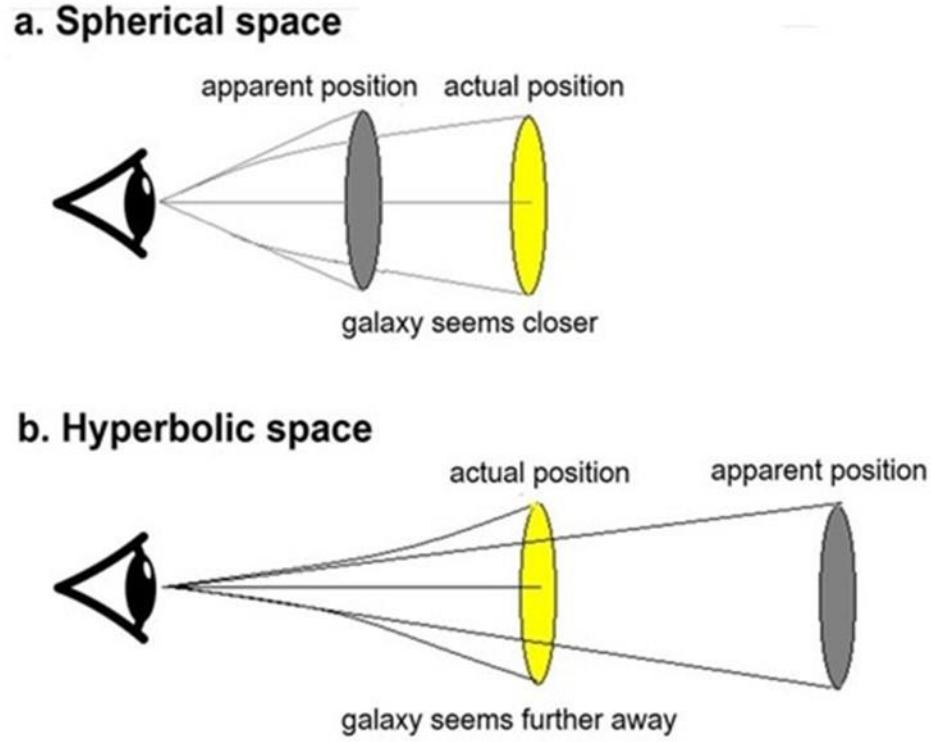


Figure 9.2. Curved Space and Apparent Distance.

the curves from the red galaxy refer to the apparent paths, assuming light travels in straight lines. Note that *spherical* space tends to *decrease* the apparent distance, whereas *hyperbolic* space *increases* it.

Moon & Spencer proposed that space is *spherical*, which will make distant objects appear *closer*, rather than *further* away. Hence, the universe will seem smaller - not larger - than it actually is.

For the universe to seem larger than it actually is, we must assume space to be *hyperbolic*. Such space will, due to the bending of light rays, make close objects appear to be far away. By choosing a sufficiently large curvature, we can fit the entire universe, apparently billions of light-years in size on the assumption of flat space, into a sphere of, say, ten thousand light-years (see Byl 1988). Note that this does have the implausible consequence of drastically flattening galaxies along their line-of-sight from the earth.

By choosing a large enough radius of curvature, this model enables light from even the most distant galaxies to reach the earth in less than ten thousand years. The distances to nearby stars, however, will be much the same as for flat space.

There are, however, means by which detect if space is curved. For example, at large distances, there should be a significant difference between *parallax* distances (derived from the apparent annual motion of a star with respect to background stars, caused by the relative annual motion of the Earth and the Sun) and *luminosity* distances (derived from the observed brightness of a star of known intrinsic brightness).

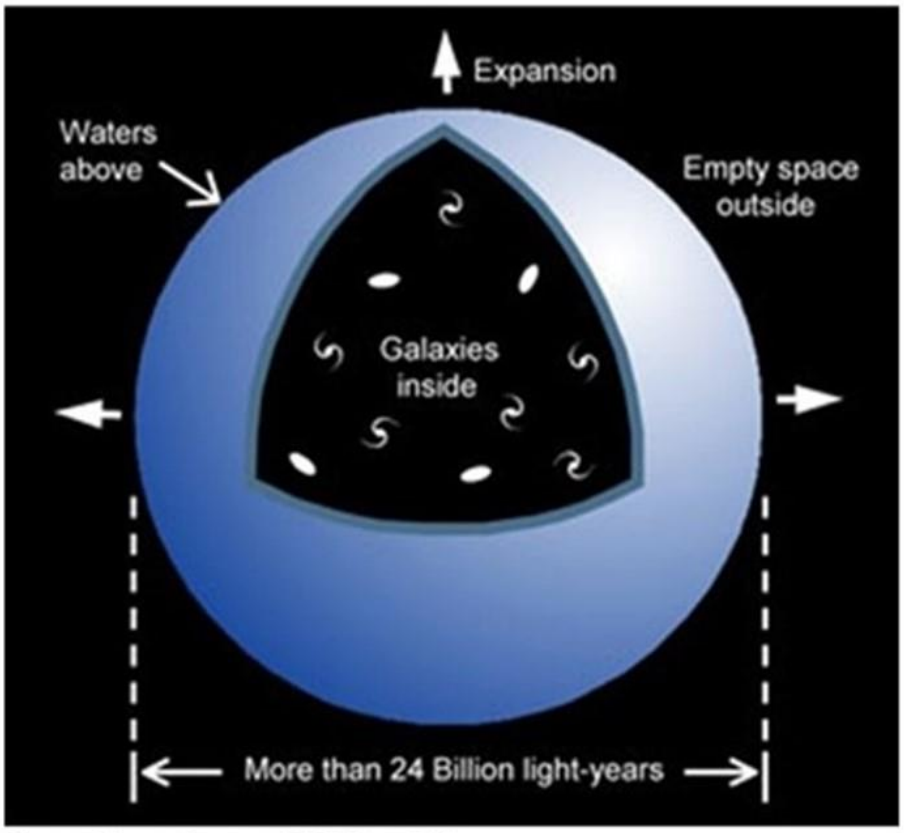
Over the last few decades, with much improved observational data, the predicted differences have not been found, ruling out the high curvature needed. Space seems to be Euclidean (*e.g.*, flat), or very close to it. Hence, the calculated distances (and sizes) of stars and galaxies are probably quite reliable. This entails that we are about 4 light-years from the nearest star (Proxima Centauri), about 30,000 light-years from the center of our Milky Way Galaxy, and billions of light-years from the furthest galaxies.

Explaining the Structure of the Physical Universe

Most creationist cosmologies accept the huge size of the celestial universe. A secondary goal of creationist cosmology is to explain why the stellar sky has the features we see. James Upton (2011) notes that here there has not been much progress. In a useful recent review of the current state of creationist astronomy, Danny Faulkner (2018) blames this on the paucity of biblical specifics, which consist primarily of the creation of the expanse on Day 2, the creation of the stars on Day 4, and the Fall shortly thereafter.

Taking the creation details of Genesis 1 into account, most creationist models posit a finite universe, often a sphere centered roughly upon the earth or our local galaxy. This would explain the isotropy of the universe (*i.e.*, that it looks the same in all directions) without resorting to the cosmological principle.

Most creationists consider the "*expanse*" to be outer space. Some



From Humphreys (2008, p.84)

Figure 9.3. Humphreys' Universe.

believe that the "*waters above the expanse*" (Gen.1:7) refers to a layer of water at the spherical edge of the (roughly earth-centered) universe (see Figure 9.3). Faulkner (2016) suggests that this water layer may explain the CMB radiation, but he does not show that it can account for the observed finer details of the CMB radiation.

The prime challenge of a creationist cosmology is to explain everything in terms of an extremely short history of only a few thousand years. Although the formation of stars is not yet fully understood, the gravitational collapse of a cloud of matter into a star life the Sun seems to take millions of years, if not more, even if dark matter were there to speed it up. Galaxies like our own require at least hundreds of millions of years to form via gravitational collapse.

To explain the existence of stars and galaxies, creationists could posit that these were created instantaneously in fully mature form. However, there seems to be strong evidence for past collisions of many galaxies (Carey 2005), past supernova explosions, past expulsions of huge jets of matter, and the like. Such events seemingly happened millions of years before their presently observed state. If God created these objects in mature form, why do they bare scars of a non-existent past? Mature creation offers very little in the way of detailed explanations for specific features of astronomical objects, other than to simply affirm that this is just how God made things. A more plausible option might be to postulate that stars and galaxies were formed very rapidly via vastly accelerated processes.

Creationist Cosmologies

A major challenge of creationist cosmology is to explain those features of the universe that seem to show ages of billions of years. In addition to explaining the origin of stars and galaxies, there is also the *distant starlight problem*: if the universe is less than ten thousand years old, how can we see galaxies seemingly billions of light-years away? Shouldn't their light have travelled for billions of years to reach us? Moreover, the stars were created to serve as signs and lights on the earth. Hence, Adam likely saw the celestial beauty of the night sky already on the first night after his creation on Day 6. Yet the nearest star, Proxima Centauri, is more than four light-years away. Are we to believe that Adam saw no stars until long after his Fall into sin?

At the end of this age, the heavens will be transformed by a cosmic cleansing from the effects of sin. This seems to happen in the twinkling of an eye: the apostle John describes the transformed sky being visible already before the new Jerusalem descends on the earth (Rev. 21:1-2). This entails that the first celestial realm was distorted by sin shortly after its creation. Thus, we have a threefold distant starlight problem:

1. How could Adam see the *first* celestial realm on Day 6?

2. How could Adam see the *fallen* celestial realm shortly thereafter?

3. How can we see the *renewed* celestial realm shortly after Christ's return?

Generally, creationist literature discusses only the first of these.

Let us consider the main creationist cosmologies that have been proposed.

1. A Variable Speed of Light

Barry Setterfield (1981) proposed that the speed of light c was virtually infinite at Creation, after which it decreased exponentially to its present value. Hence, the light from distant galaxies, travelling at huge speeds, could reach us within a brief time. This is known as "c-decay."

The observed constancy of the hydrogen spectrum from distant stars, and the need to preserve the stability of atoms, entail that a change in the speed of light c requires corresponding changes also in some other fundamental physical "constants", such as Planck's constant *h* and the electron mass *m*. This, in turn, predicts that the decay rates of radio-active substances were much greater in the past. This has great geological significance, since it implies that the large radio-dates of many rocks have been drastically over-estimated.

A similar model, without specifying a short age for the universe, has been proposed by the Russian physicist V.S. Troitskii (1987). In these models the reduction in the speed of light causes a decrease in the observed frequency, so that light from distant galaxies appears redshifted. Thus, the model also yields an alternative to expansion as an explanation of the redshifts. Indeed, Setterfield suggests that the universe is presently in a state of contraction, while Troitskii advocates a static universe. Troitskii's model also generates some of the observed characteristics of the background radiation.

Setterfield's (2009) model explains these effects by applying a changing "zero-point energy field" (ZPE), the intrinsic quantum energy inherent in a vacuum. Combining this with plasma physics, he contends that this accounts also for the very rapid formation of planets, stars, and galaxies. In his model, a star can form within a fraction of a second, a full-blown galaxy in less than two days.

Is there any observational evidence for c-decay? Historical studies suggest the values of *c, h*, and *m* may have varied slightly during the last two centuries. However, these results are marred by large experimental uncertainties, so that their statistical significance has been questioned. Strangely, over the last few decades, just as more sensitive measuring technology is available, the values of *c, h* and *m* seem to be unchanging. Even if a small, recent change in *c* were observationally proven, this is still a long way from showing that *c* was virtually infinite only six millennia ago.

There is some evidence, however, that c has been constant for at least the last few thousand years. This concerns the famous Hulse-Talyor pulsar PSR1913+16. This is a binary system, about 21,000 light-years distant, consisting of a *neutron* star (a very massive, dense star) and a *pulsar* (a highly magnetized rotating neutron star emitting pulsating beams of electromagnetic radiation). Its orbit decays very precisely according to the predictions of general relativity. This seems to prove the existence of gravitational waves, travelling at the speed of light. Since the formula for decay depends strongly on the value of c, the observed data constrains the emitted value of c to within less than one percent of its current value. This suggests that, barring any miracles, c hasn't changed in the last 21,000 years. This is strong evidence against Setterfield's solution to the distant star problem. To get around this, one may have to reject general relativity and explain the orbital decay in terms of an alternative gravitational theory more favorable to Setterfield's theory. Consequently, since this has yet to be done, Setterfield's theory currently has few active supporters.

Other variations on the c-decay theme are possible. For example, Bryan Johnson (2018) proposes that c varies with position. His main idea is that c might be much greater in regions of low gravitational potential. However, near our solar system the gravitational potential is dominated by our Milky Way Galaxy. Hence, in Johnson's model, it still takes light some 8000 years to travel to us from the Galactic Center, and even longer from more distant galaxies. Moreover, c would not be expected to vary much from us to the nearest stars. So, Proxima Centauri would not have been visible to Adam until four years after his creation. Therefore, if stars are to be visible by Day 6, this model falls short.

Johnson also explored the possibility that light might travel faster in regions of low particle density. The density in the interstellar medium is much lower than that of the best vacuum we can reach experimentally. Yet, the difference in c as measured in air and as measured in our best vacuum is so small that it is highly doubtful that c would be any different in a perfect vacuum.

No doubt one could concoct a c-decay model along the above lines that gives suitably small light travel times for distant star-light while still satisfying all the observational constraints. But without any compelling physical reason why the speed of light should vary as postulated, this seems rather contrived.

Of course, *ad hoc* theories may still be hard to disprove. Moreover, as we saw in earlier chapters, such *ad hoc* theorizing is very common in cosmology. In fact, as noted in an earlier chapter, the notion of a time varying speed of light has recently been employed by Köhn (2017), and others, to solve several pressing problems associated with Big Bang cosmology. They, too, conjecture that the speed of light was initially virtually infinite, at the Big Bang singularity. It seems that, at least in this regard, creationist cosmology is in no worse shape than Big Bang cosmology.

Most c-decay theories still require the mature creation of stars and galaxies.

2. Time Dilation – Slow Earth Clocks

In general relativity, the rate at which a clock ticks depends on its speed and its local gravitational field. It might thus be possible to construct a cosmological model where, in the distant past, Earth clocks ticked much slower than those on distant galaxies. Then light could travel billions of light-years at its normal speed, while only a few thousand years elapsed on earth.

Russell Humphreys (2008) proposed that the earth is near the center of a spherical universe surrounded by an invisible shell (the “waters above the heavens”), much more massive than all the galaxies (Figure 9.3). The rapid expansion of this shell, accompanied by the creation of galaxies throughout the universe, supposedly caused a moving zone

of “timelessness.” This allows the earth to experience only a few days while the distant galaxies experience billions of years.

An alternative model by John Hartnett (2007) uses an extension of general relativity with the 5-dimensional cosmology of Moshe Carmeli. Here, too, the Earth is taken to be near the center of a spherical universe that expanded rapidly during the creation week, thereby causing the desired slowing of the earth’s clock.

How well do these models succeed? Both are highly speculative, involving novel physics and peculiar mass distributions. Both have various theoretical difficulties to overcome (*e.g.*, getting sufficient time dilation at the earth, and getting the observed red shifts relations). Further, the special conditions (*e.g.*, sudden acceleration and, later, sudden deceleration) seem to require special supernatural effects.

Humphreys’ model received has devastating criticism, showing errors both in mathematics and in the proper application of general relativity (see Dennis 2020). Recently, Humphreys (2022) abandoned this model in favor of a newer alternative, to be discussed later.

Similarly, Hartnett’s model is still incomplete, since Moshe Carmeli, who has since died, never worked out a general 5-dimensional cosmology. Indeed, Hartnett (2015) seems to have abandoned his model in favor of Jason’s Lisle’s Anisotropic Synchrony Convention (ASC), to be discussed shortly.

I think it fair to conclude that, currently, there are no workable creationist time-dilation cosmologies.

Moreover, these models all need some form of mature creation. Time dilation might, perhaps, allow sufficient time for distant stars and galaxies to develop via natural means. However, the Sun and nearby stars have much the same cosmic gravitational potential as the earth, and hence the same clock rate. These must then have been created in mature form.

Since time-dilation does not significantly affect clock rates on nearby stars, the problem of Adam seeing stars on Day 6 is left unsolved.

3. The Anisotropic Synchrony Convention

Jason Lisle's (2010) *Anisotropic Synchrony Convention* (hereafter denoted ASC) adopts the convention that light travels infinitely fast when moving towards the earth, and at speed c/2 when moving away from the earth, with a two-way average of c (c is about 300,000 km/sec). This solves the distant starlight problem since light from distant galaxies arrives at the earth virtually instantaneously. According to Lisle, stars and galaxies were created in mature form 6000 years ago, pretty much the same as now seen.

This solution has become quite popular among creationists over the last decade. It is based on Special Relativity, where spatial position, time, and motion have no absolute values, but are all relative to the observer.

Consequently, the one-way speed of light from observer A to observer B cannot be measured directly since this requires two synchronized clocks. Observer A can measure the speed of light only by sending a light signal to B, a known distance away, and then reflecting it back to himself with a mirror. Then, using only clock A, he can calculate the two-way average speed in two opposite directions (*e.g.*, over the return path A-B-A).

In Special Relativity the speed of light is usually assumed to be *isotropic* (*i.e.*, the same in all directions). But this is merely a convention. One could explain all the observed relativistic effects just as well by taking the speed of light to be *anisotropic* (*i.e.*, direction-dependent), as long as the average two-way speed is c. Lisle's ASC model requires reformulating the equations of Special Relativity but is observationally equivalent to it. This makes it impossible to falsify ASC empirically.

Does Light Have a One-way Speed?

Are we to believe that light really travels infinitely fast towards the earth? Not quite. On the contrary, Lisle contends that the one-way speed of light is ***not*** a property of the universe. He writes:

> *Those unfamiliar with Relativistic physics are deeply inclined to believe in absolute time and space. And therefore, it will seem*

> *intuitive to them that the one-way speed of light should be an objective, invariant, and measurable quantity. But the universe is not constructed that way...God has constructed the universe is such a way that length, duration, and synchronization are relative to a given observer. Our inability to measure the one-way speed of light is not due to a lack of creativity on our part...Rather it is due to the way God has constructed spacetime (Lisle 2010:203).*

Thus, according to Lisle, whether we choose the speed of incoming light to be c/2, infinity, or anywhere in between, our choice is merely an arbitrary human convention, much like choosing to measure lengths in meters or yards. Physically, it makes no difference.

It follows that Lisle's creation model is physically equivalent to God creating the universe 14 billion years ago, starting at the furthest galaxies, and then creating inwards towards the earth, so that the first light from all galaxies reaches the earth simultaneously on Day 4, 6000 years ago.

Yet, if the one-way speed of light is not a property of the universe, it is not physically meaningful to ask how long it took starlight to travel to the earth. Therefore, Lisle's proposal is not so much a *solution* to the distant starlight problem but more a *dismissal* of the question as physically meaningless.

Relativity: Einstein Versus Lorentz

In postulating that the one-way speed of light is not a physical property Lisle follows Einstein's rather *positivistic* interpretation of Special Relativity, which limits reality to what *humans* can observe.

Einstein held that Special Relativity led to a four-dimensional "block universe" view of space-time in which past, present, and future are equally real, and where the flow of time is just an illusion. This is known also as *static* time, *eternalism*, or the *B-theory* of time.

This clashes with the common-sense notion of time as *dynamic*, where only the present really exists, the past has existed, and the future does

not yet exist. This is known also as *presentism,* or the *A-theory* of time. Presentism entails that there exists a universal "now", corresponding to the state of the universe that exists at each instant. This in turn presupposes absolute time, absolute space, and absolute simultaneity.

We *can,* in fact, interpret Special Relativity in such absolute terms. The Lorentzian view of relativity, named after the Dutch physicist Hendrik Lorentz (1853- 1928), holds there is a universal frame of reference, with respect to which light travels at speed c in any direction. For any observer moving with respect to this frame, measuring rods will contract, and clocks will slow down, so that the speed of light is always *measured* to be c, but space and time itself are not distorted as in Special Relativity. This is discussed in detail by Craig (2007).

Lorentzian Relativity is empirically equivalent to Special Relativity, but it takes the one-way speed of light to be physically meaningful, having speed c.

Surely, an omnipresent and omniscient God can assign a universal "now" for the universe at each instant of time. Such a "God's view" of things would define absolute time, space, motion, and simultaneity. It seems incoherent to think that an omniscient God, Creator of the entire universe, could not know how long it takes starlight to reach the Earth, no matter how unknowable that may be to us mere mortals. Presentism, the A-theory of time, and Lorentzian approach to relativity seem more in accord with theism than the alternative.

The ASC and the Bible

If it is not physically meaningful to ask how long it took light from a celestial event to reach us, such events can be timed only by when we see them. Consider, for example, what Hartnett writes about sunlight:

> *Based on the distance to the sun and the canonical speed of light, c, the light travel time from the sun to Earth is about 8.3 minutes. But, and here's the problem, it has been suggested that light from the core of the sun takes about 170,000 years to reach the surface. This is because gamma photons, generated in the thermonuclear fusion reaction at the sun center, undergo*

> *a random walk as they are absorbed and re-emitted by nuclei on their way to the surface...*
>
> *There is only one biblical creationist cosmogony that I know which can explain it, and it does it easily. It is Jason Lisle's ASC model. That ASC model says that the physics of Einstein allows us to time events such as in the Days of Creation, 1, 2, 3, 4, 5, etc. And we time those events by when an Earth observer could see the events happening. Thus when the light from the sun first arrived at the Earth it was Day 4.* ***It does not matter, it is even irrelevant, how long the light took to travel...***
>
> *This is the language of the Bible. Events occur when they are observed. The sun was first seen by Earth observers on Day 4 and that defines when the sun was created. That event occurred 3 days after God created the Earth on Day 1 about 6 thousand years ago (Hartnett 2019).*

The random walk of light, bouncing back and forth, involves mostly *two-way* light-speeds. It is only when light is approaching us that it supposedly moves infinitely fast. Light moves at speed c perpendicular to the line-of-sight, and at speed c/2 when moving away from us. So the 170,000-year timespan applies even using the ASC. Thus, even applying ASC, Harnett seems to think that the Sun is at least 170,000 years old.

Hartnett considers the ASC as primarily a clock convention that dates an astronomical event to when it is ***observed*** on the earth, rather than when it ***actually occurred***. In his view, Genesis 1 uses phenomenal language that equates the creation date of the Sun to when an earth-bound observer first saw it.

The problem with viewing the language of Genesis 1 as phenomenal is that it is written from *God*'s perspective. We are told, *"God made the two great lights...and the stars...and set them in the expanse...And God saw that it was good*" (Gen.1:16-18). Since God is omniscient and omnipresent, the events recorded in Gen.1 must refer to concrete facts, rather than to mere human appearances.

Moreover, the Sun and stars are placed in the expanse, which was created only on Day 2. So, there is no place where celestial objects could exist before Day 2. Further, if the stars only became visible on earth on Day 4, why does Gen.1:16 not use the same verb "appear" that was used of the dry land on Day 3? Finally, Ex.20:11 clearly says that God *made* everything in heaven and earth in six days, not that everything became visible to man in six days.

Thus the Anisotropic Synchrony Convention model does not really solve the distant starlight problem. It merely dismisses it as physically meaningless. It relies on a positivist interpretation of Special Relativity, leading to a phenomenalist interpretation of Gen.1 that contradicts the plain reading of the biblical text.

We could rescue this model by assuming that the speed of light is not merely a convention but really is infinite toward the earth and c/2 away from it. This involves interpreting relativity within an absolute reference frame that gives the earth a special status, as well as adopting a presentist view of time. Perhaps a better name for this might be the *Geocentric Lightspeed Model*.

Physically, this model seems very counter-intuitive. It seems rather *ad hoc*. Why should speed of light depend so greatly on its direction? And why should the earth be the universal point of attraction for light? Nevertheless, if only the two-way speed of light can be measured, then, as for the ASC, there can be no empirical proof (or disproof) of this model.

In the absence of physical rationale, this model must be justified by non-empirical considerations, such as its ability to solve the puzzle of seeing distant stars in a young universe. Moreover, we have seen that the earth does have a very special place in biblical cosmology.

Finally, Lisle’s convention and the Geocentric Lightspeed Model both must be supplemented by some hypothesis to account for the rapid formation of stars and galaxies. Lisle posits that these were created in mature form.

4. Mature Creation

Virtually all creationist cosmologies must be supplemented by some degree of mature creation. This naturally raises the question: since mature creation is needed anyway, why not postulate that God created the full-blown stellar heaven (including stars, galaxies, and their light in transit) instantaneously, on Day 4.

The notion of mature creation is associated particularly with Philip Gosse (1857). More recently it has been promoted by P.G. Nelson (2013) and applied to astronomy by Donald DeYoung (2010).

The Mature Creation model draws upon no speculative physics, nor unusual conditions, at least not beyond Day 4. It merely requires a miraculous creation on Day 4.

Since mature creation refers to the past, no present or future observations or experiments can ever refute it. Nor is it contrary to reason since there is nothing illogical about such an origin of the universe. Thus, it is beyond both observational and logical disproof. Cosmologist George Ellis notes:

> *A modern cosmologist who was also a theologian with strict fundamentalist views could construct a universe model which began 6000 years ago in time and whose edge was at a distance of 6000 light-years from the solar system. A benevolent God could easily arrange the creation of the universe...so that suitable radiation was travelling toward us from the edge of the universe to give the illusion of a vastly older and larger expanding universe. It would be impossible for any other scientist on the Earth to refute this world picture experimentally or observationally; all that he could do would be to disagree with the author's cosmological premises.(Ellis 1975:246).*

Another physicist, Herbert Dingle (1960:166), writes of mature creation:

> *There is no question that the theory is free from self-contradiction and is consistent with all the facts of experience we have to explain; it certainly does not multiply hypotheses beyond necessity since it invokes only one; and it is evidently beyond future refutation. If, then, we are to ask of our concepts nothing more than that they shall correlate our present experience economically, we must accept it in preference to any other. Nevertheless, it is doubtful if a single person does so.*

Despite all these obvious advantages, many creationists reject such full-blown mature creation.

Why? Let us consider some of the stated objections.

a. Divine Deception

The main objection to mature creation is the implied deception by God (Hartnett 2015:14). An instantaneous mature creation entails that the light Adam saw from a distant star was created *en route*, and never actually originated from the star from where it seemingly came from.

Moreover, the details of starlight seemingly relate to specific historical events. For example, a supernova, first seen in 1987, appears to be 170,000 light-years away, suggesting that it exploded 170,000 years ago. If this event never really happened, is this just an elaborate fiction, a hoax created by God?

Even many creationists consider such alleged deception a fatal flaw to fully-fledged mature creation. Thus, for example, Jonathan Sarfati (2015:172-3) argues that God created Adam, trees, and stars fully formed, but with only a *functional maturity.* According to Sarfati, deception arises only if such creation included the appearance of a *false history* that was unnecessary for functional maturity. He therefore concludes that Adam had no navel, that the original trees had no growth rings, and that starlight was not created in transit.

How valid is this charge of divine deception? Consider the following points:

i. Inevitable Apparent Past Events

Any form of mature creation, even functional maturity, is vulnerable to a similar charge of deception. For example, there seems to be evidence for past collisions of many galaxies (Carey 2005), past supernova explosions, past expulsions of huge jets of matter, and the like. According to John Harnett, light emitted from the surface of the Sun seemingly left its core some 170,000 years ago. Even Adam's just-created hair would have had seeming evidence of past accretions of growth. Virtually any structure, created mature but examined under assumed past uniformity of natural laws, would show apparent evidence of earlier stages and specific events that never actually existed.

P. G. Nelson (2013) finds it plausible that God created the universe not just mature, so that it appears old, but *coherently* mature, so that various age estimates give consistent results.

A star created as a functioning unit would be causally coherent: it would have its various parts in proper gravitational, thermal, and radiative relationships, else it could not remain stable. Light at the surface of a star would have been created in place, although seemingly originating from the stellar interior.

Similarly, an entire galaxy created as a functioning unit would be coherently complete with all its constituent parts: stars and gas, their gravitational fields, and light radiation (photons). Both the light photons and gravitational effects would have been created in place, although seemingly originating from the galaxy's stars. Thus, the instantaneous creation of a mature galaxy necessarily involves the creation of light en route, with all its implications of "false" histories.

The same could be said of clusters of galaxies, super clusters, and even larger structures. Indeed, the whole astronomical cosmos could have been created as a full-blown unit, complete with moving stars and galaxies, their gravitational interactions, and light photons travelling throughout the universe. The apparent histories from different light rays would give consistent results.

It seems impossible to create an entity that did not have some appearance of an illusory past. Science assumes that the cosmos is subject to a continuum of physical cause and effect working through time. Given the state of the cosmos at creation, scientists apply physical laws to calculate any future state after creation. They could likewise apply the same laws to calculate apparent past states before creation. Under such naturalist assumptions, the universe at its creation inevitably appears to have had an earlier history.

Moreover, since the same physical laws are assumed, the actual future states will appear to be of a very similar nature to the apparent past states. Created stars and galaxies would look as if they had formed in space. If future states include supernovae and galactic collisions, so should apparent past states.

ii. Does God Deceive?

Illusionary past histories arise only under the naturalist assumption that current physical laws have always been applicable, banning miracles such as mature creation. Surely God is not being deceptive when he uses supernatural powers. He is free to do what he pleases.

Moreover, as noted by physicist Edgar Andrews (1985:164), God can hardly be charged with deception if he reveals mature creation in Scripture. If man ignores the Bible, thus coming to false conclusions about the past, he has only himself to blame for unduly relying on naturalistic assumptions. Man has deceived himself, by his own faulty presuppositions.

The Bible affirms that "*God never lies*" (Titus 1:2), even that "*it is impossible for God to lie*" (Heb.6:18). However, these texts refer to God's covenantal promises to believers. Unbelievers, who reject God's word, might well be deceived by God:

> *"and if a prophet is deceived and speaks a word, I, the LORD, have deceived that prophet...and they shall bear their punishment...that the house of Israel may no more go astray from me..." (Ez.14:9-11).*

> *"Therefore, God sends them a strong delusion, so that they may believe what is false, in order that all may be condemned who did not believe the truth…" (2 Thess. 2:11).*

In sum, God *does* use deception, in response to our rejection of his Word. This generally occurs via secondary means, not least of which is our fallen human proclivity for self-deception.

b. A 5-minute Old Universe

A second objection to mature creation is that one could as well argue that the entire universe, along with our memories of an apparent past, was created 5 minutes ago. Thus, if we allow such reasoning, we have no guarantee that any part of our history is real.

Empirically, of course, we indeed have no such guarantee. Yet, although a 5-minute-old world might be possible, we have no grounds for believing it to be true. The implausibility of a 5-minute-old world does not, however, entail that all miraculous histories should be dismissed. In particular, the case for a 6000-year-old universe is no mere philosophical possibility but is grounded upon the explicit testimony of its Creator, as revealed in his Word.

c. It Is Unfalsifiable

Finally, it is sometimes charged that the theory of mature creation is not scientific because it is not falsifiable. We cannot go back into the past to disprove mature creation; and after the creation event it is observationally identical to a universe that had a long past.

However, this objection cuts both ways. If mature creation is unfalsifiable, then so is its logical opposite. Any naturalist theory of origins that denies mature creation is equally unfalsifiable. For example, the notion that Big Bang cosmology describes real past events is likewise unfalsifiable and, thus, if we adopt that standard, non-scientific.

On the other hand, mature creation is based on biblical evidence. That evidence does speak also of a future apocalypse when Christ returns

and renews the cosmos. Hence, mature creation is connected to definite future predictions that can prove its reliability.

5. A Rapidly Matured Creation

The mature creation model can readily be changed to include miraculous process. Variations of this theme have been proposed by Edgar Andrews (1985:65) and creation astronomer Danny Faulkner (2013), and Russell Humphreys (2022).

In the Genesis creation account the universe was not created *instantaneously* but was formed in stages over a six-day span. At least some of that creation work seems to have involved process. For example, on Day 3, "*the earth brought forth vegetation*" (Gen.1:12), on Day 6, "*let the earth bring forth living creatures*" (Gen.1:24). Adam, trees, beasts, and birds are all formed *"out of the ground"* by God (Genesis 2). These all suggest the employment of process, albeit rapid and miraculous. It is thus plausible that God used (very rapid) process also in making the Sun, Moon, and stars.

Consider Jonah's shade tree, "*which came into being in a night*" (Jonah 4). It seems that everything else around Jonah continued normally, but God miraculously accelerated the plant's growth so that a year's growth took place in just a few hours. Likewise, Aaron's staff sprouted, put forth buds, blossomed, and bore ripe almonds overnight (Num. 17:8). These miracles seem very similar to the earth "*sprouting vegetation*" (Gen. 1:11) on Day 3.

Creation geologist Ken Coulson (2020) postulates that during the Creation Week God used supernatural formative processes (SFPs) wherein all natural processes are accelerated at the same relative rate. Thus, creation would mature much like it would naturally but at a much faster rate, like in a time-lapse video. All rhythms are speeded up by the same amount, *except* the rhythm of day and night. What would normally happen in millions of years takes place within a single day.

This is equivalent to all rhythms staying the same, except for a slowing of the rhythm of day and night. In other words, another way of looking at this a Creation day might have lasted billions of years. However,

since the day is the basic unit of biblical time, it is preferable to view the length of the day as fixed and other natural rhythms as accelerated.

However, the SFPs were not just highly accelerated normal processes. How could plants grow during only one day, in the absence of the Sun and Moon, with their daily, monthly, and seasonal cycles? This requires further miraculous properties. Jonah's tree and Aaron's almonds grew overnight, in the absence of sunlight, water, and nutrients. Similarly, the plants grew miraculously on Day 3 *as though* all the necessary natural conditions were present.

This might work for the first three Creation days, enabling the creation geologist to explain many geological structures in the pre-Cambrian era, before animal fossils first appear. However, on Day 4, when the Sun, Moon, and stars are created, this approach raises some questions. If all natural processes are accelerated at the same rate, then 14 billion years of celestial activities entail *another* 14 billion years of geological activities *after* the creation of plants on Day 3. Since this is not feasible, this approach must be adjusted. We could conjecture that normal providence held for the earth while God worked miraculously to form the celestial bodies. All celestial processes (gravity, nuclear reactions, radiation, and the like) may have been highly accelerated (at the same relative rate), while earthly processes worked at their normal rate. Watching the creation of the stellar sky on Day 4 might be like watching a video in fast motion. What normally takes billions of years happens on Day 4 in just a few hours. This includes not just the formation of stars, collisions of galaxies, and the like, but also the transmission of their light to the earth.

Thus, for example, Humphreys (2022) postulates that one Day 1 God created a ball of water with a radius of about one light-year. On Day 2 God separated the inner part, which became the Earth, from the outer part, the expanse. The expanse expanded to about 15 billion light-years by the end of Day 4, when stars and galaxies were miraculously formed from the water within the expanse. The "waters above the expanse" were ice particles just beyond the edge of the universe. On Day 4 the speed of light, and the rate of all physical processes, was trillions of times faster than on Earth. So billions of years' worth of

activities were done in only one Earth day. Later that day the speed of light, and all processes, in the expanse dropped to normal.

One might wonder: if all the energy received on earth from space (including the Sun, Moon, and stars) seemingly over billions of years, were compressed into only one day, would this huge burst of energy not destroy the earthly vegetation previously created on Day 3?

Not necessarily. Normal physical laws may well have been changed or superseded during the miraculous formation of celestial objects on Day 4. Perhaps, for example, the earth was miraculously shielded from any ill effects.

We saw earlier that, at the eschaton, the whole cosmos will be renewed very rapidly in a process that seems very much like the original creation act. In the new heaven we shall likely see renewed galaxies billions of light-years away, raising the same distant starlight problem. Will anyone then suggest that the galaxies were renewed billions of years earlier?

Summary

To sum up, most of the creationist cosmologies discussed have serious, if not fatal, shortcomings, at least in their present forms.

The curved-space model can be ruled out on observational grounds; hence the large distances assigned to stars and galaxies are probably reliable. The decaying speed of light model lacks compelling physical rationale and observational support and is challenged by the orbital decay rate of the Hulse-Taylor pulsar. There is currently no workable time-dilation model that could account for Adam seeing stars already on Day 6.

The Anisotropic Synchrony Convention model does not really solve the problem, merely dismissing it as physically meaningless. It relies on a positivist interpretation of Special Relativity, leading to a phenomenalist interpretation of Gen.1 that contradicts the plain reading of the biblical text. The Geocentric Lightspeed Model avoids these shortcomings and is likewise impossible to disprove empirically.

However, it seems rather *ad hoc*, giving no physical justification as to why light should travel in such profoundly geocentric manner.

All these models, except for that of Setterfield, must appeal to mature creation for the origin of stars and galaxies. Hence it is simplest to appeal to the mature creation of the entire universe. The objection that this entails fictitious history applies to any miracle, when examined via naturalist assumptions. Thus, this objection, if valid, would rule out any non-naturalist theory of origins.

The most general form of mature creation is that of a *rapidly matured creation* that allows for (miraculous) process during the creation week. This allows for the possibility that the starlight we see was not created *en route* but actually comes from the star from where it appears to come.

This model has similarities with c-decay theories, in that it entails that light travelled faster in the past. However, unlike such theories, it limits this to the creation week (and perhaps shortly thereafter when the fallout of sin distorts the stars) and specifies no precise physical formulas nor mathematical rules.

Indeed, the rapidly matured creation model makes no added physical conjectures about what happened during creation. It makes no attempt to go beyond the biblical givens.

The choice is generally between (1) fully mature (or rapidly matured) creation, and (2) limited mature creation plus some combination of hypothetical new physics, unusual time conventions, *ad hoc* scenarios, and the like. It seems to me that, with many current creationist models, the plus part is often implausible, unlikely to convince opponents, possibly open to potentially disproof, and ultimately unnecessary. Therefore, mature creation, perhaps rapidly matured, seems to be the simplest solution to the distant starlight problem.

A Many-Models Approach

Requiring a scientific model to be consistent with Scripture adds to the data and constraints that a workable cosmology must satisfy. This

falsifies all secular cosmologies but still leaves many other possibilities. As we saw earlier, many cosmologies can be constructed to account for any given set of data, at least in principle.

So how do we choose the true biblical cosmology? Again, we are faced with the problem of constructing, and justifying, proper criteria for theory choice. Even after applying all pertinent biblical truths, we are still left with multiple options.

Although cosmologies contradicting Scripture are certainly false, Biblical cosmologies going beyond Scripture are still probably wrong. The speculative nature of scientific theorizing cautions against placing undue trust in any particular model. Any biblical cosmology should therefore be prudently presented as merely a hypothetical possibility, rather than as *the* solution.

This being the case, it is perhaps better to sketch out half a dozen possibilities than to stake too much upon one detailed theory. Such a multiple-theory approach to origins carries with it several advantages. The multiple model approach has more changes of finding good possibilities and underlines the fact that the observational data can be interpreted in many ways. It cautions against accepting any model as the final truth. It emphasizes the subjective, conjectural element in model building, as well as the great gap between observational data and theories that claim to explain that data.

Thus, for example, with regards to the light travel time problem, it should be stressed that several possible solutions exist. Perhaps light was created *en route*, perhaps the speed of light depends on direction, time, or space. Perhaps very rapid processes took place during the creation week, and so on. Which one is right? Only God knows, and beyond that which he has revealed - through direct observation and through his Word - we can only guess.

Biblical cosmologies are important as models of reality, as depictions of theological truth. Such models can show various possibilities of combining observational data with biblical insights, thus illustrating the harmony between the Bible and astronomical observations.

10. Conclusions

We found that cosmology, the study of the universe as a whole, is not only the most important science but also the most difficult.

The Speculative Nature of Cosmology

We can see only a small part of the universe over a small time interval. For the most part we cannot experiment but can only observe from a great distance. If scientific “facts” are to be limited to direct, confirmed observations then, in cosmology, such facts consist almost entirely of the radiation received at our earth-bound telescopes and other instruments. All else involves theoretical input.

Thus, even transforming the starlight data collected by a telescope into information about the star from which it appears to have come requires assumptions about light speed, distance measurements, and so on. Moreover, to generalize from our limited data about the stars we see to conclusions about the entire universe we must rely heavily on simplifying assumptions. Such assumptions depend strongly on our worldview beliefs about what the universe is like.

The Failure of Naturalist Cosmology

Mainstream cosmology, particular Big Bang cosmology, is based on naturalism. It assumes that the physical universe is all that exists, and that everything can be explained in terms of natural laws. Big Bang cosmology forms the origin myth of naturalism.

We saw that Big Bang cosmology currently has many deficiencies. There are many observational anomalies, theoretical problems, and heavy reliance on speculative conceptions such as inflation, dark matter, and dark energy, that have been unobserved in any physics lab. There is also the possibility of constructing alternative models, based on different worldview assumptions, that could explain the data equally well. Hence, Big Bang cosmology can never be conclusively proven to be a true account of the past.

Even if these difficulties could all be satisfactorily resolved, mainstream cosmology still is incomplete. It cannot answer the fundamental questions as to why the universe exists, what caused it to spring into existence, why the natural laws are as they are, and so on.

Moreover, naturalist cosmology is thoroughly materialistic. As such, it cannot explain the existence of mind, thoughts, and mental choices. It is a depressing, truncated view of the world that is void of any purpose, value, eternal truth, justice, beauty, or love. It has no place for God, heaven, or any human after-life. All life is doomed to die forever.

Big Bang cosmology may make it plausible that the universe had a beginning and that it is fine-tuned for intelligent life. Such evidence for a Prime-mover and a Designer should be seen as showing the deficiency of naturalist cosmology to explain reality in purely naturalist terms.

We saw that Christians should be wary of embracing Big Bang cosmology. It introduces a science-driven re-reading of the Bible that opens the door to acceptance also of geological and biological evolution, leading to the loss of the biblical Adam, and raising many theological problems. Big Bang cosmology has no place for heaven as a physical place in space and time that interacts with the celestial cosmos. To wed Christianity to Big Bang cosmology amounts to mixing two opposing worldviews. Such compromise is bound to fail, to the detriment of Christianity.

Promoting Biblical Cosmology

To transcend the limitations of human, naturalist cosmology we need a “God’s view” of the cosmos and its history. This can be acquired only to the extent that God has revealed it to us. Christians believe that God has revealed pertinent cosmological knowledge in the Bible.

A Christian view of cosmology considers God to be the ultimate reality. It distinguishes between God and his creation, which develops in history according to God’s comprehensive Plan, culminating in his glory. God sets moral absolutes and mathematical laws. He upholds the entire universe from moment to moment. He sets natural laws and alters these as he sees fit. The universe consists not just of the earthly and celestial realms we see, but also of a heavenly realm that interacts

with these. The focal point of the universe, the ultimate standard for rest, is God's heavenly throne. Our purpose is to serve and praise God; our hope is to glorify him forever on a renewed earth.

Various biblical cosmologies aim to explain our astronomical observations in terms of biblical givens, particularly regarding the origin of the universe. It is important to show that what we see can be harmonized with what the Bible tells us.

Big Bang cosmology, despite its shortcomings, is currently much more advanced in giving coherent explanations of many astronomical features. Perhaps, if creationist cosmology were granted the same amount of research funds and scientific resources, it might see a drastic improvement.

Yet, our goal in cosmology is not merely to construct a model that may have broad, but illusionary, explanatory power. Our cosmology should reflect known truths about the universe. The bottom line is that creationist cosmologies, despite their weaknesses, are more in harmony with divinely revealed facts than Big Bang cosmology.

Although biblical cosmology is important for Christians, it may well fall short of convincing unbelievers. First, since Heaven, angels, and demons are usually invisible, there can of course be no scientific proof of their existence.

Second, the main characteristic of a biblical model of visible part of the cosmos is its creation less than ten thousand years ago. This is, however, difficult to prove. Creationist physicist Jake Hebert (2019) advances several deep-space evidences for a young universe, such as the existence of spiral galaxies, the existence of hot blue stars, and the large number of neutron stars in globular clusters.

How valid are such proofs for a young universe? They certainly present current problems within the standard model. However, naturalist astronomers are confident that further research will eventually find good solutions. For example, computer simulations indicate that spirals in galaxies likely *can* persist for billions of years (D'Onghia 2013). Further, even if such problems were to stay unsolved, they still suggest

ages of at least hundreds of millions of years for spiral galaxies and globular clusters. Hence, to the unbeliever, they would still count as strong evidence against a young universe.

Whatever shortcomings naturalist explanations for stars and galaxies may have, creationists generally offer little in the way of detailed alternatives. Mature creation, to the extent that it relies on miracles, is unlikely to convince a naturalist unbeliever. Likewise, the unbeliever is unlikely to accept any explanation of the distant starlight problem that relies on miracles or speculative physics.

Caution must be taken to avoid falling into the trap of justifying faith in the Bible by our ability to provide "scientific explanations" of biblical events. An instructive historical illustration of this is described by D.C. Allen in his book *The Legend of Noah* (1963). In the 17th century, theologians were asked many scientific questions about the Flood. Most Roman Catholic theologians met scientific difficulties by declaring that the impossibility of explaining the mechanics of the Flood clearly proved that it must have been a miracle. Many protestants, on the other hand, being anxious to show that the Bible agreed with human reason, tried to work out precise scientific solutions. Their failure to explain the details to the satisfaction of the critics eventually led to the inspired history of Noah being relegated to a mere myth.

Regarding apologetics, any biblical cosmological model will be accepted by an unbeliever only if it satisfies criteria set *by him*. Since his standards are bound to be at heart unbiblical, the verdict is a foregone conclusion. Those who reject God can hardly be expected to objectively evaluate his Word.

For example, the real difficulty that many scientists have with creationists is not so much with the *ad hoc* nature of their theories as with their prior acceptance of the Bible and the restraints it imposes on theorizing. Consider, for example, the words of Michael Ruse, a prominent spokesman for the scientific community:

> *the major reason why Creation-science is not genuine science is that its supporters have to believe, without question or dispute, in the literal truth of Genesis (Ruse 1988:393).*

Clearly the basic issue here is one of religious presuppositions.

Further, the above apologetic might lead the unbeliever to believe that he is justified in rejecting Scripture until acceptable scientific explanations of it have been made. That is wrong. Rather, the unbeliever must be confronted with God's Word and the need for repentance.

The biblical data must be adopted as basic, as non-negotiable articles of faith. The trustworthiness of God's Word must not be made contingent upon our ability to explain it or prove it "reasonable" by human standards. Let the onus be on those who reject the accuracy of the Bible to prove the alleged impossibility of biblical events. And if we cannot easily explain the biblical data in terms of a scientific model, that merely illustrates the inadequacy of human theorizing. Our theories must be judged in the light of Scripture, rather than vice versa. Let us therefore stress that our prime allegiance is to God and his Word, rather than to any human, scientific explanation of any portions of it.

To defend our faith, we need not try to show how well the Bible fits in with human standards and theories. Rather, we should expose the limits of scientific theorizing, particularly about the history and nature of the cosmos. More attention should be focused on the underlying naturalist assumptions and implications. Here devastating offensives can be mounted against the alleged reliability of secular science. The secular scientific community should be challenged to acknowledge the highly subjective nature of theory construction, selection, and justification; to concede the key role in science played by religious and philosophical presuppositions; and to be less dogmatic about pronouncements about reality, its origins, and its future. We must show that naturalism, and any other worldview based on human reason, ultimately self-destruct.

Our ultimate hope as Christians is our future bodily resurrection, and our joyful new life on a renewed earth, in a redeemed cosmos, serving and glorifying Christ our Redeemer Lord. That is the culmination of God’s great Plan for his cosmos. And, once we experience such glory, that will be the conclusive proof of biblical cosmology.

Then I saw a new earth and a new earth,
for the first heaven and the first earth had passed away,
and the sea was no more.
And I saw the holy city, new Jerusalem,
coming down out of heaven from God,
prepared as a bride adorned for her husband.
And I heard a loud voice saying,
"Behold, the dwelling place of God is with man.
He will dwell with them, and they shall be his people,
and God himself will be with them as their God.
He will wipe away every tear from their eyes,
and death shall be no more,
neither shall there be mourning nor crying nor pain,
for the former things have passed away…"
(Rev. 21:1-4).

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