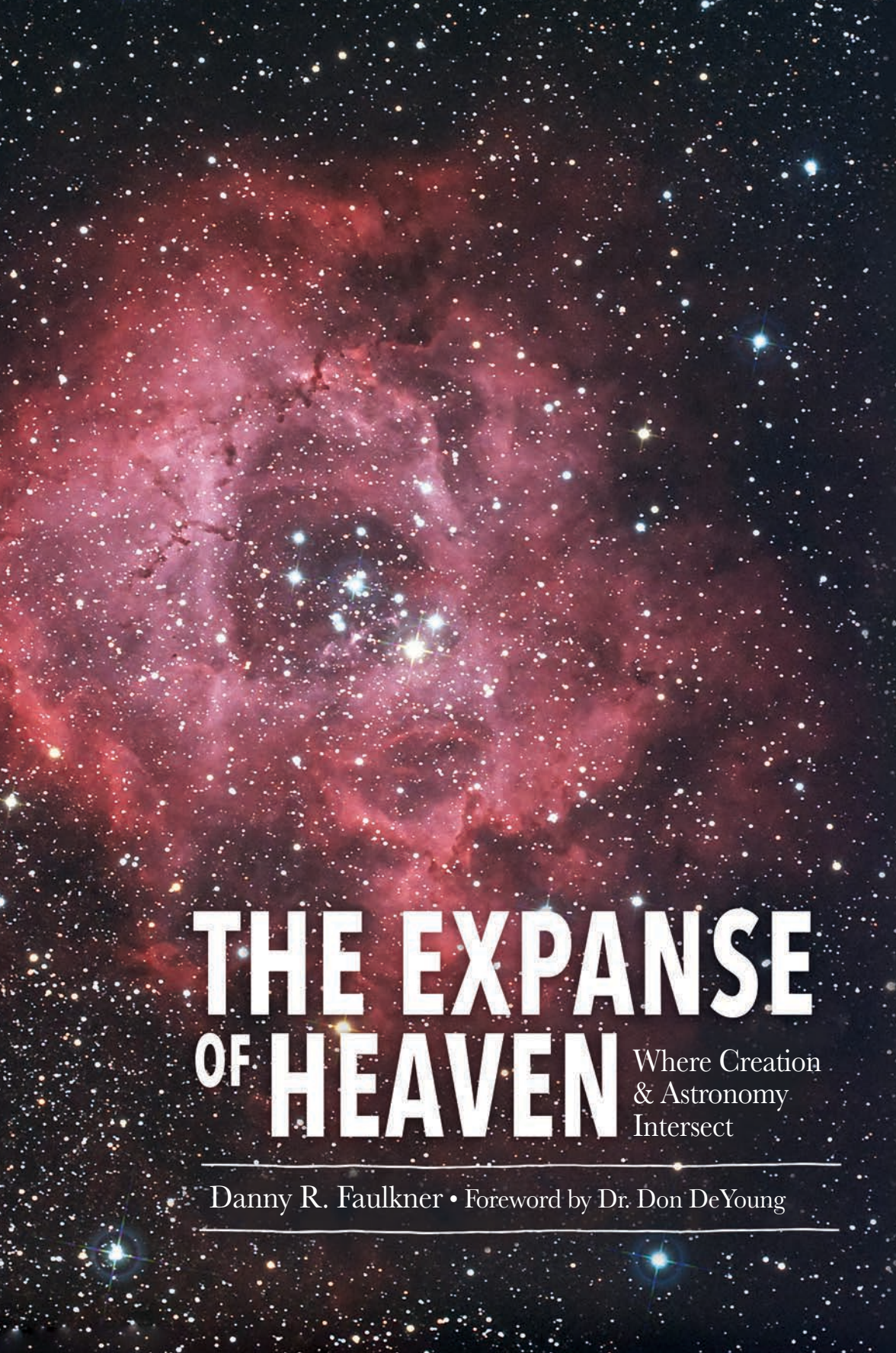

THE EXPANSE OF HEAVEN

Where Creation & Astronomy Intersect

Danny R. Faulkner • Foreword by Dr. Don DeYoung

The Expanse of Heaven

The Expanse of Heaven:

Where Creation and Astronomy Intersect

Danny R. Faulkner

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To my good friend and research partner for two decades,
Ron Samec.
Ron, your iron has sharpened my iron.

Contents

Foreword

Astronomy questions continue to generate popular interest in the media: Is there alien life on the thousands of planets circling distant stars? Are we in imminent danger of an earth collision with a wandering asteroid or comet? Could the sun suddenly misbehave and thrust the earth into either a frozen or scorched future?

In contrast to these doubtful questions, positive refreshment is found in the biblical creation worldview of history and the future. Author Danny Faulkner provides such details in this astronomy summary with an expertise ranging from ancient cosmologies to gravity waves. The Creator's fingerprint is clearly evident throughout astronomy including the laws of nature. These laws describe gravity, conservation of energy, celestial mechanics and much more. The laws are unchanging and established for our survival and well-being. Physics and astronomy texts describe these laws but cannot explain their ultimate origin which lies in the realm of supernatural creation.

The field of astronomy is overwhelming to many of us. Our minds may "glaze over" when we consider light-year distances, vast spiral galaxies, and stars as numerous as the sand grains on all the seashores of the world. Author Danny Faulkner has a special ability for giving clear explanations of such details in his teaching and writing.

I am honored to serve with author Danny Faulkner on the board of directors of the Creation Research Society. This International Society has promoted creation studies including astronomy for over five decades. This new book adds to our mission of promoting quality biblical science.

Don DeYoung, President
Creation Research Society
May 1, 2017

Acknowledgments

As I finished the final edits of *The Created Cosmos: What the Bible Reveals About Astronomy* in the spring of 2016, I realized the need for this companion book. Once again, I rounded up the usual gang of suspects. Since Lee Anderson was so valuable in completing the earlier book, I knew that he would be most helpful in writing this one. Lee once again helped organize the material and acted as my editor. This new book required many more figures and illustrations than the previous book did; and Lee suggested many of the ones that we needed, secured the illustrations, and kept track of them during the editing and preparation stages. As before, I called upon my friend and astronomy colleague, Robert Hill, to review the manuscript's content. Bob, too, recommended many figures and illustrations included in this book. Once again, Steve Golden proofread the text. I'm amazed that the many little things that we missed—but these didn't get past Steve. This book is far better than it would have been without the tremendous help of these three gentlemen. I also want to thank my department director at Answers in Genesis, Andrew Snelling, for his support for this project. Being a geologist, Andrew also read the chapter on the planet earth, and he made many good recommendations for changes. Also, as before, I wish to thank Laurel Hemmings for her masterful work on the layout of this book.

I especially thank Don DeYoung, President of the Creation Research Society, for kindly agreeing to write the foreword. Don has written multiple works on creation and astronomy, such as *Astronomy and the Bible: Questions and Answers* and, along with John Whitcomb, *Our Created Moon: Earth's Fascinating Neighbor*. I've known Don for 25 years, and it has been my pleasure to serve with him on the board of directors of the Creation Research Society for more than a decade.

Finally, I thank my loving wife, Lynette, for her encouragement in completing this book.

Danny R Faulkner
April 11, 2017

Introduction

I intend this book as a companion to *The Created Cosmos: What the Bible Reveals about Astronomy*. In the introduction to that book, I noted how it was different from other books about astronomy written by biblical creationists in recent years by comparing the difference between biblical theology and systematic theology. I likened the approach taken in *The Created Cosmos* to the approach of biblical theology, because in it I explored what the Bible had to say about astronomy, using the categories that the text itself presents, and discussing topics in terms of how the original readers of Scripture would have understood them. (I also included a discussion of a few particularly relevant things that the Bible *doesn't* say about astronomy.) A few people may have been frustrated with that book. There are two possible reasons for this frustration. One reason is that *The Created Cosmos* was not explicitly oriented toward recent, six-day creation. Recent creation was discussed, or otherwise there would have been no point in including the chapter on the light travel time problem. Other than that, though, many of the chapters did not address the age of creation at all. However, keep in mind that the direct context of most of the biblical passages discussed in that book did not specifically address the age of creation, so it would have been out of place to introduce age.

The present book is more of a systematic treatment. Its purpose is to discuss astronomy, using scientific categories, in the light of Scripture. Since I clearly see the Bible as teaching that God created the world in only six days, and that the creation was only thousands of years ago, this will be an underlying assumption in this book. I will describe various aspects of astronomy as it relates to that understanding. This is sure to satisfy anyone who may have been disappointed by what they might have perceived as a lack of sufficient attention to recent, six-day creation in *The Created Cosmos*.

The second reason some people may have been frustrated with *The Created Cosmos* was the many astronomical topics that it omitted. This present book contains far more astronomy than *The Created Cosmos* did. However, it is not meant to be exhaustive. Inevitably, some interesting astronomical topics will not be discussed. I endeavored to include material relevant to the biblical creation model of astronomy. Many astronomical topics may be of interest, but they may not have any relevance to biblical creation. As such, this book is not intended as a textbook on astronomy, though it could be so used, and it certainly could be used as a supplement for a course on astronomy.

For a long time, I have considered Paul Steidl's excellent 1979 book *The Earth, the Stars, and the Bible* to be the best book written thus far on creation astronomy.[1] It is well-written, and it covers many relevant topics. However, being nearly 40 years old, the book is a bit out of date. In many respects, I hope the book that you are now reading will replace and perhaps exceed that book.

Why Study Astronomy?

I may be biased, but I have always thought that astronomy is the most fascinating science. Many people simply are not that interested in science in general. Perhaps it came across as boring in school. Or maybe science is perceived as geeky, or a subject that only very bright people can understand. It is a pity that our educational system can turn off countless people to a variety of fascinating subjects simply because the way that we educate succeeds in sucking the life out of so many things. However, most people seem to be fascinated with astronomy. There is wonder to the natural world, wonder that I think at least hints at the wonder of the Creator. Most people would agree that astronomy is packed full of wonder. Part of the wonder of astronomy is the vastness of the universe. Douglas Adams, in his best-selling book *The Hitchhiker's Guide to the Galaxy* said it very well:

> Space is big. Really big. You just won't believe how vastly hugely mindbogglingly big it is. I mean you may think it's a long way down the road to the chemist's,[2] but that's just peanuts to space.[3]

[1] Paul Steidl, *The Earth, the Stars, and the Bible* (Phillipsburg, New Jersey: Presbyterian and Reformed Publishing, 1979).

[2] Adams was English. In England, a chemist is what we in the United States would call a pharmacist.

[3] *The More than Complete Hitchhiker's Guide* (New York: Bonanza Books, 1989), 53.

To get across some of the distances involved, when teaching astronomy at the university, I had my students work out a scale model of the solar system. In this model, the sun was about the size of a basketball, and the earth was the size of a BB nearly 100 ft (30 m) away from the basketball. Jupiter was approximately an inch across and 500 ft (150 m) from the basketball-sized sun. Neptune, the most distant planet from the sun, was a little more than a third of an inch (25 mm) across and 3000 ft (900 m) from the basketball-sized sun. If we were to place this model of the solar system in New York City, Alpha Centauri, the nearest star to the sun, would be a beach ball in Hawaii. In this scale model, most of the stars that you see at night would be far larger than a beach ball, but they would not fit on the earth because their distances would exceed the earth's circumference. But these are some of our nearest astronomical neighbors. The truly distant objects are so far away that the distance is difficult to comprehend.

Another part of the wonder of astronomy is the beauty that we see. How can anyone not be awed when looking at photographs of astronomical bodies, or better yet, seeing them directly? Both the vastness and the beauty ought to convince all that there is a God. The Bible relates the wonder of astronomy to our Creator. Psalm 19:1 tells us that the heavens declare God's glory, and that God has made everything. In Psalm 8:3–8, gazing at the night sky inspired David to reflect upon man's place in the world. In Job 9:8–9, Job referenced astronomical bodies in contemplating the power of God, while God in turn challenged Job's thinking (Job 38:31–32) by making reference to various astronomical bodies. Given the God-honoring nature of astronomy, the study of astronomy ought to be the burning desire of every Christian. But then, perhaps I am biased.

Astronomy is different from other sciences. One large difference is that astronomy is almost entirely observational rather than experimental science. With other sciences, we use our hypotheses and theories to make predictions concerning the outcomes of experiments and then test our predictions by conducting those experiments. However, in astronomy we are so far removed physically from the subjects of our study that we generally cannot conduct experiments.[4] Instead, we make predictions of what certain observations might reveal and then carry out those observations to test our predictions. In this manner, astronomy is more passive than other sciences.

[4] Exceptions would include studies of samples from astronomical bodies. At this time, the only samples that we have are meteorites, lunar rocks returned by the Apollo astronauts, and microscopic pieces of a comet returned to earth.

The Assumption of Naturalism

Science often is defined as the study of the natural world using the five senses. Notice that since the subject of science is the natural world, there is much emphasis on nature in science. Indeed, what we now call *science* originally was called *natural philosophy*. It was William Whewell in the 1830s who suggested the name change from *natural philosophy* to *science*, and that convention rapidly took hold. Previously, *science* referred to systematized study of any subject that was not considered an art.

Science largely consists of describing natural phenomenon in terms of consistent patterns that we observe. Consider physics, the most quantitative of the sciences. We see regularity in the way the physical world works. Physicists describe this behavior in terms of mathematical equations that can be relatively simple but always elegant. Scientists often revel in the patterns that we see in nature, but far too few of them dwell on the question of *why* those patterns are there. It generally is assumed that the patterns simply exist with no more thought given to the matter. This seeming lack of interest in the source or origin of these patterns in nature easily and subtly can shift into the assumption of *naturalism*, the belief that the natural world is all that exists. A scientist with this persuasion understandably may object that the question of the source of the patterns in nature is beyond the scope of science, as far as the practice of science generally is concerned today. The origin of the patterns in nature is a philosophical question rather than a scientific one. Perhaps when science was known as natural philosophy, this question would have been more welcome than it is today.

All people, including scientists, begin with certain assumptions, and the answer to the philosophical question of the source of patterns in nature falls under the category of assumptions. Many scientists of the past and present see the handiwork of God in the patterns and regularity of nature. This is consistent with Colossians 1:17, which states that in Christ all things hold together, and Hebrews 1:3, which teaches that Christ upholds all things by the power of His word. If the Creator sustains the world moment by moment, one might expect this to be done in a consistent manner which we then perceive as pattern. Again, a scientist committed to naturalism may object that this is a metaphysical assertion because belief in a Creator is an assumption of a spiritual reality beyond the physical. Indeed, this is a metaphysical assertion, but is this

a fair criticism? The assertion that there is no Creator equally is a metaphysical assertion. While a scientist committed to naturalism may sincerely believe that only his assumption is logical and proper, it is an assumption and hence cannot be demonstrated. Therefore, neither that assumption of naturalism nor its denial is superior or inferior, but rather they are opposites that are equivalent in terms of proper argumentation.

Does it matter whether one assumes naturalism or not when generally practicing science? When practicing what some people call operational science or experimental/observational science, no, because we can agree that pattern and regularity exist apart from addressing any reason as to why they exist. However, some modern scientists have altered the definition of science from being *the study of the natural world using the five senses* to being *the search for natural explanations*. This new definition is a very subtle yet profound shift that tacitly embraces naturalism. It specifically excludes the possibility that a Creator occasionally has or might again interact with His creation. Those who believe in biblical creation recognize that God normally sustains the creation and any deviation from that would be a rare event, an event that few scientists would ever encounter. Therefore, in the matter of operational science, there does not appear to be much harm in accepting this new definition of science. However, this new definition precludes God from *ever* involving Himself in the operation of the world. More specifically, this new definition denies that God created the world. Note that this denial of creation cannot be demonstrated, but simply is asserted.

This new philosophy of science has become so deeply entrenched in the minds of many people to the extent that it appears intuitively obvious to them that the world must have a natural explanation. Thus, atheism has come to dominate the direction of what some call historical, or origins, science. Historical science is the attempt to elucidate processes that occurred in the past. Since these are past processes, they cannot be tested today in the traditional way that science works. Hence, the rules of historical science are a bit different from those of operational science. One may attempt to reproduce the conditions of the past, but how do we know what those conditions were? We must assume those conditions; but if the conditions were different from what we assume, then the conjectured processes likely are in error. For instance, there is no single, widely accepted theory of how Grand Canyon formed, even among those

who are committed to naturalism. Rather, there are many different theories. Each theory can explain certain aspects of Grand Canyon reasonably well, but cannot explain other aspects. If historical science were such a straightforward enterprise as many proponents would have you believe, why are there so many different theories? Unlike operational science, we cannot perform a laboratory experiment or an observation that would settle the issue.

As you might expect, there are many theories dealing with origins in astronomy. Probably the ultimate evolutionary theory is the origin of the universe. However, what if we apply the first and second laws of thermodynamics to the history of the universe? The first law of thermodynamics is the conservation of energy—energy can neither be created nor destroyed.[5] If the universe had a beginning, then that would amount to the sudden appearance of energy, and thus it would violate this law of conservation. Therefore, the first law of thermodynamics would seem to preclude energy and the universe having a beginning. If there was no beginning, then energy must be eternal. However, the second law of thermodynamics dictates that while the total energy of the universe remains constant, the energy available to do work decreases with time. Physicists quantify this with entropy, defined so that it always increases as the available energy decreases. Therefore, entropy *always* increases. If the universe is eternal, then more than enough time has elapsed for the universe to have reached maximum entropy, with no useful energy remaining. This clearly has not happened, so the universe cannot be eternal.

The first and second law of thermodynamics are two of the most tested theories in science. They appear to apply universally, and they clearly do so today. Applying the assumption of naturalism, the two laws must have applied indefinitely into the past. But the first law requires that the universe be eternal, while the second law requires that the universe have a finite age. This is a contradiction. How can we resolve this dilemma? A possibility is that one or both of the first and second laws of thermodynamics must not have applied universally in the past, but how do you know which? Furthermore, altering either one in the past would violate the assumption of universality of physical law throughout space and time, an assumption upon which science is based and thus

[5] The first law of thermodynamics was formulated before the modern understanding of the equivalence of matter and energy via Albert Einstein's famous equation, $E=mc^2$. We now recognize that it is the sum of matter and energy that is conserved, though in most instances we merely speak of energy.

every scientist must make. This would be a huge price to pay. Once one abandons the universality of physical law, then one cannot have any real confidence that universality will hold in today's world, rendering science impossible.

But let us suppose for the sake of argument that sometime in the past one of these two laws was violated. For instance, if the universe suddenly appeared, that would constitute a huge violation of the first law of thermodynamics. How could we apply a scientific test to determine if this indeed happened? We cannot, which illustrates my point that we do not test theories of historical science the same way that we test theories of operational science. More importantly, since this would have been a radical departure from the manner in which the world normally works, would this not constitute a miracle? A person committed to naturalism may assert that this violation is no violation at all but merely some not yet understood natural mechanism.[6] However, this is grasping at straws. When confronted with what appears to be a genuine miracle, a person committed to naturalism retreats into special pleading to preserve his worldview. This underscores the perverse and pervasive nature of the assumption of naturalism. Naturalism cannot allow any departure from naturalistic explanations, to the extent that any departures are excluded more or less by definition. The takeaway from this discussion is that the question of ultimate origins is a metaphysical one.

Once one recognizes the metaphysical nature of the question of origins, it does not necessarily follow that the God of the Bible is the Creator. However, it does follow that the God of the Bible is a viable answer to the question of ultimate origins. It is the assumption of this book that He is, and I hope that it also is the assumption of you, the reader. But even that is not the most important point. You may agree with everything that I write about astronomy, but it is all for naught if you do not have a personal relationship with Jesus Christ, our Creator and Redeemer (John 1:1–18). I hope that this book will encourage the Christian in his faith and that it will help the lost to find salvation through the finished work of Jesus Christ.

[6] A good example of this is Lawrence M. Krauss' book *A Universe from Nothing: Why There Is Something Rather Than Nothing* (New York, New York: Free Press, 2012). Krauss used a questionable interpretation of quantum mechanics, along with many speculative ideas about physics, to argue that we have good physical reasons to believe that the universe came into existence by itself. While exuding confidence throughout, Krauss' argument amounts to a faith-statement about his own reasoning, undergirded by the metaphysical assumption of naturalism. I will discuss this further in Chapter 9.

CHAPTER 1

A Historical Perspective: Ancient Cosmologies and the Bible

The Ancient Near East and the Bible's Cosmology

The Bible largely is a product of the ancient Near East (ANE). As such, it has become fashionable today to study and interpret the Bible in terms of its ANE background. This goal is laudable, even necessary, for some things in Scripture involving cultural context are difficult to understand fully in our modern world. There are certain customs observed in the Bible which are foreign to our modern contexts. For instance, marriage customs in ancient Israel were different from ours today, so the account of Joseph's intended response to his betrothed Mary's pregnancy in Matthew 1:18–19 is difficult for us to comprehend without more information. To twenty-first century people reading the Bible, subtlety and fine detail often is lost, and it is easy to misinterpret the author's meaning. However, it is not proper to use the ANE background to reinterpret passages to mean something other than what the author clearly intended. A prime example of how authorial intent is violated is to claim that the ANE background of the Bible's creation narrative provides justification for reinterpreting the plain sense of what that narrative expresses, especially as it concerns the temporal aspects of God's creative work.

One approach in reinterpreting the creation account this way is to note that the creation account has certain aspects of a polemic against the pagan gods of the cultures surrounding ancient Israel. For instance, the sun and moon were deities worshipped by nearby cultures, but the Genesis 1 creation account does not even mention the sun and moon by name. Rather it refers to them as the greater and lesser lights. The purpose for this probably was twofold.

First, the creation account does not even deign to mention the names of those pagan gods. Second, the true and living God made the sun, moon, and stars. Because God made the sun, moon, and stars as non-sentient and non-living beings, they are not gods. While Genesis 1:1–2:3 functions as a polemic on a larger scale to communicate the fact that God is unopposed in His creation of the world, it does not follow that the text is merely a polemic. The major point of chapter 1, that the Lord God created the universe through sovereign, unopposed action, is part and parcel to the polemic. However, the main point of the chapter is not the polemic itself, but the theological truth conveyed in the polemic. Yet some have seriously suggested that the details of Genesis 1 do not matter, but instead it is some subtle message behind the creation account that matters. The truly important message supposedly is that God created the world, but that the exact details are inconsequential. Related to this approach is the claim that the creation account of Genesis 1:1–2:3 is a poetic description of the creation event rather than historical narrative. There indeed are some poetic elements present, but that does not make them ahistorical. Notably, there is an unhealthy trichotomy that has emerged even in conservative studies, which drives a wedge between the study of the text as literature, as history, and as theology. The text is *all three of these*, and these emphases must be studied in unison.

Playing off this false trichotomy, some claim that while we today are understandably confused into thinking that this is historical narrative, if we considered the ANE context, we would realize that the ancient Hebrews knew better. However, within the context of ANE culture, what would the ancient Hebrews have thought? They were surrounded by cultures that each had their own respective creation stories. Certainly, the surrounding nations thought that their stories reflected truth; otherwise, why did they persist in believing something that they knew to be false? If the ancient Hebrews thought about their creation story any differently, then they were not thinking in terms of the ANE background. What of the polemic elements of Genesis 1:1–2:3? A polemic is supposed to be a refutation of an idea. If the ancient Hebrews believed that the creation account in Genesis was not true, then it amounted to myth. One cannot legitimately refute one mythology with another mythology. Only truth can properly refute myths.

A different approach to reinterpreting the first few chapters of Genesis in accordance with other ANE literature is to claim that the first part of Genesis is an amalgamation of stories prevalent among societies surrounding the Hebrews in ancient times. Notice that this approach is completely opposite to the approach previously discussed, so both clearly cannot be true at the same time. In this view, the creation account contains aspects of cosmology that commonly were believed in the ANE, but now are known to be false. But the Bible allegedly is unscathed by this, because the details of the creation account do not matter. One must instead look at the big picture. According to this theory, the real "truth" behind the story somehow was lost, so the belief that the creation account was historical narrative eventually took hold and managed to become emplaced as truth, particularly in the West because of the influence of Christianity.

This view of history is illustrated by the engraving reproduced in Figure 1.1. This illustration, in turn, perpetuates this view of history. The engraving

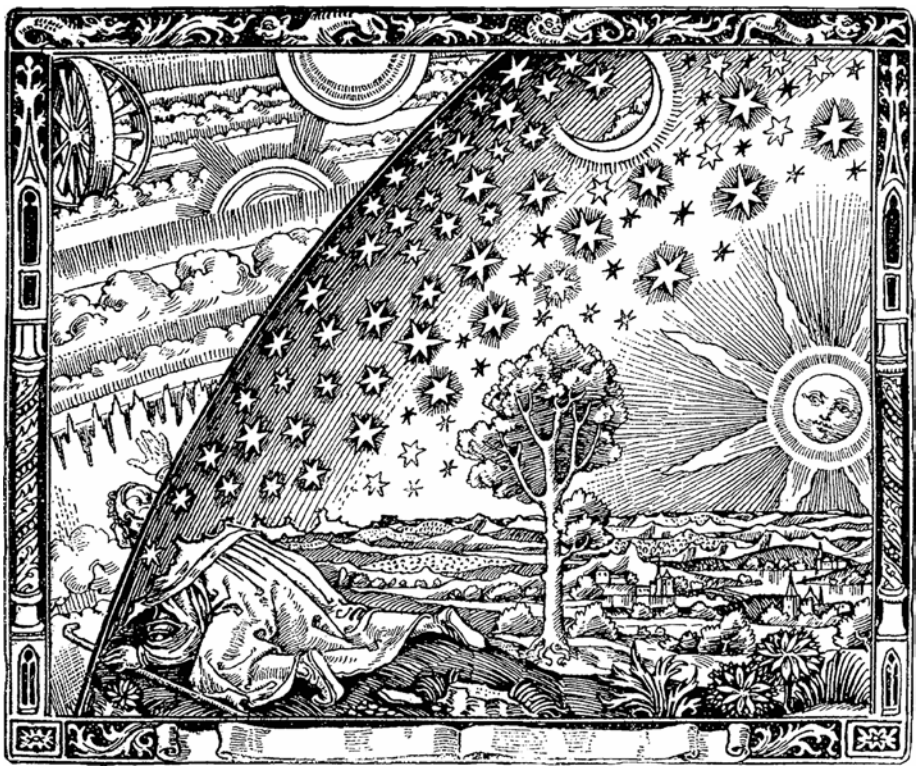

Figure 1.1. Flammarion engraving. (Public Domain).

shows a flat earth with an edge to the left. On either side are pillars that support heaven, which is on the top and to the left. In between is the domed vault of the sky, to which the sun, moon, and stars are attached. On the left, one can see an intrepid individual finding the edge of the vaulted dome and daring to peek through to see what lies beyond. The general public is familiar with this engraving, because it has been reproduced countless times. It is commonly believed that the engraving is of medieval origin, but the general public is wrong. The engraving first appeared in Camille Flammarion's 1888 book, *L'atmosphère: Météorologie Populaire* (*The Atmosphere: Popular Meteorology*). Hence, rather than being a product of the Middle Ages, this engraving is the product of the late nineteenth century.

More than anything, the Flammarion engraving, as it is known, illustrates the hatchet job that the so-called Enlightenment did on the Middle Ages, Christianity, and the Bible. It was Enlightenment thinkers who coined the term "dark ages" to refer to the Middle Ages, though the Middle Ages were not nearly as dark as many of us were taught in school. The Enlightenment of the eighteenth century laid the foundation for higher criticism, uniformitarianism, and Darwinism of the nineteenth century. By the time of the publication of Flammarion's book in the late nineteenth century, the damage to the reputation of the Middle Ages had already been done. But the real objective was to discredit the Bible. The storyline that had developed was that the Bible's cosmology was fundamentally wrong, but that its cosmology had nevertheless become entrenched in the West due to the influence of Christianity and, accordingly, that it remained the status quo until modern times. As the argument goes, it was time for modern scientific thinking to unseat antiquated ideas. Let us now begin evaluating this supposed history.

What Shape Is the Earth?

It is common knowledge today that until about five centuries ago, nearly everyone thought that the earth was flat. However, common knowledge often is wrong, as it is in this case.[1] The earliest record that we have of belief in a spherical earth is that of Pythagoras, in the late sixth century BC. Most people today find this difficult to believe, because it so contradicts what they have heard

[1] An excellent discussion of how the late ancient and medieval world understood the earth is spherical is found in Russell, J. B. 1991. *Inventing the Flat Earth: Columbus and Modern Historians*. New York, New York: Praeger.

their entire lives. People recognize that with modern technology the shape of the earth must be easy to determine, but how did supposedly primitive people in the past discern this? It really is quite simple. A lunar eclipse occurs when the earth passes exactly between the sun and moon so that earth's shadow falls on the moon. As you might expect, a lunar eclipse is not a common event, on average happening for any given location on earth less often than once per year. After observing a few lunar eclipses, one comes to realize that the earth's shadow cast on the moon always is round. If the earth were flat and round, like a disk, it could cast a circular shadow, but only during an eclipse that happened near midnight (Figure 1.2). An eclipse that happened near sunrise or sunset would cast a very differently shaped shadow. However, the earth's shadow always is circular, regardless of the time, and hence, regardless of the orientation of the earth. The only shape that always casts a circular shadow is a sphere. Therefore, the earth must be a sphere.

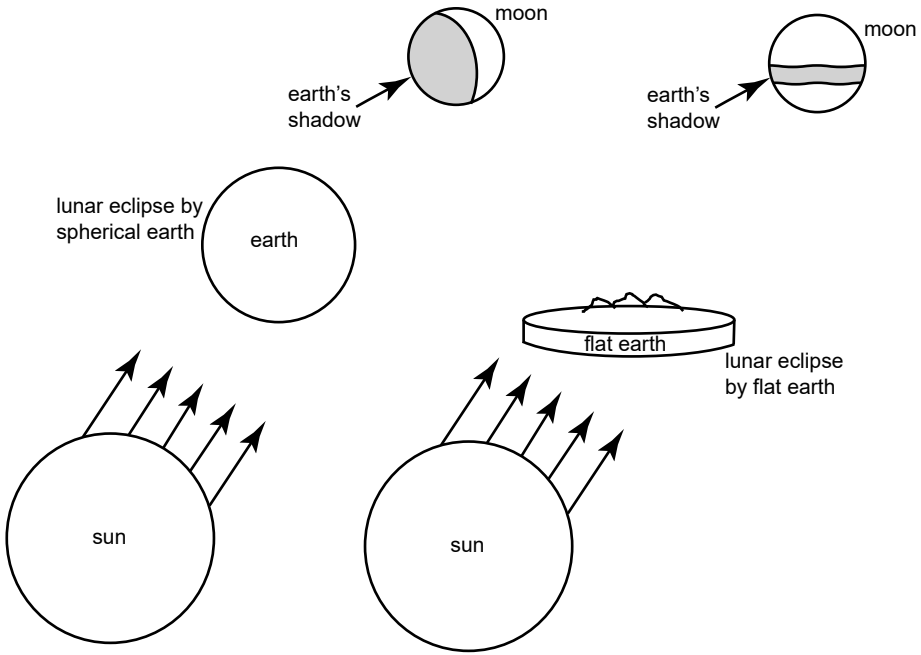

Figure 1.2. Hypothetical lunar eclipse by a flat earth.

There are other arguments for the earth's spherical shape of which the ancients were also aware. As one travels northward, the stars visible in the northern part of the sky rise higher, while stars visible in the south fall lower,

even falling into invisibility below the horizon. Traveling southward, the effect is reversed—stars visible in the northern part of the sky descend and in some cases disappear, while stars in the south climb higher in the sky. For instance, from where I used to live in South Carolina, I could see Canopus, the second brightest-appearing star to us, low in the sky briefly on winter evenings. However, where I now live in northern Kentucky, at more than 4° farther north latitude, I cannot see Canopus at all. This can happen only if the earth is curved in the north-south direction (Figure 1.3).

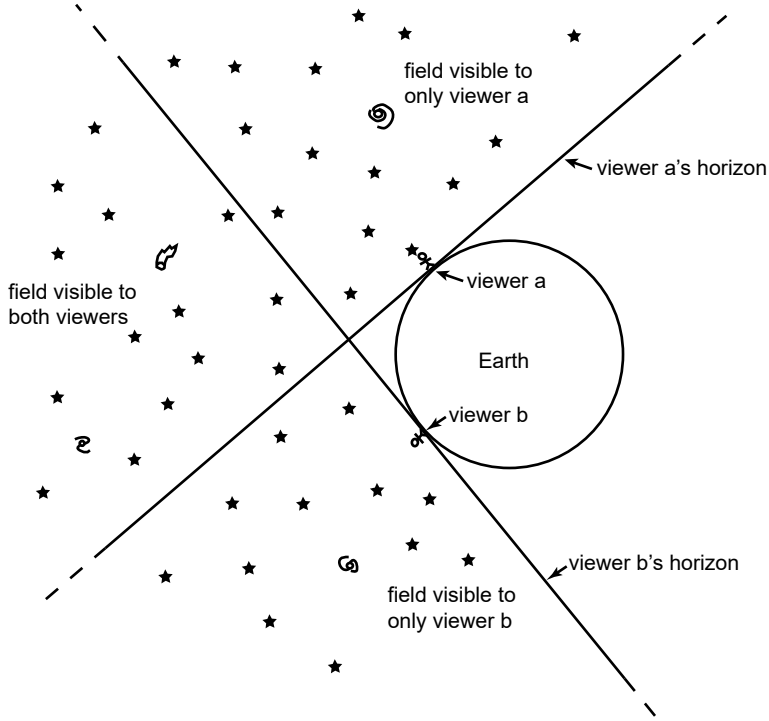

Figure 1.3. Different fields of view in the night sky (not to scale).

Related to this phenomenon was a legend that the Phoenicians circumnavigated Africa in early antiquity. The Phoenicians were excellent sailors, and in their time their culture dominated maritime trading in the Mediterranean world. The peak of their culture is conventionally dated between 1200 BC and 800 BC. Part of this legend states that on the other side of Africa, the sun was in the northern part of the sky. In the north temperate latitudes, the

sun always is in the southern sky, but in southern temperate latitude, the sun always is in the northern sky. But this might not be expected, if the earth were flat. By the classical Greek period, the fifth and fourth centuries BC, the Greeks definitely knew that the earth was spherical, and they believed the Phoenician legend to be true, because of this one detail.

As for curvature in the east-west direction, a similar thing happens. You may be aware that the sun rises and sets about three hours earlier on the East Coast than on the West Coast of the United States because of the earth's spherical shape. With today's rapid transportation, instant communication, and accurate time pieces, this is easy to verify; but this was not possible in the ancient world. However, they had a different method. A lunar eclipse that began shortly after sunset at one location in the east would begin before sunset at a location that was many miles to the west. The eclipse began at the same instant, but at different local times due to the earth's curved surface. Of course, a single person in the ancient world could not observe this, but two people separated by a large distance could observe it and later compare their observations. This sort of experiment was noted in records from the ancient world. If the earth is curved both in the north-south and east-west directions, then its most likely shape is a sphere.

The ancients also noted that the hull of a departing ship would disappear before the mast would. This could happen only if the earth were spherical so that a ship sailing away passed below the visible horizon. Actually observing this is difficult without optical aid, and the telescope was not invented until four centuries ago. Another difficulty is atmospheric refraction that frequently can bend light around the curvature of the earth. More likely, the ancients observed this phenomenon in reverse. As a ship approaches land, the land first is visible to someone atop the mast. People on the deck cannot see the land yet, because the land lies below the horizon from their perspective. However, as the ship ventures closer to land, the land eventually becomes visible to those people on the deck. This can happen only if the earth is spherical.

These arguments are rigorous, and they established the earth's spherical shape among ancient people. Once established, people also developed other, less rigorous arguments for the earth's spherical shape. The sun and moon clearly are circular, because they appear round. However, are they round and flat in two dimensions, like a disk? Or are they round in three dimensions, like a sphere?

The sun constantly appears round, so if it is a disk rather than a sphere, then it must keep the plane of its disk perpendicular to our line of sight at all times. Likewise for the moon, except that the moon's phases offer a definitive clue to its three dimensional shape. Lunar phases are the expression of how much of the moon's surface visible to us is lit by the sun, and that in turn is the result of the relative geometry of the earth, moon, and sun.[2] The terminator is the division between light and dark on the moon. The terminator generally is curved. But that can be only if the moon is curved in a third dimension, along our line of sight. Therefore, the moon must be spherical. By analogy, if the earth is anything like the moon or the sun, it must be spherical too. This is proof by analogy, which is not as rigorous as the other methods.

Another less rigorous argument involved concepts of perfection. The ancient Greeks, and probably other ancient cultures, thought that the circle was the most perfect shape. A sphere merely is a circle spun in a third dimension. In their cosmology, it was fitting that the heavenly bodies were perfect, so it was not surprising that the sun and moon were spherical. One might expect that the earth too is spherical. However, this aspect was at odds with other characteristics of their cosmology. The earth, unlike the heavenly realm, was imperfect, so one could make the case that the earth did not follow this rule. Apparently, the ancient Greeks did not notice this possible inconsistency.

About 200 BC, Eratosthenes, a Greek living in Egypt, built on knowledge that the earth was spherical and measured accurately the size of the earth. He did this by measuring the difference in the altitude of the sun at noon at two locations widely separated by latitude on the summer solstice (Figure 1.4). Obviously, he

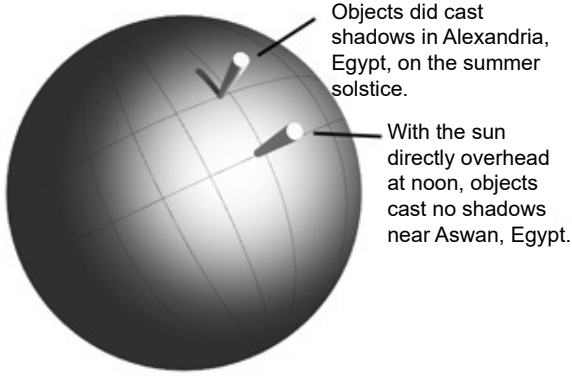

Figure 1.4. Illustration of Eratosthenes' experiment (Danny R. Faulkner, *Universe by Design* [Green Forest, Arkansas: Master Books, 2004], 9).

[2] See Chapter 3 for further discussion of lunar phases.

could not do this the same year, but rather he made the measurements on the summer solstice two different years. The two locations were separated in the north-south direction by 500 mi (800 km). Eratosthenes found that the difference in the altitude of the sun was $^1/_{50}$ of a circle. Therefore, the circumference of the earth was 50×500 mi (800 km), or 25,000 mi (40,200 km). Of course, Eratosthenes used units other than miles, but the results that he got closely matched the modern value. Eratosthenes' measurement remained the standard size given for the earth for nearly two millennia.

By the time of Eratosthenes, belief in a spherical earth had been common since the time of Pythagoras, about three centuries earlier. Virtually all ancient Greek scientists and philosophers that we know of believed in a spherical earth. Plato and Aristotle clearly did, and their teachings played a crucial role in shaping the thinking of those in the Roman Empire and the West for two millennia after they lived. One is hard pressed to find any writings from the past 25,000 years that espoused a flat earth. So why do so many people today think that belief in a flat earth was prevalent until recently? The answer is the development of the *conflict thesis* in the late nineteenth century.[3]

The conflict thesis was a result of the growing hostility toward Christianity in the post-Enlightenment world. According to the conflict thesis, religion in general, and Christianity in particular, opposed thought and learning. Supposedly, it was not until man threw off the restraints of ignorance brought about by religion that intellectual pursuits could flourish. In this view, it was the shift from theism to humanism that enabled the beginning of science as we know it in the seventeenth century. In truth, it was the Protestant worldview of northern Europe that provided the fertile ground for science as we know it to develop. Not only did the humanists of the so-called Enlightenment hijack science, but they rewrote history so that they took credit for the development of science.

When Charles Darwin published his *Origin of Species* in 1859, much of the church opposed Darwin's ideas. The prime objective of the conflict thesis was to intimidate the church into giving up this fight.[4] The conflict thesis buried

[3] Key figures in the development of the conflict thesis were John William Draper (1811–1882) and Andrew Dickson White (1832–1918). Draper published *History of the Conflict between Religion and Science* in 1874, while White published *A History of the Warfare of Science with Theology in Christendom* in 1896.

[4] At the same time, a very different sort of battle was shaping up within academia concerning textual study. Higher criticism was attempting to argue for internal contradictions in the Bible (and rewriting the history of textual composition in the process). Hence, there was no one cause that led to the advancement of the secular worldview. It was the result of influences in multiple sectors. The conflict thesis was just one theater in this war of worldviews.

the church under a load of false guilt for its supposed transgression of resisting science and progress in the past. Exhibit A in this argument was the church's alleged opposition to the idea of a spherical earth. The church faced the charge that it had persecuted those who dared question whether the earth was flat. The story of Christopher Columbus was retold in a way to bolster this false history, and this false narrative unfortunately is deeply rooted in our belief system today. This story is so compatible with the false notion of the dark ages from which mankind slowly emerged during the Renaissance that it seems plausible to most people. However, even casual study of true history, or brief reflection on this myth, reveals how poorly founded this thesis is. For instance, Columbus sailed westward from Spain to the Caribbean and then sailed eastward back to Spain. Four times. How did that prove that the earth was spherical? That key part of the story doesn't even make sense, but it escapes the notice of most people today. While the conflict thesis was widely embraced by historians in the latter part of the nineteenth century and much of the twentieth century, it now is rejected by most historians. However, the conflict thesis remains deeply embedded in the belief system of most people today, and thus amounts to a "modern mythology."

To illustrate the lengths taken to rewrite history on this matter, consider medieval discussions of the *antipodes*. Antipodes are points on the earth that are diametrically opposite one another. The word *antipode* derives from Latin literally meaning "opposite feet," so the derivation of the word comes from the concept of a point on the opposite side of the earth, opposing where we stand (where our feet are planted). Knowing that the earth was spherical, Plato used an equivalent Greek term in his dialogue, *Timaeus*, as did Aristotle, Strabo, and Plutarch. There developed a belief that there was another large land mass on the other side of the earth opposite the Mediterranean world that possibly could be inhabited. However, the two were separated by a vast ocean, and transit between the two would require passage through the tropics. There was considerable discussion as to whether men could survive a voyage through the heat of the tropics.

By the Middle Ages, the antipodes came to refer less to this hypothetical land and more to possible inhabitants of that land. This use is traced to Isidore of Seville's early seventh century work *Etymologiae*. Many people in the Middle Ages came to doubt whether these people, or antipodes, existed. The

difficulty or impossibility of transit to that far away land came to involve two related theological issues. First, if that land were inhabited, how did people, being descendants of Adam, arrive there? Augustine raised that objection. Second, the Great Commission commands that we preach the gospel to the entire world (cf. Matthew 28:18–20), but how could Christ's followers do this if transportation between the two inhabited parts of the earth was not possible? Further complicating this matter was an eighth century dispute between Boniface and Vergilius of Salzburg that eventually involved Pope Zachary. Some of the words of this dispute and later discussions expressing doubts about the antipodes have been misconstrued to refer to the opposite side of a spherical earth rather than to possible inhabitants on the other side of the earth. Hence, people who perpetuate the flat earth myth often use medieval quotes denying the existence of the antipodes as evidence of a denial of a spherical earth—when in fact the question addressed by those quotes was whether the opposite side of the world was inhabited.

Keep in mind that Pythagoras' understanding that the earth is spherical is only the first *recorded* mention; it is possible that some belief in a spherical earth predated Pythagoras. No written works of Pythagoras survive, so what we know of Pythagoras and his teachings relies upon much later sources. This is the case of the writings of people from this time period (late sixth century BC) and earlier. Early in the sixth century, Anaximander (who may have been Pythagoras' teacher) taught that the earth was a flat disk, with its diameter three times its thickness. Notice that in this model the earth is round, yet flat. This apparently was a common belief in ancient flat earth cosmologies. In Anaximander's cosmology, the Mediterranean world was the center of earth's land, hence the name for the Mediterranean Sea, which means "middle of the earth." That land was supposedly surrounded by a vast ocean that extended to the edge of the flat earth. This, too, was a common element of ancient flat earth cosmologies. However, while in most cosmologies the flat earth rested on other things, such as the backs of turtles or elephants, in Anaximander's view, the earth rested upon nothing. It is believed that most earlier Greek, Egyptian, and Mesopotamian cosmologies consisted of a flat disk, with central land surrounded by water. Ancient cosmologies of the Far East and of the Americas were similar, and they persisted into relatively modern times.

Contrast the common ancient belief that the earth rested upon something with Job 26:7, which reads,

He stretches out the north over the void and hangs the earth upon nothing.

The content of the book of Job is very old,[5] yet this statement does not conform to most of the cosmologies of the ANE, which typically assert that the earth rests upon something. If the Scriptures reflected the cosmologies of surrounding cultures, why is it different from them in this one important aspect? Some Christians have taken Isaiah 40:22, which speaks of the circle of the earth, as evidence that the Bible teaches a spherical earth. However, one ought to be circumspect here, because it is not clear that this verse actually means that the earth is spherical. In similar manner, skeptics have claimed that biblical passages that refer to the four corners of the earth (e.g., Isaiah 11:12) imply that the earth is flat. However, if these verses were meant to reflect common ANE cosmological beliefs, the earth could not have corners, because in most ANE cosmologies, the earth was flat, but round. The Hebrew word used here refers to extremity, and is translated thus elsewhere, such as in Numbers 15:38, where it is rendered "borders." From the Bible, the phrases "four corners of the earth" and "ends of the earth" (e.g., Job 37:3; 38:13) have entered the English language as idioms referring to the greatest extent of anything. We use these phrases today, though very few, if any, of the people using such phrases think that the earth is flat.

As of the time of the writing of this book, there has been a surge of interest in the idea that the earth is flat. Much of this has been promoted on social media, including many videos on various internet sites, such as YouTube. Unfortunately, a large number of Christians have been taken in by this idea. This topic is discussed in Appendix A.

Biblical Cosmology

Many cosmologies of the ANE were related intimately to cosmogonies, or, more properly, to *theogonies*. Theogony refers to the origin or genealogy of gods. Many of these cosmogonies amount to stories of how their gods came to be, with gods giving rise to other deities. Along the way, the earth and sky often were formed from parts of those gods' bodies. The sky and celestial objects frequently are manifestations of those gods. Many of those worlds arise out of primordial water, water that is sometimes eternal.

[5] The events of the book of Job predate the writing of the Pentateuch in the fifteenth century BC. It is not clear whether the book was written prior to Moses writing the Pentateuch or later.

Contrast this to the biblical creation account. There is only one self-existent eternal God, so there is no theogony. Matter is not eternal, but instead matter is a creation of God in the finite past. In the biblical creation account, the earth and sky are not body parts of a god or gods. The earth and sky are creations of God, but with no explicit statements concerning cosmology. Rather, to reach conclusions about biblical cosmology, one must draw inferences from certain biblical passages, such as the Day One, Day Two, and Day Four creation accounts. Unfortunately, far too many people instead use the ANE cosmologies and creation myths to make those inferences and conclusions. That is, the beliefs and customs of the cultures that the ancient Hebrews were immersed in are used to interpret the biblical cosmology.

Even the ancient Hebrews sometimes were guilty of interpreting the Bible in terms of the beliefs of the cultures surrounding them. The Septuagint was a translation of the Hebrew Old Testament into Greek completed in Alexandria, Egypt, probably in the third century BC. Founded by Alexander the Great, Alexandria quickly became a thriving international city of trade, culture, and learning. The latter is evidenced by Alexandria's legendary library. While the Jews still living in Israel continued to read the Scriptures in Hebrew, many Jews of the Diaspora did not. Many Jews, such as the ones in North Africa, became Hellenized, and Hebrew became a lost language to them. Through Alexander's conquest and its aftermath, Greek became the international language and would remain so until eventually replaced by Latin in the latter years of the Roman Empire (at least in the West). With a desire among the Jews to read the Scriptures in their common language, a group of Jewish scholars in Alexandria reportedly translated the Septuagint into Greek. The word *Septuagint* derives from the word for 70, reflecting at least two legends about the Septuagint. One legend is that 72 scholars worked on the translation; another is that it took them 70 days to complete the translation. Most scholars today doubt the veracity of these legends, but the truth of the legend's details are immaterial to our discussion here.

In Genesis 1, the Hebrew word *rāqîaʿ* appears nine times (it appears only eight more times elsewhere in the Old Testament). The *rāqîaʿ* is that which God made on Day Two to separate waters above from waters below. The King James Version translated this word as "firmament," though more modern translations usually render it "expanse." The Septuagint translators chose the Greek word

stereoma to translate *rāqîa*ʿ. The word *stereoma* refers to a crystalline structure, something hard and transparent. In ancient Greek cosmology, the earth was surrounded by a hard, transparent sphere to which the stars were affixed. It appears that the translators of the Septuagint chose to equate the *rāqîa*ʿ with the *stereoma* in order to incorporate into the Scriptures the cosmology of the ancient Greeks. In translating the Bible into Latin (the *Vulgate*), Jerome followed suit with the Septuagint and used the word *firmamentum*, which the King James Version transliterated into English. Jerome had good knowledge of the Hebrew language, so his choice in reflecting the Septuagint's translation probably was the result of his not knowing the meaning of the rare word *rāqîa*ʿ.

What was this *rāqîa*ʿ that God made on Day Two? Many people today would argue that the *rāqîa*ʿ was the physical dome or solid vault of the sky that is part of ANE cosmologies. In many respects, this dome is similar to the *stereoma*. But this is to interpret the Old Testament in light of the ANE cultural beliefs. The Septuagint's treatment of *rāqîa*ʿ might seem to suggest this, as well as medieval Jewish writings about cosmology. However, since these sources are much later than the writing of Genesis (by more than a millennium), all that this is evidence of is how the Jews *eventually came to view* the Genesis creation account. The translators of the Septuagint were Hellenized and hence their translation reflected Greek culture, not the ANE culture. And the medieval sources reflect their times, with an embrace of Aristotelean thinking, which in turn was a product of the ancient Greek worldview. It is one thing for unbelievers to view Genesis as a product of its times, but it is an entirely different matter for true believers in Christ to view Genesis this way. Ultimately, to view Genesis as merely a product of the surrounding ANE culture is to undermine the inspiration and authority of Scripture.

Supporters of such an interpretation of the Genesis creation account argue that the ancient Hebrews could not have understood the true cosmology (as we understand it today), so God revealed theological truth in a manner that they could understand, even if that implied cosmology was wrong. The faulty cosmological account is merely a vehicle for the communication, supposedly, of higher truth. Of course, this assumes that our cosmology of today is correct. But this also overlooks the fact that the Genesis creation account gives very little detail of cosmology, and instead gives a very brief description of cosmogony, the creation of the world. The creation account merely states that God made the *rāqîa*ʿ on Day Two without revealing exactly what this *rāqîa*ʿ is.

Even with all that we supposedly know today, there probably is more debate now than there ever has been as to the identity of the *rāqîa*ʿ. That is the beauty of this aspect of the creation account: it adequately describes what God did on Day Two (and Day Four) without endorsing any particular cosmology. We can be certain that God made the *rāqîa*ʿ on Day Two, though even today we may not understand any better than the ancient Hebrews what the *rāqîa*ʿ is. The ancient Hebrews may have come to *interpret* what the *rāqîa*ʿ was in terms of the ANE or Greek cosmologies, just as we today tend to interpret what the *rāqîa*ʿ is in terms of our modern cosmologies (such as identifying it with space, or the earth's atmosphere, or both). But this is a far cry from concluding that the *original text* necessarily reflected any particular cosmology of the ANE. The assumption that the Genesis creation account reflects the faulty cosmology of the ANE undermines scriptural authority.

With these caveats about cultural influences on biblical interpretation in mind, what is the most likely identity of the *rāqîa*ʿ? Clearly, the author of this book rejects the notion that it is some hard dome of the sky. At the risk of being guilty of interpreting the *rāqîa*ʿ in terms of what we know (or think that we know) about modern astronomy and cosmology, let us work through this. As previously mentioned, God made the *rāqîa*ʿ to separate waters below from waters above on Day Two of the Creation Week (Genesis 1:6–7). The word *rāqîa*ʿ appears four times in the Day Two account. A second clue is provided by that statement immediately following and concluding the Day Two account that God called the *rāqîa*ʿ heaven (*šāmayim*) (Genesis 1:8). The Hebrew word *šāmayim* appears in the Old Testament far more often than *rāqîa*ʿ does, more than 400 times. The word *šāmayim* is plural; it lacks a known singular form in Hebrew. This introduces a problem for translation into English, because our equivalent word, heaven, has distinct singular and plural forms. The word *šāmayim* usually appears as an object in a sentence rather than the subject, so the verb used typically is of no help in determining whether the English translation ought to be singular or plural. That generally is left as the choice of the translator, which explains why various translations may differ on whether *šāmayim* is translated as plural or singular.[6] Unfortunately, this choice often reflects the cosmology assumed by the translator.

[6] For instance, in the first appearance of *šāmayim* in the Bible (Genesis 1:1), the King James Version translated it as "heaven," while the English Standard Version translated it as "heavens."

The word *rāqîa*ʿ does not appear again until the Day Four account (Genesis 1:14–19), but *šāmayim* occurs right away in the next verse (Genesis 1:9) in the Day Three account, which states that God gathered the waters under the heaven(s) into one place to form the seas. Since Genesis 1:9 immediately follows Genesis 1:8, we may argue on the basis of context that the heaven(s) of these two verses must be the same thing. This is further reinforced by the fact that the entity made on Day Two was to separate the waters above it from the waters below it, and the Day Three account clearly concentrated on the waters below. The next time that the word *šāmayim* appears is in the Day Four account, the creation of astronomical bodies, where it appears three times (Genesis 1:14, 15, 17). All three times it appears in conjunction with *rāqîa*ʿ. This combination reads "firmament of heaven" in the King James Version, though it appears as "expanse of the heavens" in the English Standard Version. This repetition may be significant. This construction seems to emphasize the connection of *rāqîa*ʿ with *šāmayim*, with the point being that the thing in which God placed the astronomical bodies on Day Four is the same thing that God made on Day Two.

The word *rāqîa*ʿ occurs one more time in the first chapter of Genesis (verse 20), during the Day Five account. This is in the context of the creation of birds, which the King James Version describes as flying "above the earth in the open firmament of heaven." The English Standard Version describes the birds as flying "above the earth across the expanse of the heavens." This language is different from how the firmament of heaven is presented in the Day Four account. First, it is described as being above the earth, which does not appear in the Day Four account. Furthermore, there is additional language ("in the open" in the King James Version, and "across" in the English Standard Version) modifying the firmament, or expanse, of heaven. The Hebrew expressed here is difficult to translate into English. It may indicate that the birds were to fly across the near face, or surface of the *rāqîa*ʿ. If that is the case, then the *rāqîa*ʿ encompasses the sky right above our heads, but much more beyond that. That is, the sky right above our heads is the near surface of the *rāqîa*ʿ, but the *rāqîa*ʿ extends much farther.

If this is the case, then what emerges is the understanding that the *rāqîa*ʿ corresponds to what we today would call the lower parts of the earth's atmosphere and everything beyond—including outer space. Of course, this is

our version of cosmology today; the ancient Hebrews would not have made such a distinction between the atmosphere and outer space. Perhaps God did not get more specific here, because if He did, it would have required endorsing some particular version of cosmology. If God had endorsed a common ancient view, it would be dismissed today as being wrong and hence undermining the Bible's veracity and authority. If God had endorsed modern cosmology, the ancient Hebrews would not have comprehended it, which likewise could have laid Scripture open to the accusation then that it was wrong. And who is to say that our modern cosmology is the correct one? There is no definite line of demarcation between the earth's atmosphere and outer space. We arbitrarily define space to begin at some specific altitude. However, there are at least two standards of defining the altitude where space begins. One standard is 50 mi (80 km), while the other is 100 km (62 mi). The fact that there are two distinct standards underscores the fact that the standard is somewhat arbitrary. One easily could change that definition to be a bit higher or lower. Hence, one could consider both the atmosphere and outer space part of the same thing, albeit with a gradient of how much air is present. Indeed, the biblical terminology surrounding *rāqîaʿ* is consistent with its being what we call outer space along with much, if not all, of the atmosphere.

Over the past half century, it has been common for biblical creationists to view the *rāqîaʿ* as the earth's atmosphere. This largely was motivated by support for the *canopy theory*. The canopy theory proposes that the earth originally was surrounded by water above the atmosphere (the waters above) that collapsed to provide one of the two sources of water for the Flood explicitly mentioned in the Flood account (the windows of heaven, as opposed to the fountains of the great deep, in Genesis 7:11). Support for the canopy theory has waned considerably in recent years, which should have been accompanied by the erosion of support for the idea that the *rāqîaʿ* is the earth's atmosphere—but that concept has endured. Integral to the equation that the *rāqîaʿ* is the earth's atmosphere is the belief that the first mention of the heavens in Genesis 1:1 refers to the creation of outer space. However, as previously discussed, this separation between the atmosphere and space is modern, and so may not coincide with what is meant in Genesis 1. Certainly, the ancient Hebrews would not have understood Genesis 1 this way.

Also note that Genesis 1:8 equates the *rāqîa*ʿ with heaven. If Genesis 1:1 is a declaration of the specific act of the creation of heaven at the beginning of Day One, then it appears that God created heaven again on Day Two. One way out of this dilemma is to suggest that two different heavens were created on these days, outer space on Day One, and the earth's atmosphere on Day Two. As already pointed out, part of the motivation of this understanding was to support the canopy theory. Absent the canopy theory, is there a good reason to make this distinction? Further, is this interpretation supportable by the text? Would the ancient Hebrews have made this distinction? We know that later cultures, such as the Greeks, developed a concept of three heavens (the close environment of birds and clouds, the astronomical realm, and the abode of God), but there is no evidence that the Hebrews had this concept at the time of the writing of Genesis.[7]

A better resolution to this dilemma is to recognize that Genesis 1:1 serves as an introductory encapsulation, a summary of the creation account, with details to follow. In this manner, the phrase "the heaven and the earth" is a merism, an expression of totality by contrasting parts. There are several examples of merisms in English, such as "high and low," "young and old," and even "heaven and earth" (the Bible contains many merisms: Ecclesiastes 3:1–10 contains 14 merisms, while Romans 8:38–39 has several merisms). Thus, Genesis 1:1 is a bold and powerful statement that God made *everything*. This is reinforced by John 1:1–3, which reads,

> In the beginning was the Word, and the Word was with God, and the Word was God. He was in the beginning with God. All things were made through him, and without him was not any thing made that was made.

The Apostle John went on to identify this Word as Jesus Christ. Jesus is God, and as such, He is the Creator. But John explicitly states two different ways (both positively and negatively) that Jesus created everything. The creation account of Genesis 1 could have stopped with the first verse, but God wanted us to know some of the details of creation, such as the fact that He created the world in six days and rested on the seventh day. He wanted us to know that

[7] The only mention in the Bible of this three-tiered cosmology is in the New Testament, in 2 Corinthians 2:21. Since cosmology is not the point of this passage, it is not clear that this amounts to a biblical endorsement of this cosmology. Even if it is, this is not a problem, because this three-tiered cosmology conforms to our modern understanding.

He created man on the sixth day, along with land animals. He wanted us to know that He made the stars on the fourth day and that He made the *rāqîa*ʿ on the second day. Furthermore, God wanted us to know some detail as to how he made man and woman, and what marriage is, lest there be any confusion about that, so He gave us more detailed information of the creation of man in Genesis 2.

We also ought not to be confused about how old the creation is. Some people may claim that if Genesis 1:1 is an introductory encapsulation, then it leads to belief that the creation is billions of years old. However, that would detach the introductory statement from the account that it heads. It is the details of the creation account that give us specific information about the creation. One cannot make an alleged inference about the broad introductory statement and then use that to reinterpret specific details from the following account. Rather, it is the specific details that allow us properly to understand the introductory encapsulation. There are strong textual reasons why the six days of creation were normal days, not long periods of time. Furthermore, the historical narrative of Genesis flows from creation through the death of Joseph in Egypt. The genealogies, along with specified lifespans, in Genesis 5 and 11 strongly indicate that the creation was just thousands of years ago, not billions of years ago. Therefore, viewing Genesis 1:1 as an introductory encapsulation does not lead to belief in billions of years. However, it does allow us properly to understand that God made the heavens (what we today would call the atmosphere *and* outer space) on Day Two.

So how ought we to view the Bible in relation to the creation mythologies and cosmologies of the ANE? The proper view is that, through the inspiration of God, the Bible records the true account of the creation of the world and its early history. The pagan sources do not. At best, those other sources relay garbled versions of the truth. For instance, we saw earlier that many pagan cosmogonies and theogonies prominently included water. Water also figures prominently in the creation account of Genesis 1. We have seen that on Day Two God separated water above and below by the *rāqîa*ʿ, and that on Day Three God gathered together the waters below the *rāqîa*ʿ to form the seas. However, the first mention of water is the deep (in Hebrew, *tᵉhôm*) in the first half of Genesis 1:2, referring to the state that God initially created the earth in on Day One. The Hebrew word *tᵉhôm* is equivalent to the Greek word *abussos*, from

which we get the word *abyss*, referring to very deep water. The first time that the Hebrew word for water, *māyim*, appears is in the second half of Genesis 1:2, which states that the Spirit of God moved, or hovered, over the surface of the waters. From this we glean that God created the earth on Day One entirely out of water or totally covered by water, and that it remained so until Day Three. The word for water appears five times in the Day Two account, and twice on Day Three. On Day Five, God turned His attention back to the water to create sea creatures. The word for water appears three times in the Day Five account. The importance of water in the creation is repeated in 2 Peter 3:5–6, where the word *water* (*hudatŏs* in Greek) appears three times:

> For they deliberately overlook this fact, that the heavens existed long ago, and the earth was formed out of water and through water by the word of God, and that by means of these the world that then existed was deluged with water and perished.

This passage again emphasizes the importance of water in the creation. Even more significantly, water played a key role in the destruction of the world by the Flood. Notably, the Apostle Peter went on to tie the past judgment of the world by water to the coming judgment of the world by fire. Given the importance of water in the true account of the creation of the world, it is not surprising that various mythologies about the creation of the world would include that element. The cultural memory of the Flood may have contributed to this prominent inclusion of water in those mythologies, if nothing else, by convolving creation and the Flood. Likewise, it is not surprising that as ancient cultures developed their cosmologies, they convolved them with what little true knowledge of creation they had retained. Therefore, instead of the Genesis creation account reflecting the ANE cultures, it is the ANE cultures that very poorly reflect the truth of creation as found in Genesis.

Does the Earth Move?

As we saw earlier, the conflict thesis has heavily influenced our cultural mythology. This mythology teaches that the church supposedly held to the notion of a flat earth and opposed the idea that the earth is spherical. Another part of this mythology is that the church actively opposed the concept of the earth orbiting the sun, opting instead for an earth-centered universe. Unlike the flat earth myth, there is some truth to this story, though the details are a bit overwrought. We ought to begin with a few definitions. The *geocentric theory*

is the belief that the earth is the center of the universe. That term comes from two Greek words: *geo*, meaning earth, and *kentron*, meaning sharp point, such as the point used on a compass to draw a circle (we get the word *center* from this root). The *heliocentric theory* is the belief that the earth is just one of several planets orbiting the sun. It comes from the Greek words *helios*, meaning sun, and *kentron*. Notice that unlike the geocentric theory, where the earth is the center of everything, in the heliocentric theory, the sun merely is the center of the solar system.

Throughout history, the majority viewpoint was the geocentric theory, but this began to change four centuries ago. How did belief in the geocentric theory come about, and why did it persist so long? Our cultural mythology is that people in the past were superstitious and didn't know any better. However, when asked, most people today cannot give a single reason how we know that the heliocentric theory is true. They think that they know what is true, and they have faith that science somehow has proven it. But how is this different from the "ignorant" people of the past?

A common belief today is that people in the past thought that since humanity was the center of God's attention, we must be at the physical center of creation. This is anachronistic, because better reasons came first. Furthermore, being at the center was far from being in a favored location. In the Aristotelian worldview, things naturally moved downward. That is, things fell toward the earth's center, because that was the natural direction that things went. There is equivocation here, because this rule applied not only physically, but also morally. Man obviously was corrupt, but the ancient Greeks thought that the world (the earth) in which man lived was corrupted as well (this probably was a vestige of the truth of Genesis 3). This is in contrast with the heavenly realm, where the gods lived. Things were perfect in the heavenly realm, but the earthly realm was far from perfect. The center of the earth was as far from the heavenly realm as one could be, so the earth's center was the lowest place, both physically and morally. Thus, being on earth's surface, man was perched right above perdition. Far from being in a favored location, man was only one level above the least favored location. Therefore, the necessity of the geocentric cosmology is a pagan Greek concept, not Christian.

We shall discuss in greater depth the motions that we see in the sky shortly, but we can consider them at some level now. Everyone is familiar with the fact

that the sun rises in the east and, after moving across the sky, sets in the west each day. There can be two causes of this motion: either the sun moves around the earth each day, or the earth turns on an axis each day. Which one of these is true? That is not immediately clear. Ancient cosmologies were a bit divided on this question. If the earth were flat, rotation of the earth around an axis does not make sense, so flat earth cosmologies generally had the sun move across the sky each day. Once people realized that the earth was spherical, it was possible to conceive that the earth might rotate each day. However, notions are difficult to change, so belief in a non-rotating earth often persisted even with a spherical earth. Less well known is that at night most stars, the planets (which appear as bright stars), and the moon also rise and set similar to how the sun does each day. Again, this could be explained either by the earth spinning or the sky spinning around the earth each day. Out of this observation developed the notion of the *stereoma*, which, as we saw before, was a hard crystalline sphere on which the sun, moon, and stars were affixed.

Ignoring the apparent rotation of the sky around the earth each day, other changes take place over longer time periods. From one night to the next, the moon moves about 13° eastward with respect to the stars, taking one month to complete one circuit. Both today and in ancient times, this motion was attributed to the moon orbiting the earth. The sun appears to move about 1° eastward through the stars each day, taking a year to return to its starting place. As with the daily motion of the sky, this can be interpreted two ways: either the sun orbits the earth with respect to the stars once per year, or the earth orbits the sun. More than daily motion, this annual motion of the sun through the stars is the major observation that the geocentric and heliocentric theories attempt to explain. Which theory is true? That question is more difficult than many people realize. Ancient philosophers and scientists developed many answers to this question. Some protested that if the earth moved, we ought to feel that motion. However, our ability to feel motion relies upon bumps and other irregularities in motion. We now recognize that motion can be so smooth that the sensation of motion is not possible. Another objection to the earth's motion was that the moon obviously orbits the earth each month, but if the earth moved, it would leave the moon behind.

However, the greatest objection to the heliocentric theory in the ancient world was an inability to observe *parallax*. Parallax is the apparent change

in position that an object displays as we change our vantage point. You can demonstrate this by viewing a thumb held up at arm's length first with one eye and then the other. Your thumb will appear to shift left and right. In a similar manner, as the earth orbits the sun each year, stars appear to shift back and forth due to our changing position. Ancient astronomers watched for this parallax effect, but they never saw it. Being good scientists, they rejected the heliocentric theory in favor of the geocentric theory. That is, ancient scientists actually considered the heliocentric theory (rather than rejecting it on philosophical grounds) and discarded it because of the failure of prediction that the theory made. Lest you worry that you've been lied to about the earth's motion around the sun your entire life, the ancients did not see parallax because the stars are too far away. The amount of parallax decreases as the distance to stars increases. Stars are so far away that their parallax is extremely tiny, requiring a telescope. The first parallax measurement was not until the 1830s.

There were a few people in the ancient world who believed in the heliocentric theory anyway. The first person that we know of who taught the heliocentric theory was Aristarchus of Samos in the third century BC. Aristarchus based his heliocentric belief upon his estimates of the relative sizes of the earth, moon, and sun. He determined that the moon's diameter was one-third that of the earth, while the sun's diameter was seven times that of the earth.[8] It made more sense to Aristarchus that the smaller bodies should orbit the larger bodies. Since the sun was larger than the earth, the earth must orbit the sun. Aristarchus even got the ordering of the planets from the sun correct. He based this upon how fast the planets appeared to move, with the faster moving planets closest to the sun. Aristarchus, though, was not the first person to suggest that the earth moved, because a century earlier, Philolaus, a student of Pythagoras, taught that the earth moved. However, in Philolaus' system, the earth orbited a central fire, not the sun. How did Aristarchus explain the lack of observed parallax? He explained it the same way that we do today—stars are so far away that their parallax is too small to be seen by the eye. This was not a new concept either, because even earlier, in the fifth century BC, Anaxagoras had suggested that the stars were very distant objects similar to the sun. Anaxagoras argued that the stars appear so much fainter than the sun

[8] In reality, the moon is one-quarter the size of the earth, and the sun is 109 times larger than the earth.

because of their tremendous distance. For some time, historians had thought that heliocentric view as taught by Aristarchus was a small minority viewpoint in the ancient world. However, in recent years, some historians have begun to think that the heliocentric theory may have been more popular than previously believed. At any rate, it probably remained in the minority, and by the second century AD belief in the heliocentric theory had disappeared. Part of the reason for the dominance of the geocentric theory undoubtedly was the tremendous influence of Aristotle, who predated Aristarchus by nearly a century. Aristotle clearly favored the geocentric theory, again upon the basis of lack of observed parallax.

Probably what cemented the dominance of the geocentric theory was the cosmology developed by Claudius Ptolemy in the second century AD. Ptolemy attempted to explain the motion of the planets, the one motion of heavenly bodies that we have not yet described. Due to the earth's rotation, the entire sky seems to spin around us once each day and night. The moon orbits the earth through the stars once a month. The sun appears to move through the stars once per year, causing seasonal changes in the stars we see at night. All of these motions are very regular. However, the five naked-eye planets, Mercury, Venus, Mars, Jupiter, and Saturn, appear as bright stars that move through the stars in a less regular manner. The planets usually move eastward among the stars, the same direction that the sun and moon move. However, from time to time, the planets reverse direction and travel westward with respect to the stars, before once again reversing direction and traveling eastward again. Astronomers call the normal eastward motion of planets *prograde*, or direct, motion, and they call the westward movement *retrograde*, or indirect, motion. Both prograde and retrograde motion generally are along the ecliptic, the projection of the earth's orbital plane on the sky delineated by the sun's apparent annual motion. However, the motions of the planets are inclined slightly to the ecliptic, intersecting in two points called *nodes*. The moon's motion similarly is tilted to the ecliptic a few degrees.

How do these motions take place? Consider a planet farther from the sun than the earth, such as Mars. With a larger orbit, Mars has greater distance to travel to complete one orbit. Furthermore, being farther from the sun, the attraction of the sun's gravity is less than that on the earth, so Mars moves more slowly than the earth does. Consequently, it takes longer for Mars to complete

one orbit around the sun, about two years instead of one year for the earth. Figure 1.5 shows what happens as the earth overtakes and then passes Mars. The numbered lines illustrate the direction that one must look to see Mars from various points on the earth's orbit. Those lines are projected onto background stars. Notice that at first the projection of Mars onto the stars increases upward on the diagram. This illustrates prograde motion (eastward). However, as the earth overtakes Mars, the projection of Mars' position appears to reverse, going retrograde (westward). Once the earth has passed Mars sufficiently, the projections again reverse direction and Mars appears to move prograde (eastward) again. A similar thing happens when Mercury and Venus, planets with orbits smaller than earth's orbit, pass the earth. The slight bobbing up and down of the planets (and the moon) with respect to the ecliptic is due to the inclination of each planet's (and the moon's) orbit with respect to the ecliptic.

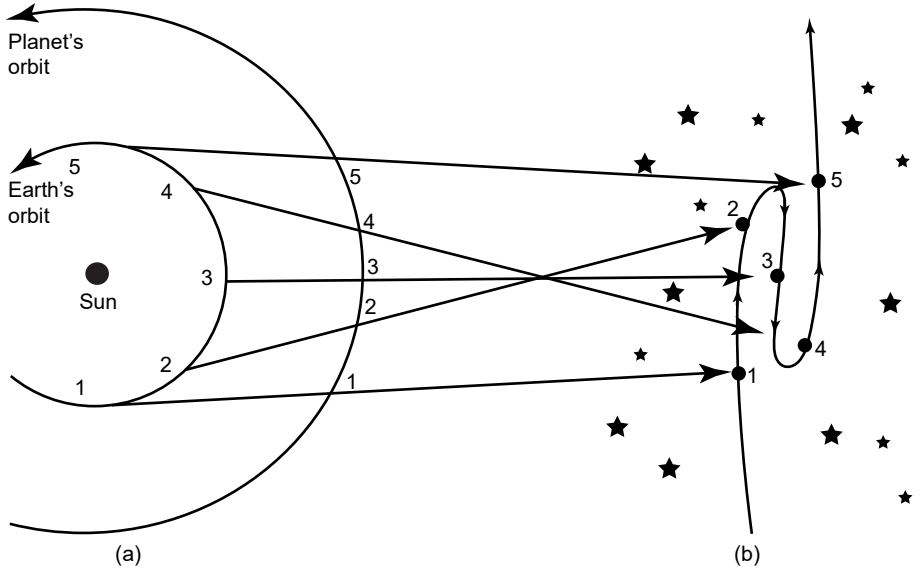

Fig. 1.5. Earth passing Mars in orbit relative to star field (Danny R. Faulkner, *The New Astronomy Book* [Green Forest, Arkansas: Master Books, 2004], 11).

While the behavior of the planets' motion is relatively easy to explain in terms of the heliocentric theory, it is much more difficult to explain with the geocentric theory. One could suppose that the planets simply moved in one direction for a while as they orbited the earth, but then reversed direction for a while before returning to normal, prograde motion. However, there is no

predictive power in that proposal. Furthermore, as previously mentioned, the ancients thought that the circle was the perfect shape, and since the heavenly bodies were considered to be perfect, they must follow perfect, circular motion. This concept of perfection extended to the insistence that the motion along circles be uniform. But motion cannot be uniform if it reverses direction. Figure 1.6 illustrates Ptolemy's solution to this problem. Ptolemy had each planet move uniformly on a circle called an epicycle. The epicycle in turn uniformly moved on a larger circle called a deferent. Normally, a planet's motion along its epicycle combined with the epicycle's motion along the deferent to produce prograde motion. However, there is a portion of an epicycle that is closest to earth. When a planet passed through this part of its epicycle, its motion appeared from earth to oppose the motion of the epicycle on the deferent. The effect is that the planet appears to move backward for a while. With adjustment of the sizes of the epicycle and deferent, along with the two speeds of motion, Ptolemy produced a good fit to observations.

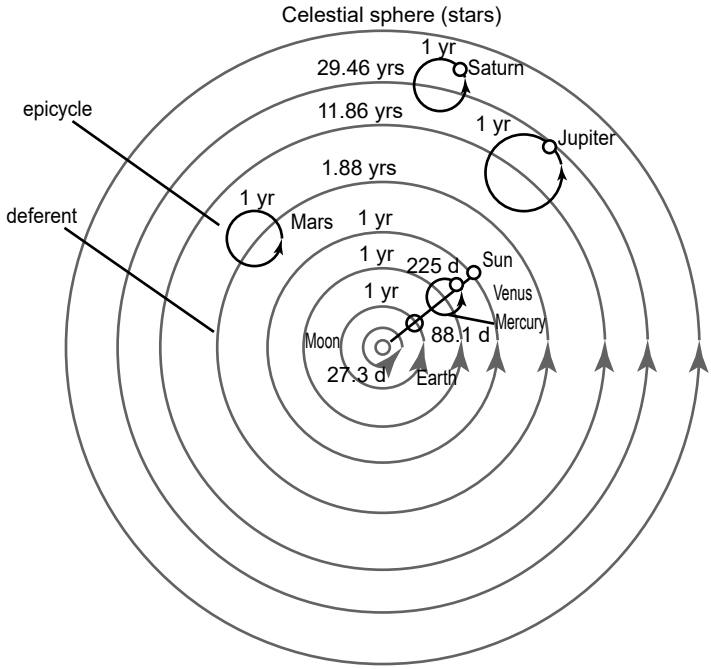

Figure 1.6. Illustration of Ptolemy's epicycles (Danny R. Faulkner, *Universe by Design* (Green Forest, Arkansas: Master Books, 2004), 12.

As it was, though, Ptolemy's theory required additional adjustments. Ptolemy explained the planets' small bobbing up and down from the ecliptic by a second, smaller epicycle perpendicular to the first, larger epicycle required for each planet. An epicycle of this type also was required for the moon's motion. To further improve the fit with planetary data, Ptolemy displaced the earth slightly from the center of each deferent. This was necessitated by the fact that planetary orbits are not circular, but instead are ellipses, with the sun at one focus (not at the center) of each ellipse. However, the orbits of the planets are not so elliptical that they cannot be approximated by circles with the earth off-center. The second refinement was that each epicycle did not move at a uniform rate with respect to the center of its deferent, but instead it moved at a uniform rate with respect to the *equant*. The equant of each deferent was the point collinear with the earth and the center of the deferent, but opposite and the same distance from the center as the earth. This was required by the fact that the planets do not move at a uniform rate along their orbits around the sun, but rather they move at rates so that the line between each planet and the sun sweeps out equal areas in equal time intervals. These latter two adjustments, displacing the earth from the center and the redefined manner in which the planets uniformly moved, were departures from the basic assumptions of the geocentric model, but apparently not many people objected to that. Perhaps they were impressed by the fact that the Ptolemaic model worked pretty well to predict planetary positions, where no theory prior to the Ptolemaic model had. At any rate, 15 centuries later, Johannes Kepler would reformulate these two major adjustments within the heliocentric theory in the form of the first two of his three laws of planetary motion.

The next series of developments is especially important in the history of astronomy. It appears that Ptolemy did not intend that his model be taken literally. Rather, he merely was describing the motion of the planets, and he used the best mathematics available to him, geometry. Today we use algebraic expressions to describe planetary motion, but no one thinks that the algebraic expressions themselves are reality. However, people eventually came to think of the circles of the Ptolemaic model as reality. That is, people believed that the planets actually moved along these circles.

A few centuries after Ptolemy, the Roman Empire collapsed, leaving chaos and turmoil in its wake. There was serious erosion of commerce, technology, and

learning that led to the Middle Ages. Late in the Roman Empire, Christianity had shifted from being a persecuted sect, to a tolerated religion, to *the* state religion. This move toward acceptance and then compulsion inevitably led to the inclusion of many unregenerate people within what was recognized as the church. In the West, this corrupted church began to centralize in Rome, the original capital of the Roman Empire. As people longed for the security that Rome had provided in the past, people increasingly came to view the Roman Church as its leader. Thus, the Roman Catholic Church came to dominate not only theology, but also academics and political power. A millennium later Europe emerged into the Renaissance. By the so-called Enlightenment of the seventeenth century, it became fashionable to call the Middle Ages the Dark Ages and to blame Christianity for the erosion of learning during the Middle Ages. Ultimately, this led to the previously-discussed conflict thesis. The Middle Ages were not that dark, as many historians now acknowledge. Furthermore, the great losses of the Middle Ages occurred early, before the Roman Catholic Church came to dominate, so the Roman Catholic Church hardly could be blamed for the problem. Instead, the dominance of the Roman Catholic Church came about in response to crises that Europe faced.

In the waning days of Rome, Augustine was bishop of Hippo, in North Africa. Augustine's writings were extremely influential in the development of western philosophy and Christian theology, and are well regarded today by Roman Catholics and some Protestants. Augustine was heavily influenced by the writings of Plato, and he incorporated Platonism or, more properly, Neoplatonism into his philosophy and theology. It is a shame that Augustine did not attempt to build a truly biblical worldview from the Scriptures,[9] but instead chose to build a pseudo-biblical worldview on a foundation that included pagan ideas from the ancient Greeks. His approach allowed for, among other things, the belief that men using their rational minds could arrive at spiritual truth (which undermined a biblical perspective on the noetic effects of sin and the need for biblical revelation). One consequence of Augustine's teachings was the de-emphasis of Aristotle in the West. Unlike Plato, who was more of a philosopher, Aristotle was both a philosopher and

[9] For a discussion of the importance of Scripture in the development of a biblical worldview, see Danny R. Faulkner, *The Created Cosmos: What the Bible Reveals about Astronomy* (Green Forest, Arkansas: Master Books, 2016), 323–333.

a scientist. Through Augustine's influence, the works of Aristotle and other ancient scientists virtually disappeared in the West. This probably led to the common belief today that in the Middle Ages people did not conduct science as we know it to explore the world around them, but instead philosophized about the world. One of those scientists whose work was lost in the West was Ptolemy.

However, the works of Aristotle, Ptolemy, and others remained in circulation in what had been the eastern part of the Roman Empire. In the wake of the Islamic conquest of the seventh century, Muslims came into contact with these works, which they translated into Arabic. Of particular interest to the Muslims was the work of Ptolemy. The Muslims were so impressed with the Ptolemaic model's ability to predict planetary positions that they began to call Ptolemy's work "the Greatest," or, in Arabic, *Almagest*. This is the title by which Ptolemy's work is known today. By the twelfth century, translations of Aristotle, the *Almagest*, and other ancient Greek works into Latin and even modern European languages began to appear in the West. In the thirteenth century, Thomas Aquinas did for Aristotle what Augustine had done for Plato eight centuries earlier. Soon Aristotelian philosophy held sway in Western thought, and this undoubtedly provided fertile ground for renewed interest in the pursuit of science in the West. Augustine had laid the groundwork for accepting man's ideas as ultimate truth, but Aquinas more fully developed it. Aristotelianism became the filter through which Scripture was viewed. Since Aristotle had taught the geocentric theory, certain Bible passages, such as the account of the long day at the Battle of Gibeon in Joshua 10, were interpreted in terms of the geocentric theory. That is, it became *doctrine* that the Bible allegedly taught the geocentric theory. The Bible does no such thing, but this nevertheless eventually became the general belief. This is an excellent example of *eisegesis*, reading a foreign meaning into the Bible. By contrast, our approach ought to be to strive for sound *exegesis*, that is, the practice of drawing the author's intended meaning out of the text, and so determining what Scripture actually teaches. Only then can we properly test our ideas.

This change in attitude did not happen immediately, but it was fully in place by the early seventeenth century. At that time, the Roman Catholic Church certainly felt that it was under assault. The Protestant Reformation had exploded nearly a century before, and it had led to much loss of influence in

parts of northern and western Europe. At the same time, Islam was on the prowl gobbling up portions of Southeastern Europe. The Roman Catholic Church did not have the stomach for more attacks upon its authority. It was at this time that Galileo Galilei began to present a problem in northern Italy. Galileo was a brilliant mathematician and scientist. As a young man, Galileo had read the book by Nicolaus Copernicus, written a few decades earlier, in which Copernicus espoused the heliocentric theory. Copernicus often is credited with inventing the heliocentric theory, but, as we saw earlier, this is not true. Rather, Copernicus resurrected, developed, and popularized the heliocentric theory. The primary argument for the heliocentric theory was that it was much simpler than the geocentric theory. Since the time of Ptolemy, people had found that the Ptolemaic model required a number of additional adjustments, such as many more epicycles, to explain planetary motion adequately. Surprisingly, though Copernicus' book challenged the official teaching of the Roman Catholic Church and was widely read, it had received relatively little condemnation.

Even Galileo garnered little attention at first. While Galileo already believed the heliocentric theory when he began to use a telescope, his telescope provided evidence that the Ptolemaic model was wrong. Contrary to popular belief, Galileo did not invent the telescope, but he does appear to be the first person to put the telescope to use to study astronomical bodies. With his telescope, Galileo saw that the planet Venus went through a complete set of phases similar to the moon. Unlike the moon, which can be anywhere along the ecliptic, Venus is never more than 47° from the sun. For Venus to exhibit a full range of phases, it must orbit the sun. Hence, this simple observation disproved the Ptolemaic model, opening the door to the heliocentric theory. One argument that Aristotle had advanced against the heliocentric theory was that if the earth moved, the moon would be left behind. However, through his telescope, Galileo saw that four satellites, or moons, orbited Jupiter. It was clear that Jupiter moved, even in the Ptolemaic model, yet its satellites were not left behind as it moved. Therefore, Aristotle's objection to the earth moving was not correct. Galileo found other challenges to Aristotelian thought. For instance, Galileo saw craters on the lunar surface and spots on the solar surface. Both the sun and the moon, being heavenly bodies, were deemed perfect, and perfect bodies could not have craters and spots.

These observations emboldened Galileo, and as he more forcefully taught the heliocentric theory, Galileo began to come under attack. However, those attacks came not from theologians but from other scientists, who complained that Galileo was contradicting established science. In response, in 1615, the Roman Catholic Church ruled that the heliocentric theory could be discussed as a theory, but not presented as fact, since it contradicted the Ptolemaic model, which the Roman Catholic Church had endorsed. Seventeen years later, in 1632, Galileo published a popular book that not only espoused the heliocentric model, but also ridiculed the Pope, as well as many of Galileo's critics. Highly offended, these leaders called for Galileo's discipline, which led to a trial. Galileo was accused of several charges. Some of these charges, such as insubordination, he clearly was guilty of. At the conclusion of his trial, Galileo was found guilty, required to recant, and was sentenced to house arrest. Now elderly, Galileo spent the rest of his life under house arrest. Contrary to popular belief, Galileo was neither charged with nor found guilty of heresy. If he had, he likely would have suffered far worse punishment, even unto death—other people at the time certainly did. The issue was not even theological in nature, but instead was scientific; and much of the argument against the heliocentric theory in the trial came not from Scripture, but from Aristotle and Ptolemy.

Galileo's opponents were fighting a losing battle. Already, support for the Ptolemaic model was rapidly eroding. In 1600, nearly everyone believed the Ptolemaic model. By 1700, no one did. Why was there such a rapid shift? The Ptolemaic model was very complicated. Over the years, there were slight discrepancies between the predictions of the model and the observed locations of the planets. The fix to this problem was to add additional epicycles. While this modified system correctly predicted planetary positions, it was unwieldy. Some versions required a hundred epicycles. It is said that in the thirteenth century, when Alfonso X of Castile was schooled in the Ptolemaic model, he reportedly commented that, "If the Lord Almighty had consulted me before embarking on creation thus, I should have recommended something simpler." A general principle of reasoning is that the simplest explanation probably is the correct one (this often is called *Occam's razor*, for William of Occam of the fourteenth century). By the seventeenth century, many people began to realize that the heliocentric model's explanation for retrograde motion was much simpler than that of the Ptolemaic model. This paved the way for getting

out of the rut of Aristotelian thinking, such as constraining heavenly bodies to move uniformly in circles. This soon led to Newton's formulation of gravity and the development of physics. Galileo provided the first direct evidence (the phases of Venus) that the Ptolemaic model was wrong, but it was not until the eighteenth century that the first direct evidence (the aberration of starlight) that the heliocentric theory was true was seen.