Part II

The Mind of the Maker:
Physics, Biology and Human Origins

Chapter Seven

The Twist in the Tale:
Modern Science *versus* Scientific Atheism

How can the discoveries of modern physics relate to Christian doctrine?
What is the Big Bang Theory, and does it prove the existence of God?
How can the discoveries of modern physics help us to better appreciate the truth about God the Creator?
What is beauty, and how is beauty involved in our scientific understanding of the universe? Does the beauty of the universe tell us anything about the Creator?

"What is God? The mind and reason of the universe. What is God?
Everything that we see, because in all things we see his wisdom and assistance,
and so we confess his greatness, which is so great that we cannot think of anything greater."
-Venerable Louis of Granada, 1584

A. Marvels Beyond All Expectations

In the Spring and Summer of 1919 the eyes of the world were focused on France. The battles of World War I that had killed 13.5 million people were over, and representatives of the great powers had converged upon the palace of Versailles, once the home of the French monarchy, to negotiate terms of peace. It was a moment of incalculable importance for humanity. But, another momentous event was taking place, though little noticed – expeditions of astronomers and physicists were making their way to Sobral, Brazil, and to the West African island of Principe in order to view a total solar eclipse that was to occur on May 29. Just as the Treaty of Versailles would forever affect the future of international relations, the findings of these astronomers would forever affect our understanding of the universe.

What the astronomers wanted to observe was not the eclipse but a cluster of stars positioned very near the Sun; only during an eclipse, when the Sun's intense radiance is blocked out by the moon, would these stars "come out" and be observable. Nor were they primarily interested in the stars themselves, which form a cluster called the Hyades. They were testing a new theory that predicted that gravity attracts light as well as ordinary matter. Their goal was to see if the light from these stars would be deflected slightly as it passed close by the Sun on its way to the Earth. They would be able to detect this deflection by observing if the positions of these stars appeared to be slightly shifted from their actual position in the sky. If they appeared out of place, this would confirm the bold new gravitational theory, a possibility so revolutionary that it would be well worth their efforts and travel.

Any new theory of gravity was bold, since the old one—proposed by none other than Sir Isaac Newton, the greatest physicist the world had yet known—had passed every experimental test for 232 years. The scientists set up their observation sites, gathered their data, and returned to Europe. On November 6, at a special meeting in London of the Royal Society, one of the oldest and most prestigious scientific organizations in the world, they stunned their audience with their report. The next day, the *Times of London* ran the following headline:

Revolution in Science
New Theory of the Universe
Newtonian Ideas Overthrown

Within hours, the news raced around the world. The scientist who had proposed the new theory—the so-called *General Theory of Relativity*—became a household name. Indeed, his name, Albert Einstein, is probably better known than that of any other scientist who has ever lived either before or after his rise to prominence. And rightly so, for his theoretical breakthroughs opened a whole new era in the physical sciences and would allow other scientists to illuminate some of the greatest secrets of the universe, including many of the mysteries of the universe's origin.

This new scientific era, now a century old, would be full of surprises. From the time of Copernicus up until the end of the nineteenth century, the trend of scientific discoveries had seemed to some people to be leading away from the traditional religious conception of the universe. Indeed, as we saw in Chapter Three, throughout the nineteenth century atheism became more common among scientists and intellectuals generally, partly because of what they thought science was saying (and partly for other reasons). But, in the twentieth century, scientists would make discoveries that were totally unanticipated; there was one "twist in the plot" after another. Many people came to see that the old "scientific atheism" was based on outdated scientific ideas. In this chapter, we will look at three "twists in the tale" of the physical sciences that have occurred since Einstein's great breakthroughs. In each case, we will see that they have helped to deepen our understanding of God's creation and what he has revealed through Sacred Scripture and Sacred Tradition. In order to really appreciate the first of the three plot twists, we have to take a philosophical pause and ask two "big questions" about God and the universe.

B. A Perpetual Universe?

What if the universe just stretched back infinitely, such that there was neither a starting point to it nor a first moment? Would the universe be uncaused, or would it still need a Creator?

These are incredible questions; they are so big that most usually never even attempt to ponder them. But, the question of "beginning, or no beginning" has been asked about the universe many times throughout the history of Western Civilization. Most ancient philosophers, such as the Greek philosopher Aristotle (384-322 BC), held that the universe has always existed

in some form or another, that its history and time itself are infinite. In the 19th century this ancient idea made a comeback. As scientists delved deeper and deeper into the secrets of the physical universe, it seemed to many that the universe was a perfectly interlocking system, a machine that had operated endlessly, without a first moment. Twin theories – *the law of the conservation of mass* and *the law of the conservation of energy* – seemed to support this view. The law of the conservation of mass states that when matter undergoes changes (for example, in chemical reactions) the total amount of mass in the universe does not change. The law of the conservation of energy states that energy can be neither be created nor destroyed but only converted from one form to another. These principles seemed to imply that matter and energy must have always existed which, if true, would imply that the universe itself had always existed.[1]

1. God and the Limits of a Perpetual Universe

The issue of whether the universe did in fact have a beginning is the first plot twist we will consider. For now, let us suppose "for the sake of argument" that it did not and see where that leaves us. Many people think that the statement "the universe never had a beginning" is an atheistic one. To say that something is without a beginning seems to necessarily imply that it is uncaused; and if the universe is uncaused, then it has no Creator. But if it were true that the universe had no first moment, would that really mean that it is uncaused? The answer is "no" – at least according to St. Thomas Aquinas.

St. Thomas' approach to this difficult question shows how our faith never stops us from thinking critically about all of the possibilities, even ones that contradict our faith. For even though he believed, as a matter of faith, that the universe did have a beginning, he was willing to consider the idea of a perpetual universe from a purely philosophical point of view. His conclusion was that reason by itself could not settle the question of whether the universe (or to use his term, the "*mundi*' or "the world") had a beginning or not. We only know that the universe had a beginning, he reasoned, because God has revealed that it does. In his words, "By faith alone do we hold, and by no demonstration can it be proved, that the world did not always exist... The reason of this is that the newness of the world (*novitas mundi*) *cannot* be demonstrated on the part of the world itself."[2]

On the other hand, St. Thomas believed that human reason by itself, i.e., without the aid of Divine Revelation, *must* arrive at the conclusion that the universe has a Creator. Obviously, then, for him the universe must have a Creator *whether or not it had a beginning.* In other words, "having a beginning" and "being created" are not necessarily the same thing.

How did Aquinas arrive at the conclusion that a perpetually existing universe would still need a Creator? He did so by observing that the universe could have been caused to perpetually exist by God, that is, it could have always been because God caused it to always be. Even so it would still need God to explain its existence. As an analogy, let's return to our image of the

---

[1] These two principles are now recognized by scientists to be the same principle.
[2] St. Thomas Aquinas, *Summa Theologiae* I.46.2 resp.

universe as a play. A play has a beginning and an end. But, the reason we say a play has an *author* has to do with the fact that *it exists at all.* Even if a play had a beginning and no end, or an end and no beginning, it would need an author, since the fact of the play cannot explain the reason for its existence. As we noted in Chapter Three, the opening line of Shakespeare's *Romeo and Juliet* are: "Two households, both alike in dignity, In fair Verona, where we lay our scene..." That is the *beginning* of *Romeo and Juliet*; it references a point in time when the play begins in Shakespeare's fictional Verona. But, Shakespeare is the *origin* of those lines and everything else in *Romeo and Juliet*, and so it is with God the Creator and the universe. Anything that exists, but might not have existed, has to have its existence explained. There must be a cause or explanation of its existence, regardless of whether it has a beginning or not.

In the same way, we might reasonably entertain the possibility that the universe may or may not have had a beginning, just as we might entertain the possibility that it may or may not have an end. But, the reason we say that God creates it has to do with the fact that it exists at all. Even if the universe had no beginning and no end, or an end and no beginning, it still requires a Creator. We have already considered the idea that the universe's sheer existence requires a Creator in general in Chapter Three, but let's delve more deeply.

2. A Metaphysical Moment

Let's start with a basic observation: none of the beings in our experience (e.g. ourselves, plants, planets, atoms, molecules, animals, etc.) are self-sufficient. All of them need certain conditions to be in place in order for them to exist at any given moment.[3] As we look around us, we see that beings depend upon other beings outside of themselves in order to exist. For example, beings depend upon other beings that came before them in order to come into existence. This is especially obvious in the case of animals, which have parents who generated them. The parents are causes of their offspring's existence. Such causes, which produce effects in such a way that those effects can continue to exist even after the causes themselves have ceased to exist, can be called "*non-simultaneously acting causes."* But, this kind of causality is *not* what St. Thomas was focusing on when he constructed his argument for a Creator.

There is a second kind of dependency in which a cause *keeps* a thing existing in the present moment. You needed to have parents to come into existence, but you do not need them to exist right at this moment – your parents are not holding you in existence as we speak, except financially, perhaps. But, there is another kind of causality, in which the effect would cease to exist should the cause cease to exist or stop its causal activity. Let's call these "*simultaneous causes"* or "*simultaneously acting causes."* For example, the earth is causing its "gravitational field" to exist *right now*. The existence of the earth is a *present condition* for the existence of its gravitational field – the earth is the *simultaneous cause* of its gravity. A gravitational field is an example of something that depends on another thing, distinct from itself, in order to exist, in

[3] Clarke, 216.

such a way that this dependence is simultaneous with the ongoing existence of that distinct thing.[4]

Apply the same idea to yourself – you are a being that relies on other beings as conditions for your existence. Air, temperature within a certain range, the existence of the water molecule – without any one of these, you would not exist. They exist, therefore you can exist – they are simultaneously acting causes of your existence. They each have simultaneously acting causes that make it possible for them to exist – for instance, the existence of the water molecule relies on the stability of the proton, which makes the atomic elements (such as hydrogen and oxygen) capable of existing.

Now let us apply this analysis to all of reality: can all beings be conditioned, dependent on the ongoing existence of others for their existence? The answer is "no." Think about it – for A to exist, B must exist, for B to exist, C must exist, and so on. But, this chain of simultaneously acting causes cannot be an unending one, because then the whole chain would never get to a being which makes A (or B, or C, etc.) actually exist. Nor can the chain of simultaneously acting causes go around in a circle—A depending on B, B on C, and C on A—because A cannot be making other things exist while also depending on those very things for its own existence. In either scenario, there would be no ultimate reason for the existence of the whole chain of causes, and, if this were the case, there would be no reason, no intelligibility, in any part of the chain. If there is no uncaused Cause, then no things in the chain could actually exist. There has to be at least one "thing" that currently exists which does not depend on another thing for its existence, a being that is totally *unconditioned* in its existence. This being has to be the ongoing reason for the existence of the whole chain, the thing that all other things depend on for their existences, the condition for all other beings. It has to be self-sufficient, self-explanatory, and uncaused, or else it, too, is conditioned and dependent.[5] In short, for any conditioned thing to exist *right now*, there has to be a God, who is "to all things the cause of being *right now*."[6] That being said, it would be erroneous to come away from this discussion thinking that if we peered deeply enough into the fundamental realities of matter that we would somehow "find" God there. God, as the uncaused Cause, always remains wholly transcendent and wills creation into existence as its divine simultaneous cause in the here and now in a way that is different than that of created simultaneous causes. It is precisely because God transcends the universe and is not part of it that makes the existence of a fundamentally conditioned universe possible.

In summary, the preserving power which holds all things in being, right here and right now, "can ultimately only be something that is not in turn held in being by something else."[7] Our

---

[4] Barr, *Modern Physics,* 258-259.
[5] Clarke, 216.
[6] Barr, *Modern Physics*, 261.
[7] Koltermann, *Grundzuege der modernen Naturphilosophie. Ein kritischer Gesamtentwurf* (Frankfurt, 1994), 134, as quoted by Christoph Cardinal Schönborn, "He upholds the universe by his word and power," http://www.stephanscom.at/edw/katechesen/articles/2006/02/15/a10185/.

investigation of what we can observe through our common human experience leads us to God, if we patiently and intelligently consider the way the cosmos works.

To return to our big question, we would be led right to God even if the universe was ever-existing. Even if the great chain of *non-simultaneously* acting causes stretched back infinitely, "a father being a cause of a son and another person the cause of that father, so on, endlessly,"[8] there must be a beginning to the chain of *simultaneously* acting causes which make anything exist in the present moment. God stands at the beginning of that chain – all things ultimately depend on his necessary existence for their own existence at every moment, no matter how many moments there have been or will be.

Our consideration of a perpetually existing universe still leaves the questions: "Did the universe have a first moment? Is its history infinite or finite?" These questions lead us to one of the greatest stories of modern physics, the discovery of the Big Bang, the first "twist in the tale" of twentieth century physical science. It has to do with one of the implications of Einstein's theory of gravity that he himself found hard to accept, and indeed resisted for years. This implication would hit the scientific community like an explosion – literally.

C. Starting Things Off With a Bang

Above we observed that many people equate a perpetual universe with atheism – if the universe has no beginning, they assume that it is also uncaused. As we learned from St. Thomas Aquinas, this jump is philosophically unjustified. Even a perpetual universe would be "contingent" and therefore need an ultimate cause. But, the Christian Faith tells us more than this. It says not only that the universe has a Creator but that it had an actual beginning in time, an actual first moment at which it appeared out of nothing, thanks to God's will and power. The Book of Genesis begins with the words, "In the beginning…", as does the Gospel of St. John in its own retelling of the creation account. So, at the beginning of the twentieth century it seemed to some that if the scientific evidence that pointed to the universe's perpetual existence had not disproved God's existence, at the very least it had weakened the authority of the Bible and called into question the teachings of the Catholic Church.

Among those who believed in a perpetually existing universe was the great Albert Einstein. Though by his own account, he was "religious" in some sense, and often spoke of God, his conception of God and God's relation to the world made it hard for Einstein to accept the idea of a first moment, a temporal beginning to the universe. The great irony is that it was his own General Theory of Relativity that played a key role in bringing back the idea of a beginning. To understand why, we must look more closely at the theory that made him famous and the equations he used to demonstrate it.

1. Einstein's Equations

[8] Barr, *Modern Physics,* 259; cf. St. Thomas Aquinas, *Summa contra Gentiles,* II.38 ad 5.

In Einstein's theory of gravity, things attract each other by warping the space (actually the space *and time*) near them. The way matter warps space and time is described by a set of equations, now called "Einstein's Equations." These remain among the fundamental equations of theoretical physics in our own day.

The logic that led Einstein to these equations back in 1916 left a certain ambiguity. There was a "term" that could be included in the equations or left out; it did not seem to make much difference either way. Today this term is called the "cosmological constant." Einstein thought the theory would be simpler and more elegant without this term, so he originally decided to leave it out. However, Einstein quickly noticed something that disturbed him. His equations could only describe a universe that was expanding or contracting, not a stable universe that could exist for infinite time into the past and future. He therefore put the cosmological constant back into the equations, thinking that it would allow the theory to describe a stable eternal universe. Later, the physicist Arthur Eddington (1882-1944) showed that, even with the cosmological constant, the expansion or contraction of the universe was an unavoidable implication of Einstein's equations.

Had Einstein believed what his theory was telling him, instead of running away from it, he could have *predicted* the discovery of both the expansion of the universe and "the Big Bang," which was discovered by astronomers years later. His philosophical belief in an eternal universe made him miss the most important implication of his own theory. He later reproached himself severely for this blindness, as he saw it, and called it the biggest blunder of his life.[9]

2. Fr. Lemaître and the "Primeval Atom"

The scene now switches from Europe to America. The last name of *Edwin Powell Hubble* (1889-1953) is known to many Americans from the famous Hubble Space Telescope. But, he did not invent this telescope;it was named in his honor because of a great discovery he made in the 1920's using another telescope, one located at the Mt. Wilson Observatory in California. Hubble peered into space and discovered that other galaxies were moving away from our own. His observations showed that this expansion really was occurring and at incredibly high speeds. The expansion was so massive and so fast that some other galaxies were actually millions of light-years away.[10]

At the same time mathematicians and physicists were taking Einstein's insights in the very direction that he himself dismissed – towards a universe that is expanding from a "beginning." Two thinkers independently discovered that Einstein's Equations can describe such a universe: one was a Russian mathematician named Alexander Friedmann (1859-1925), the other was a Belgian physicist and Catholic priest named *Georges Lemaître*. As we saw in

---

[9] George Gamow, *My World Line* (English: Viking, 1970), 44. There are many historical ironies in this story. Theorists since Einstein's day have considered that Einstein's equations make more sense *with* the cosmological constant. And the term may indeed be needed to explain a discovery made in 1998. So even some of Einstein's blunders were pretty smart.

[10] Barr, *Modern Physics*, 38-39.

Chapter Five, it was Lemaître who saw the significance of Hubble's discovery and related it to his own theoretical work with Einstein's equations. In 1927, Lemaître proposed that the universe had started out very small and has been expanding for billions of years. If that were so, then all of the matter in the universe must originally have been concentrated in a super-dense mass, which Lemaître called the "primeval atom." It was the explosion of this "atom," said Lemaître, which had led to the expansion of the universe that Hubble would observe in 1929. In his words, "At the origin, all of the mass of the universe would exist in the form of a unique atom; the radius of the universe, though not strictly zero, being relatively small. The whole universe would be produced by the disintegration of this primeval atom."[11] Thus was the "*Big Bang Theory"* born.[12]

While he originally told Fr. Lemaître that although his math was "correct," his grasp of physics was "abominable," Einstein eventually accepted that we live in a dynamically expanding universe; however,it is not clear if he ever accepted the idea of a first moment, a beginning. He revealed his change of mind in 1933 in a way that displayed his great humility and character: after listening to a lecture in which Fr. Lemaître explained his ideas on the beginnings of the universe, Einstein stood up and applauded enthusiastically.

The Big Bang Theory in its standard form says something much more profound and strange than that stars and galaxies and matter had a beginning. It says that *space and time themselves* had a beginning. What Hubble saw was that the distance between galaxies was increasing. The obvious interpretation of this is that galaxies are moving *through space* away from each other. But what is actually going on, as Fr. Lemaître understood, is that the space between the galaxies is *stretching*. Space itself is like a stretchable fabric, and, so, the amount of space is actually growing. If you followed this stretching process backwards in time, one would find that space itself was smaller in the past. And, if you followed it far enough back you would find that the amount of space would go to *zero* at the very moment of the Big Bang. Space would shrink to a zero-state. If you could run the film of the universe's history backwards, the entire universe—the matter *and the space*—would seem to "wink out" altogether at the Big Bang.

It gets even stranger: since Einstein's theory says that space and time are part of one fabric called "spacetime," accordingly, *there was no time either* before the Big Bang. In fact, it is meaningless (in the standard Big Bang Theory) even to say "before the Big Bang." There is no such thing as "before the Big Bang" since "before" implies a time previous to the Big Bang, and there was no time previous to the Big Bang. Strange as it may seem, the Big Bang was "a day without a yesterday," as Fr. Lemaître referred to it.

This is a mind-boggling idea, but one person understood it very well 1,600 years ago—St. Augustine. St. Augustine's autobiography, *The Confessions*, contains a very famous

---

[11] Georges Lemaître, "The Beginning of the World from the Point of View of Quantum Theory," *Nature* 127 (1931): 706, as quoted in Stacy Trasancos, *Particles of Faith: A Catholic Guide to Navigating Science* (Notre Dame, IN: Ave Maria Press, 2016), 63.
[12] Ibid., 43.

discussion of the nature of time. It is so profound that physicists who work in the field called "quantum cosmology" frequently quote from it.[13] Even the eminent twentieth century philosopher and mathematician Bertrand Russell (1872-1970), an atheist and no friend of religion, praised St. Augustine for his "admirable relativistic theory of time."[14]

St. Augustine was answering the taunts of pagans who believed that the universe was perpetual. The pagans mocked the Christian belief that the universe had a first moment by asking, "What was God doing for all that time before he created the world? Why did he wait for an infinite time doing nothing before he got around to creating the world?" St. Augustine gave his answer in the form of a long prayer: "You [O LORD] created … time, and no time could pass by before you created it. But if there was no time 'before' you created heaven and earth, why do they ask what you did 'then'? There was no 'then,' where there was no time."[15] This is very similar to the answer that a modern physicist would give: there was no "then" before the Big Bang as it is understood in Einstein's Theory of General Relativity. The nineteenth century idea of time in physics was the same as the ancient pagans' idea of time. The idea of time in the standard Big Bang Theory is St. Augustine's idea of time, the Christian idea of time.

To sum up: when we talk about "the beginning," we really mean not just the beginning of the universe but the beginning of time. As taught by the Fourth Lateran Council in 1215 and the First Vatican Council in 1870, God created the universe "from the beginning of time" ("*ab initio temporis*").

3. The End of the Debate

Einstein was very uncomfortable with the idea of a beginning precisely because it sounded too biblical; as he told Fr. Lemaître, "it suggests too much the (theological) idea of creation."[16] He was not alone. Arthur Eddington, who had been on one of the 1919 expeditions that proved Einstein's theory, responded to Lemaître's theory by declaring, "The notion of a beginning is repugnant to me… I simply do not believe that the present order of things started off with a bang." An eminent scientist named Walther Nernst (1864-1941) even wrote that the foundations of science would be undermined by denying that the universe and time had always existed. In fact, the idea of an ever-existing universe persisted for many years after Hubble's discovery that the universe is expanding. In 1959, two-thirds of American astronomers and physicists still believed that the universe had no beginning. It is generally admitted that the scientific community was slow in accepting the Big Bang Theory in part because of a widespread prejudice in favor of a perpetual universe. This prejudice was one reason (although not the only one) that a new hypothesis emerged that explained the expansion of the universe

---

[13] For example, see Steven Weinberg, "The cosmological constant problem," *Reviews of Modern Physics* 61 (1989): 15, n.13.
[14] Bertrand Russell, *History of Western Philosophy* (London: Allen and Unwin, 1946), 373.
[15] St. Augustine, *Confessions,* XI.13, as quoted by Barr, *Modern Physics*, 48.
[16] Dominique Lambert, "Einstein and Lemaître: two friends, two cosmologies…," http://inters.org/einstein-lemaitre.

without a beginning. This so-called "Steady State Theory" eventually fell by the wayside as the evidence against it and in favor of the Big Bang Theory accumulated.[17]

It is a strange story how the Big Bang Theory ended up being confirmed. In 1948, two students realized that the Big Bang, if it had occurred, must have been unimaginably hot due to the enormous squeezing of the matter – one second after the Big Bang the temperature of the universe would have been ten *billion* degrees centigrade! This had an interesting consequence: the universe just after the Big Bang would have been filled with intense radiation, much of it in the form of light, and a residue of that radiation would remain even now in the form of microwaves, filling the universe with a faint "afterglow" of the Big Bang.

Curiously, this idea was ignored. Almost two decades would pass before anyone would follow it up. When finally someone made the decision to look for this radiation, they were too late—it had already been discovered accidentally. The two scientists who found it, *Arno Penzias* and *Robert Wilson*, did not use a telescope but a radio detector. Stephen Barr described their process of discovery in the following way:

> They found a noise, or static, that seemed to come equally from all directions in the sky. At first they thought that it was a problem with the device itself, or some local interference – they even considered the possibility that heat given off by bird droppings inside the antenna was responsible. Eventually, however… the true significance of what they were seeing was realized. They were hearing a whisper from the Big Bang.[18]

Penzias and Wilson were awarded the Nobel Prize in Physics in 1978 for this discovery. Since then, several other pieces of evidence have confirmed their discovery, and very few now dispute the Big Bang Theory. Calculations made by scientists suggest that this event, apparently the first moment of our universe, happened almost 14 billion years ago. Physicists agree that all of the stars and galaxies that we observe were once packed into an almost "infinitely dense… point of pure energy."[19]

4. Going Out With a Bang: Modern Science versus Materialism

The discovery of the Big Bang was a revolution in science. However, the revolution involved a battle not simply over science but over the materialistic assumptions of many in the scientific community. The significance of the Big Bang has been compellingly described by the astrophysicist Robert Jastrow: "For the [modern materialist] scientist… the story ends like a bad dream. He has scaled the mountains of ignorance; he is about to conquer the highest peak; as he

---

[17] Barr, *Modern Physics*, 44-45.
[18] Ibid., 46.
[19] Francis Collins, *The Language of God: A Scientist Presents Evidence for Belief* (New York: Free Press, 2007), 64-65.

pulls himself over the final rock, he is greeted by a band of theologians who have been sitting there for centuries."[20]

Jastrow's point is that the Big Bang was more than just a glimpse into the origins of the universe. It also represented a major crack in the materialist, reductionist worldview of scientific atheism because it suggests that the physical universe does not contain its own explanation entirely within itself. The materialist ideology reduces the explanation of things to merely giving an account of how they arose from whatever existed beforehand. They explain what happens today by what happened yesterday. But, what if there were a "day with no yesterday," as the Big Bang Theory suggests? The Big Bang forces upon us deeper questions about the mystery of the universe, questions such as why the universe exists at all, and why it is the way it is.[21]

5. Theology on the Cutting Edge: The Big Bang and Faith

Elsewhere in his book, Robert Jastrow makes another provocative declaration: "Now we see how the astronomical evidence leads to a biblical view of the origin of the world. The details differ, but the essential elements in the astronomical and biblical accounts are the same; the chain of events leading to man commenced suddenly and sharply at a definite moment in time, in a flash of light and energy."[22]

Is Jastrow correct? Should the Big Bang be understood, as it is by some, as proving the existence of God and the divinely inspired truth of the Bible? The answer is "no." Pope John Paul II once cautioned that we should not be too hasty in our use of the Big Bang Theory in this way.[23] In 1985, he said that "to desire a scientific proof of God would be equivalent to lowering God to the level of the beings of our world, and we would therefore be mistaken methodologically in regard to what God is. Science must recognize its limits and its inability to reach the existence of God: it can neither affirm nor deny his existence."[24] We cannot find a proof of God's existence through scientific discovery. Science studies the material world, and God is not part of the material world. That doesn't mean that believing scientists cannot affirm God's existence, but when they do so they do so through either faith or arguments from philosophy, not through any scientific method.

Fr. Lemaître himself was extremely concerned about the danger of believers drawing hasty theological conclusions from his theory; he knew that it was subject to further revision.[25] In fact, today theoretical physicists explore other scenarios besides the standard Big Bang Theory. In the words of particle physicist Stephen Barr

---

[20] Robert Jastrow, *God and the Astronomers* (New York: W.W. Norton, 1992): 207.
[21] Barr, *Modern Physics*, 35.
[22] Jastrow, 14.
[23] John Paul II, Message to the Reverend George V. Coyne, S.J.
[24] John Paul II, General Audience, 10 July 1985, http://inters.org/John-Paul-II-Science-Proofs-God.
[25] Trasancos, *Particles of Faith*, 64-65.

> That the Big Bang theory is correct, however, does not necessarily settle the question of whether the universe had a beginning. There remains the possibility that the explosion that occurred 14 billion years ago was only the beginning of a certain part of the universe or a certain phase in its history, rather than the beginning of the universe as a whole. In fact, over the years many scenarios and theories [in which the Big Bang is not the Beginning] have been proposed.

In these scenarios, such as the bouncing universe, the cyclic universe and "eternal inflation" models, the Big Bang was not the beginning of time, space, and matter, but it was merely the beginning of a particular phase of the history of the universe.[26]

Many contemporary Catholic theologians and philosophers would agree with St. Thomas Aquinas that the existence of a first moment in time cannot be absolutely proven through reason unaided by faith, because it is impossible to see past something that is supposed to be the first moment to verify that it is truly first. In the words of Fr. Paul Haffner, a priest and physicist, the beginning of the universe "is like a safe with a combination-lock and the combination is locked inside the safe."[27] The words "In the beginning…" will always remain a matter of faith because of the limitations of human reason. Simply put, temporal creatures such as ourselves, "locked" within the universe's history, can only say "this is as far back in time as our science allows us to go."

So, if it is not a slam-dunk proof of either God's existence or a beginning, then why is the Big Bang Theory important for theology? Three reasons stand out. First, the Big Bang Theory is important because it may suggest that more than science is needed to explain the universe. As John Paul II once observed, the problem of the universe's beginning requires "[the kind of] human knowledge which rises above physics and astrophysics and is called *metaphysics*."[28] When one runs up against what might be the very limits of time and space, one has to confront the issue of a Cause that transcends time and space. Once again, this does not mean that the moment of the Big Bang is necessarily the beginning. But, since it is as far back as we can currently observe, it does raise the question of not only the historical beginning but also of the *origin* of the universe—what causes it to exist at all?

Second, the Big Bang Theory shows that the idea of a beginning can be made sense of scientifically, something that was not at all clear before Einstein's theory. It shows that it is not "unscientific" to ponder an act of power and creativity that is not the mere unfolding of a process *within* the realm of matter, space, and time, but actually brings matter, space, and time into existence out of nothing.

---

[26] Barr, *Believing Scientist*, 128.
[27] Paul Haffner, *Mystery of Creation*, 170.
[28] John Paul II, "Address of October 3, 1981 to the Pontifical Academy of Sciences," https://www.ewtn.com/library/PAPALDOC/JP2COSM.HTM.

Third, the Big Bang Theory shows us that time—like space and matter—is not a necessary feature of existence but merely a feature of the physical universe. Therefore, where there is no universe, there is also no time. Or, put in theological terms, time itself is something created, such that it only exists as a result of creation. This supports the traditional concept, clearly formulated by St. Augustine, of God's "timelessness." God, transcending the universe, also transcends time. *Time*, the measurement of change, does not apply to God who, being perfect, never changes. The Big Bang, as potentially the first moment in time, draws the mind to marvel with St. Augustine at the eternal mystery of God who is outside of time.

Now we can move to the next plot twist, which emerged when scientists began to theorize about the kind of events that must have happened *after* the Bang.

D. Curious Coincidences – The Setting of the Stage

The Big Bang Theory of Friedmann and Lemaître sent physics in a new direction. It is the foundation on which all of modern cosmology, which is the study of the universe as a whole and how it develops, is built. At the same time, enormous strides were being made by particle physicists in understanding the basic forces of nature, the subatomic particles of which matter consists, and the mathematical laws that govern them. Scientists could then begin to explore such fundamental questions as how matter originated and how it became formed into galaxies and stars. Strange and surprising discoveries awaited them, and many of these findings had something in common – they seemed to reveal a universe that had been fine-tuned for the possibility and existence of life, including human beings.

These surprising discoveries are commonly referred to as *anthropic coincidences*. The word "anthropic" comes from the Greek word *anthropos*, which means "human being." An anthropic coincidence is defined as a feature of the universe that is exactly what is needed for the existence of life but yet seemingly could have been otherwise.[29] Had such features been otherwise, *human beings would not exist*. Let us look at three examples of anthropic coincidences.

1. Gravity and the Big Bang

As cosmologists studied the mathematics of the Big Bang, a remarkable feature of the universe's very first moments came to light. Scientists had understood since the time of Isaac Newton that all massive objects are attracted to each other by gravity. So, as all of the energy in the universe flew apart at fantastic speeds just after the colossal explosion of the Big Bang, the attraction of gravity was trying to pull it all back together. There was therefore a competition between the outward impetus from the explosion and the inward force of gravity. This competition had to be very precisely balanced, otherwise one of two disasters would have happened. Had the gravitational attraction been too strong, it would have quickly halted and then

[29] Ibid., 25. I have modified Barr's definition slightly for clarification.

reversed the expansion, and the matter would have come crashing back together while the universe was still very tiny and new. On the other hand, had the gravity been too weak, the matter would have spread out much too quickly and stars and galaxies would not have been able to form. We would either have had no universe or one that would not support life. As Harvard astrophysicist Owen Gingerich puts it, "The balance between the energy of expansion [i.e. the force of the explosion] and the braking power of gravitation had to be extraordinarily exact…"[30]

Why so exact? The reason is that near the time of the Big Bang both the outward speed of expansion and the inward pull of gravity were vastly greater than they are now. (The outward speed was much greater back then because gravity has had 10 billion years since then to slow it down. The gravitational pull was much greater because all the matter was much more densely packed.) The gravitational pull in the moments after the Big Bang was so great that if it had not been in precise balance then it would have collapsed the universe in a tiny fraction of a second.

How exact was the balance? One way to measure it is by the temperature of the explosion. Imagine that you could have set the temperature of the Big Bang as you set the temperature of your oven. Most digitally controlled ovens will allow you to set it to a single degree. For baking a cake, this is more than enough. An oven whose temperature could be set to within a hundredth of a degree, say, would be much more sophisticated—you might find such a thing in a research laboratory, but not in a kitchen. But, for the Big Bang to happen in such a way that life as we know it could result, the "dial" had to be set not to an accuracy of a hundredth of a degree, or a millionth, or even a billionth, but to *thirty decimal places*, that is, to 0.000000000000000000000000000001 of a degree. Otherwise, *this* "cake"—this universe that was able to bring forth living things—would have been ruined. The balance necessary for our universe was so exact that it is unbelievably improbable. And, yet, exactly what needed to happen *did* happen.

2. The Strong Nuclear Force and the Building Blocks of Life

A second anthropic coincidence has to do with the origins of the building blocks of life, the formation of atoms. As scientists analyzed the process of the Big Bang and the events that followed it, much attention was focused on the structure and formation of atoms and atomic elements – hydrogen, carbon, oxygen, etc. None of the atomic elements existed at the very beginning of the universe. A few were constituted shortly after the Big Bang; all of the others were either formed within stars as they burned or in post-Big Bang explosions of stars called *supernovas.* These supernova explosions also served to spew the elements made inside stars out into space, where they could form into new stars, planets, and living things. Scientists emphasize that everything we see around us, and we ourselves, are quite literally made of stardust.[31]

The process of the formation of atomic elements began with the formation of the nuclei of these elements, each of which is made up of one or many neutrons and protons. The simplest

---

[30] Owen Gingerich, *God's Universe* (Cambridge: Harvard University Press, 2006), 49.
[31] Barr, *Modern Physics*, 119.

and earliest nucleus was that of the most basic form of hydrogen (hydrogen 1), which has a single proton as its nucleus. Then pairs of particles fused to make a two-particle nucleus – hydrogen 2. (This element is also called *deuterium*, from the Greek word *deuteros*, which means "second," because it is the second kind of nucleus.) The process of "fusion," by which smaller nuclei combine to make larger ones, continued until all of the elements were made. These fusion processes release energy and are what power the Sun and other stars—and thus they are the energy source, ultimately, for life on earth.

What interests us is the attractive force that causes protons and neutrons to stick together to form nuclei, which is called the *strong nuclear force*. Scientists discovered that the strength of this force is also fine-tuned in such a way as to make life possible. If it were only a few percent weaker, then protons and neutrons could not stick together; if it were only a few percent stronger, then the fusion processes in stars would be able to happen in a completely different way that would allow them to burn hundreds of times faster than they do. In the first case, the building blocks of life would never have formed; in the second, the Sun (and other stars) would have burned out so quickly that there would not have been time for living organisms to evolve.[32] This force *in* us seems to be *for* us.

3. Cosmic Convergence and the Chemistry of Life

With our third anthropic coincidence we move from the inorganic world of gravity and subatomic particles to the chemical foundations of the *biosphere*, the global system of living beings and their relationships, and the issue of biological evolution. In the last 30 years increasing attention has been paid by evolutionary biologists to the phenomenon called *evolutionary convergence*, "whereby unrelated [species] evolve nearly identical biological traits."[33] A classic example is the camera-type eye present in both humans and octopi that evolved in nearly identical ways. Both the human eye and the octopus eye have an iris, a circular lens, pigment cells, and photoreceptor cells, even though the evolutionary lineages of mammals and molluscs diverged before eyes evolved in either lineage.[34] Marsupial mammals in Australia and placental mammals in the Americas provide another example. These separated from some common ancestor more than 100 million years ago. Despite this massive separation of space and time, we find in these similar environments species with similar ways of life, with similarities in shape, feeding and locomotive patterns: marsupial mice and placental mice, marsupial wolves and placental wolves, etc.[35] The variation between these convergent species is minor compared to the striking similarities that they share.

---

[32] Ibid., 119-121.
[33] Conor Cunningham, *Darwin's Pious Idea: Why the Ultra-Darwinists and Creationists Both Get It Wrong* (Grand Rapids: Eerdmans, 2010), 144.
[34] Ibid., 147.
[35] "Convergence: Marsupials and Placentals," https://www.pbs.org/wgbh/evolution/ library/01/4/pdf/l_014_02.pdf.

In a series of important books, most recently his 2015 book *The Runes of Evolution,* the Cambridge paleontologist *Simon Conway Morris* has followed this trail of convergences to a remarkable conclusion: the general forms that life can develop and adapt are not haphazard but follow definite genetic and environmental pathways that were largely "predetermined from the Big Bang."[36] In other words, there is a deeper structure that makes the adventure of biological life not utterly random but orderly, somewhat like jazz music in which basic tunes (such as "When the Saints Go Marching In") are recognizable when played but are always played with innovation and creativity so that they are also a little different each time. *The Runes of Evolution* offers hundred of examples of convergence. For example, aquatic creatures developed the ability to breathe air at least 38 separate times in the history of evolution, following separate paths but converging upon the capacity for dwelling on land. Also, all of the major steps in the evolution of human beings—multicellularity, tissues, sensory systems, immune systems, eyes, limbs, and brains—are convergent.[37]

Let's focus on one such chemical convergence that makes life possible. The basic genetic code that all living things share is only one of 100 million chemical possibilities for the *nucleotides*, the nucleic acids that are the basic structural units and building blocks for DNA. And, yet, they seemed to have converged upon the right combination and structure with "eerie perfection" once all of the environmental circumstances were right for sustaining life.[38] Morris compares the surprising precision by which these chemicals converged in just the right way to the discovery of Easter Island, the most remote speck of land on earth in the earth's vastest ocean, by Polynesian seafarers 1500 years ago. Superficially, one might guess this to have been an accident, a vessel blown off course and randomly drifting, but, as anthropologist Geoffrey Irwin has demonstrated, this view is incorrect. The clever Polynesian seafarers had developed superb navigation techniques and had discovered a way to quarter the ocean, century by century, widening their net of exploration until they covered it all and came upon Easter Island. In a similar way, the nucleotides somehow "navigated" over a vast "ocean" of chemical possibilities until they converged upon the fantastically complex genetic code that all life shares. In Morris' own words

> As with the audacious and intelligent Polynesians, so life shows a kind of homing instinct. Its central paradox revolves around the fact that despite its [abundance] and… richness life is also strongly constrained. The net result is a genuine creation, almost

---

[36] Simon Conway Morris, *Life's Solution: Inevitable Humans in a Lonely Universe* (Cambridge: Cambridge University Press, 2003), 310.
[37] Ian Curran, "Headed Toward Christ: The Grand Narrative of Evolution," review of Simon Conway Morris, *The Runes of Evolution: How the Universe Became Self-Aware* (West Conshohocken, PA: Templeton Press, 2015); March 17, 2016, *The Christian Century*.
[38] Morris, *Life's Solution*, 13-19.

> unimaginably rich and beautiful, but one also with an underlying structure in which, given enough time, the inevitable must happen.[39]

The laws of physics and chemistry, therefore, seem not only fine-tuned to make life possible, but even fine-tuned to produce life. The universe, like the ancient Polynesian mariners, seems to have a kind of homing instinct for life's chemistry that is "built into" its chemical laws.

4. Anthropic Coincidences and God the Creator

We have looked at three examples of anthropic coincidences, but physicists and cosmologists have discussed many more. These coincidences have to do with strengths, ranges, and characteristics of the basic forces of nature; the masses, electric charges, and other properties of the particles that exist; the properties of space and time (for example, that time is an "arrow," and that space has three dimensions); and various other features of the laws of physics and the structure of the universe. Numerous factors have to balance just right and be in just the correct relationships to each other for the universe to produce life and human beings.[40]

Could all these anthropic coincidences really *just* be coincidences? Most people who have looked into the matter find that impossible to believe. Let us go back to the oven analogy, except now let us imagine the laws of physics are like a device with a large number of switches, knobs, and dials that control various features of the universe. One switch would turn on and off the force of electromagnetism; one dial would set the strength of that force, another dial would control the mass of the electron, and so forth. If all those switches and dials have to be set to just the right positions—some of them to fantastic accuracy—in order for life to appear, and we indeed find them set that way, is that not pretty strong evidence for a Creator who had the intention of creating a world with life in it? So it has seemed to many people, even many who did not start off believing in God. Even the famous astrophysicist Fred Hoyle (1915-2001), an atheist who came up with the term "Big Bang" as an insult to the theory and who died without ever accepting it, remarked that the universe looks like a "put-up job," i.e., something carefully arranged.

If you are unsure, consider this quote from Roger Penrose, a famous English mathematical physicist and Oxford scholar. He is describing the size of the number that represents the odds *against* the emergence of human life:

> This is an extraordinary figure. One could not possibly even write the number down in full in the ordinary… notation: it would be 1 followed by 10^123 successive 0's. *Even if we were to write a 0 on each separate proton and on each separate neutron in the entire*

---

[39] Ibid., 20.
[40] Collins, 74.

universe—and we could throw in all the other particles for good measure—we should fall far short of writing down the figure needed.[41]

Do the anthropic coincidences "scientifically prove" that God exists and so designed the laws of the universe that life and human beings would emerge? As we learned in regard to the Big Bang Theory, that would be saying too much. In fact, some scientists have already proposed a way to explain some of the anthropic coincidences without invoking God. It is called the "multiverse" hypothesis.

The multiverse idea can be explained with the same control-panel analogy we used before. Suppose that all those "switches" and "dials" are not set to the same positions everywhere in the universe but, instead, vary randomly from place to place. For example, the strength of the strong nuclear force might be different here and in parts of the universe very far away. (They would have to be *very* far away indeed, since there is conclusive evidence that in all the places we can see with telescopes the "dial settings" are the same as here.) If so, then in most places in the universe the dial settings would be wrong for life, but if the universe were big enough, then there might be some places where the dial settings were just right for life to be possible. In other words, if you buy enough lottery tickets, one is bound to be the "lucky ticket."

The multiverse idea is interesting, but it is not yet a testable scientific theory, and it is hard to see at present how it could ever become one. However, even if it turned out to be true, then it would not really explain away the anthropic coincidences. The point is that a "multiverse", i.e., a universe some of whose "switches" and "dials" were set differently in different places, is a very strange kind of universe and probably could not arise unless some *other* switches and dials were set to special values. The lesson of the anthropic coincidences is that a universe that can give rise to life probably has to be very special indeed.

The seeming fact that the universe had to be extremely precise, fine-tuned "just so" for human beings to exist, seems suspiciously like a plan. The anthropic coincidences leave one with the overwhelming impression that, contrary to scientific atheism, the universe's fine-tuning was built in by a "Fine-Tuner"—God the Creator, who made the universe for the sake of life and humanity. In this regard, we must recall that such "fine-tuning" should not be understood as God violating the integrity of nature by constantly intervening through miracles; rather, God upholds in existence a universe that naturally fulfills his will. In the words of the International Theological Commission, "God's action does not displace or supplant the activity of creaturely causes, but enables them to act according to their natures and, nonetheless, to bring about the ends he intends."[42] God does not need to tinker with the universe that He wills into existence; rather, He wills a universe into existence that is what he desires it to be, a wisely-ordered universe that is capable of producing and sustaining life. In the words of Nobel prize-winning physiologist George Wald:

---

[41] Roger Penrose, *The Emperor's New Mind*, rev. ed., (Oxford: Oxford University Press, 1989), 445-446.
[42] *Communion and Stewardship*, no. 68.

> …mind, rather than emerging as a late outgrowth in the evolution of life, has existed always, as the matrix, the source and condition of physical reality—that the stuff of which physical reality is composed is mind-stuff. It is mind that has composed a physical Universe that breeds life, and so eventually evolved creatures that know and create: science-, art-, and technology-making animals.[43]

Or, as St. Paul says of Christ in his Letter to the Colossians (1:16), "For in him were created all things in heaven and on earth, the visible and the invisible…; all things were created through him and for him." The anthropic coincidences, when considered with the eyes of faith, are reflective of the Divine Mind, the Son-*Logos* through whom the universe is created and sustained in its existence.

E. Beauty Beyond Description: Symmetry, Modern Physics, and the Argument from Design

In Chapter 13 of the Book of Wisdom, written just 50-100 years before the birth of Jesus, the sacred author condemns nature worship, the pagan practice of worshipping natural forces as if they were divine beings. He then goes on to suggest a proper way in which beauty in the natural world can lead us to worship the one true God:

1 Foolish by nature were all who were in ignorance of God, and who from the good things
that we see did not succeed in knowing the One who is, and from studying the artworks did not
recognize the Artist.
2 Instead they assumed that fire, or wind, or the swift air, or the circuit of the stars, or the
mighty water, or the luminaries of heaven, the governors of the world, were gods.
3 Now if out of joy in the beauty of these they thought they were gods, let them know how
far more excellent is the Lord than these; for the LORD, the Original Source of beauty, fashioned
them.
4 Or if they were struck by their might and energy, let them realize from these things how
much more powerful is the One who made them.
5 For from the greatness and the beauty of created things their Original Author, by analogy,
is seen.

What is meant here by "the beauty" of created things? The ancients defined *beauty* as the proper relationship between the parts of something and the whole. Beauty is the splendor we discover when we see order and harmony in things. Think of a beautiful face, or a beautiful piece

---

[43] George Wald, "Life and Mind in the Universe," *International Journal of Quantum Chemistry Biology Symposium* 11 (1984): 1-2.

of music, and you get the idea. As the author observes in verse 3, such beauty causes joy. God is seen by analogy in the beauty and greatness of created things.

In our own day, scientific atheists would disagree. They see the world as governed not by a loving, personal God but by blind and impersonal forces, mechanisms, and processes. Everything, they believe, can be explained by a combination of mathematical laws and pure chance. An ordinary person might point to some beautiful natural phenomenon—a gemstone, a rainbow, an *aurora borealis*, the harmonious movements of the planets—and say, along with the Book of Wisdom, "Here, clearly, is evidence of the divine Artist at work." Scientific atheists, while not denying the beauty of these things, would answer, "We do not need to invoke any Artist, because we know exactly how these things arise. We understand the forces and principles that cause those gemstones and rainbows to form; and we know that those forces and principles are merely natural, the products of blind chance." The scientific atheist does not deny that there are elegant patterns, harmonious structures, beautiful forms, and remarkable examples of order to be found in nature. He thinks, however, that they can all be explained, ultimately and exhaustively, by the laws of physics.

This is where the next plot twist comes in. In the twentieth century one discovery after another revealed that the very laws of physics *themselves* exhibit patterns even more elegant, structures even more harmonious, forms even more beautiful, and order far more remarkable than those that they were invoked to explain. It turned out that, in discovering the laws of physics, scientists did not "explain away" the beauty and order that was visible in nature, but they instead uncovered a beauty within the depths of nature much greater than that which is visible on its surface.

Let us look at one example. Consider the harmonious movements of the planets. At the beginning of the seventeenth century, *Johannes Kepler* (1571-1630) unlocked the secrets of these movements and published his three great Laws of Planetary Motion. (One of these was that the planets went around the Sun in elliptical orbits, with the Sun at the "focus" of the ellipse. The second was that in its course around the Sun a planet always "sweeps out equal areas in equal times." The third was a precise algebraic relationship between the time it takes a planet to orbit the Sun and its distance from the Sun.) Kepler himself saw these as magnificent examples of divine artistry. He exclaimed in his great treatise entitled *Harmonices mundi* (The Harmonies of the World), "I thank thee, LORD God our Creator, that thou allowest me to see the beauty in thy work of creation."

More than eighty years later, Isaac Newton articulated his Universal Laws of Motion and the Law of Gravitation. These explained all three of the laws of Kepler and much else about the movements of the heavenly bodies. But, in fact, the laws Newton discovered were far more majestic and mathematically elegant than even the laws that Kepler had discovered and which had made Kepler cry out in praise of his Creator.

And this is only the beginning of the story. For, as we have seen, more than two centuries later Einstein found that Newton's laws did not exhaust the richness of the phenomenon of

gravity. He showed that Newton's law of gravity was just an approximation to a much more beautiful and profound theory of gravity in which gravity was caused by the curvature of spacetime described by Einstein's Equations. Since then, evidence has begun to emerge in recent decades that Einstein's theory is itself but a piece of some even deeper and more remarkable mathematical structure. This newer theory (which is still untested) is so mathematically rich that one of the leading theorists, Edward Witten, proclaimed its "wonder, incredible consistency, remarkable elegance, and beauty."[44]

This is the third twist in the plot: the deeper into nature that science has penetrated, the *more* beauty it has uncovered. This is why, as the twentieth century unfolded, fundamental physicists began to be guided in their search for deeper laws more and more by the criterion of beauty. Stephen Barr describes how one of the greatest discoveries of twentieth century physics, the Dirac Equation, was found:

> The physicist *Paul Dirac* [1902-1984] was seeking an equation to describe electrons in a way that would be consistent with the principles of relativity theory. In this search he was guided primarily by mathematical beauty: "A great deal of my work is just playing with equations and seeing what they give," he said. In this case, as he was playing with some equations he found something "pretty." "[It] was a pretty mathematical result. I was quite excited over it. It seemed that it must be [of] some importance." *Notice that it was the "prettiness" of the mathematics that convinced him he was on the right track* [italics mine]. Soon after, he found the great equation…[45]

In fact, Dirac famously remarked that it was more important to have "beauty in one's equations" than to have them fit one's experiments. *Werner Heisenberg* (1901-1976), one of the founders of quantum mechanics, also stressed the importance of the criterion of beauty in physics. He wrote, "In exact science, no less than in the arts, beauty is the most important source of illumination and clarity."

Some people have argued that the beauty referred to by physicists like Dirac is a purely subjective judgment, one based on personal taste. Maybe scientists come to think that their theories are beautiful just because they discovered them, that is, out of some kind of vanity. But, there is a powerful argument against this: Dirac did not see the beauty *after* he discovered the equation, it was the beauty that *led* him to the equation.

In fact, this has happened many times accidentally. Again and again throughout history, mathematicians have come up with mathematical ideas and developed branches of mathematics purely for the sake of their "mathematical beauty" without ever dreaming that they had any relevance to the physical world, only to have it discovered much later that these mathematical formulations were needed to express fundamental laws of physics. For example, the idea of

---

[44] Quoted in John Horgan, *The End of Science* (New York: Addison-Wesley, 1996), 69.
[45] Barr, 23.

"complex numbers" was invented and thoroughly investigated by the early 1800s, at which time they seemed to have no relevance to physical reality at all. However, in the 1920s it was discovered that they were needed to write the equations of quantum mechanics.

In 1852, a system of numbers called quaternions were invented by the mathematician *William Rowan Hamilton* (1805-1865). Quaternions seemed to be a very elegant, but scientifically useless, piece of mathematics, until it was found that quaternions were needed to describe the way electrons and similar particles "spin," as well as other properties of subatomic particles. These and many other examples reveal that the beauty found in the laws of physics, the artistic perfection of their design, is so perfect that it seems to be accessible in some cases simply through mathematical creativity.

Hermann Weyl (1885-1955), one of the great mathematicians of the twentieth century, who also played a leading role in theoretical physics, once said the following in a lecture in 1931

> Many people think that modern science is far removed from God. I find on the contrary, that it is much more difficult today for the knowing person to approach God from history, from the spiritual side of the world, and from morals; for there we encounter the suffering and evil in the world, which it is difficult to bring into harmony with an all-merciful and all-mighty God. In this domain we have evidently not yet succeeded in raising the veil with which our human nature covers the essence of things. But in our knowledge of physical nature we have penetrated so far that we can obtain a vision of the flawless harmony which is in conformity with sublime reason.[46]

What Hermann Weyl is saying here, and what Kepler was saying in his book *Harmonices Mundi*, is that the beauty, harmony, and order in the world are a sign of its creation by a Mind, by "sublime reason." This is a very ancient argument for the existence of God, sometimes called the "Argument from Design." It can be found in Sacred Scripture, particularly in Proverbs 8:22-31, Jeremiah 33:25-26, and Wisdom 11:20. We saw it clearly presupposed in the First Creation Account, where God's designing intelligence and awesome power is described as bringing the world and its creatures into existence – as we saw in Chapter 4, even the shape of the story, its symbolic structure, reveals God's design. This idea is also found in many places in the writings of early Christians. For example, at the beginning of the third century AD, the Catholic theologian *Minucius Felix* (died c. 250 AD) wrote

> If upon entering a home you saw that everything there was well-tended, neat, and decorative, you would believe that some master was in charge of it, and that he was himself much superior to those good things. So too in the home of this world, when you see providence, order, and law in the heavens and on earth, believe that there is a LORD

[46] Herman Weyl, *The Open World: Three Lectures on the Metaphysical Implications of Science* (New Haven, CT: Yale University Press, 1986), 28-29.

> and Author of the universe, more beautiful than the stars themselves and the various parts of the whole world.[47]

As found in Sacred Scripture and in early Christian writings, the argument is primarily based on the fact that the universe as a whole is orderly, lawful, harmonious, and beautiful.

In the eighteenth and early nineteenth centuries, however, some Anglican theologians and philosophers began to make the argument in a narrower and more questionable way. They pointed to specific *things*—especially living things—as evidence that God had directly *intervened* in nature in a supernatural way to produce them. The argument was that these things were too complex to have been the products of natural processes. The Anglican theologian *William Paley* (1743-1805) gave one of the most famous examples of such reasoning. In his book *Natural Theology* he compared the complexity found in living things to the complexity of a pocket watch one might find lying in a field where it had been lost. No one, Paley argued, would conclude that it, unlike a stone in the field, was made by natural forces acting at random: "There must have existed, at some time, and at some place or other, an artificer or artificers, who formed [the watch] for the purpose which we find it actually to answer; who comprehended its construction, and designed its use…" In other words, living things are too complex to have emerged naturally; God must have made them directly. (Often, when people think of "the Argument from Design, they have Paley's ideas in mind.)

We have already seen in Chapter Five that this runs contrary to the Catholic approach, which has always upheld the integrity of nature. The trouble with Paley's argument is that it pits "design" *against* "nature" and "law"—it assumes that nature is chaotic and that, when we find complex and beautiful things in it, they stand out as proof that a Designer exists. Yet this is not what Minucius Felix meant in his quote above, which points to nature itself as designed and lawful. It was precisely this natural "order and law in the heavens and on earth" that points to God for the Catholic tradition.

Paley's narrowing and distorting of the emphasis of the "Argument from Design" had very unfortunate consequences, which we shall see in more detail in the next chapter on God and evolution. When Charles Darwin showed how the structures of living things might be explained naturally (just as others had shown that structures found in the inanimate world, such as the solar system, could be), it led him and others to think that the Design Argument for God had been refuted. The only thing that had been refuted was Paley's version of the design argument. The irony is that twentieth century discoveries in physics and cosmology have actually given splendid examples of the older and deeper version of the design argument. For they have shown that the "order and law in the heavens and on earth" is much more profound and impressive than anyone had ever imagined. Indeed, as Hermann Weyl said, the laws of physics give us "a vision of the flawless harmony which is in conformity with sublime reason."

---

[47] Minucius Felix, *Octavius* 18.4 as quoted in Barr, *Modern Physics,* 68-69.

The physicist Stephen Barr uses a single term to sum up this great beauty uncovered by twentieth century physics – *symmetry*, a word that means "equal measure" in Greek. All order that we see, including the beautiful complexity of living creatures, comes from and is founded on the greater order of the universe's fundamental symmetry, the symmetry of the laws of nature.[48] In his words, "we do not live in a universe with a great deal of order. We live in a universe whose order is *perfect*, or nearly so…" As we continue, we will reencounter the concept of symmetry, which is very helpful for seeing how science and faith, nature and spirit, creation and redemption, fit each other with "equal measure." Symmetry and beauty are crucial to rediscovering faith on the frontiers of science.

Here is Barr's recapitulation of the Argument from Design, based on the latest and the best science:

> At the roots of the physical world, therefore, one does not find mere… slime or dust but instead a richness and perfection of form based on profound, subtle, and beautiful mathematical *ideas*. This is what the famous astrophysicist Sir James Jeans meant when he said many decades ago that "the universe begins to look more like a great thought than a great machine." [Pope] Benedict XVI expressed the same basic insight when in his Regensburg lecture he referred to "the mathematical structure of matter, its intrinsic rationality…"
>
> It is true that the cosmos was at one point a swirling mass of gas and dust out of which has come the extraordinary complexity of life as we experience it. Yet, at every moment in this process of development, a greater and more impressive order operates within—an order that did not develop but was there from the beginning. In the upper world, mind, thought, and ideas make their appearance as fruit on the topmost branches of an evolutionary tree. Below the surface, we see the taproots of reality, the fundamental laws of physics that shimmer with ideas of profound simplicity… And we begin to discover that matter, although mindless itself, is the product of a Mind of infinite profundity and infinite simplicity.[49]

The Creator is the Mind behind the universe, not merely an all-powerful mechanic. And, his "thoughts" as Creator are discovered in the beauty of nature's laws, which are a dim reflection of the perfect beauty of the Son-*Logos*, God's eternal Word.

F. Conclusion – From the Universe to the Biosphere

In this chapter we have seen how the journey of two small bands of scientists at the end of World War I moved human thought in directions that no one anticipated. Scientists began to ask the ultimate scientific questions about the nature of space and time, the earliest state of the

---

[48] Barr, *Modern Physics*, 80-81.
[49] Barr, *Believing Scientist*, 166-167.

universe, and the deep mathematical structure of its laws. Far from making theological and philosophical reflection irrelevant, these discoveries suggested new applications and clarifications of classical philosophy and theology. The Big Bang stimulated theologians to clarify the difference between the beginning of time and the ultimate origin of the universe; the anthropic coincidences and the beauty of the universe's laws provided opportunities to see the Hand of the Creator who works through his creatures to bring about his will; the profound beauty found in the mathematical structure of the universe gave evidence of Divine Beauty in ways previously unknown. Scientific atheism, which seemed to many to be compelled by the discoveries of nineteenth century science, turned out to be a superficial reaction in the light of twentieth century physics.

Physics, however, is not the only science in which the existence of God and the truth of the Christian Faith has falsely seemed to be in danger of being swept away by the currents of progress. This is even more so in biology. The greatest controversy in the relationship between faith and science centers around the theory of biological evolution. For over a century, American society has been the site of a great culture war, fought in print, from pulpits, in legal courts and even in politics regarding the compatibility of evolution and the Christian Faith, a war that still rages today. Is evolution the final nail in the coffin of Christian belief? Or, is evolution another example of God's wisdom, love and power, the "disguised friend of faith," as Christian theologian and biochemist Arthur Peacocke once called it? In the next chapter, we will address this crucial issue.

Chapter Seven
The Twist in the Tale:
Modern Science *versus* Scientific Atheism

I. VOCABULARY

Define the following terms:

1) General Theory of Relativity
2) Cosmological Constant
3) Edwin Powell Hubble
4) Georges Lemaître
5) Big Bang Theory
6) Spacetime
7) Ab Initio Temporis
8) Arno Penzias and Robert Wilson
9) Time
10) Anthropic Coincidences
11) *Anthropos*
12) Supernovas (atom formation)
13) Deuterium
14) Strong Nuclear Force
15) Evolutionary Convergence
16) Simon Conway Morris
17) Protein Folding
18) DNA
19) Nucleotides
20) Multiverse Hypothesis
21) Book of Wisdom
22) Beauty
23) Johannes Kepler (*Harmonices mundi*)
24) Paul Dirac (Dirac Equation)
25) Werner Heisenberg
26) William Rowan Hamilton (Quaternions)
27) Hermann Weyl
28) Argument from Design
29) Minucius Felix (Argument from Design)
30) William Paley
31) Stephen Barr (Symmetry)

II. STUDY QUESTIONS

Section A

1) What major changes occurred in science in the twentieth century? Why are they significant for the relationship between faith and science?

Section B

2) Why did the discovery of the laws of the conservation of matter and energy lead many nineteenth century scientists to assert that the universe had no beginning?
3) Is the idea of a perpetual universe necessarily atheistic? If not, how can it be reconciled with belief in God?
4) How is the idea of a perpetual universe an obstacle to belief in the authority of Scripture and the Church?
5) What kind of causality leads logically to the conclusion that there must be an Uncaused Cause? How is this related to the issue of whether or not the universe has a beginning?

Section C

6) How did the Big Bang Theory originate?
7) Describe the major features of the Big Bang Theory regarding space and time.
8) Describe St. Augustine's explanation of time as it relates to the Big Bang Theory.
9) How was the Big Bang Theory finally confirmed?
10) Why did it take so long for the Big Bang Theory to gain acceptance? What does this reveal about the blind "faith" inherent in materialism and scientific atheism?
11) Why is the Big Bang Theory a major crack in the materialist worldview?
12) Does the Big Bang Theory prove the existence of God? Why or why not?
13) Does the Big Bang Theory prove that the universe had a first moment in time? Why or why not?
14) List three ways in which the Big Bang Theory is important for rediscovering faith on the frontiers of science.

Section D

15) In what new direction did the Big Bang Theory send physics?
16) Why is the role of gravity in the Big Bang considered an anthropic coincidence?
17) Why is the strong nuclear force considered an anthropic coincidence?
18) Describe how the chemistry of life can be understood as an anthropic coincidence.
19) Using the device analogy, explain why it is unlikely that the anthropic coincidences are really just coincidences.
20) Do the anthropic coincidences scientifically prove the existence of God? Why or why not?
21) In the light of faith, how can the anthropic coincidences be interpreted as reflective of divine wisdom and of the Son-*Logos*?

Section E

22) Summarize Wisdom 13:1-5 and its message about the beauty of nature as leading to God.

23) How do scientific atheists explain the phenomenon of beauty in the universe?
24) What has modern science revealed about beauty in the universe? What does this fact imply?
25) Describe the processes of discovery in science and mathematics regarding beauty in the universe. Why does this process reinforce that the discovery of beauty is not simply a matter of purely personal taste?
26) What mistake was made in the eighteenth and nineteenth centuries by philosophers and theologians (e.g., William Paley) regarding the Argument from Design? What did this mistake fail to recognize?
27) Where does the beauty that we see around us come from, according to modern physics?
28) Restate the Argument from Design, using a) the notion of symmetry and b) the discovery of beauty and order in the laws governing the universe.

III. PRACTICAL EXERCISE

1) Rampant materialism created blinders for the scientific community that kept many from accepting the Big Bang. What other natural truths about the universe might be inaccessible to materialists? (Note: list only philosophical and scientific truths.)