THE BIG BANG AND HOW THE WORLD BEGAN

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As a child, I first began to entertain doubts about the existence of God when I discovered that my parents—who had vouched for his existence—were not being truthful about Santa Claus. My efforts to verify with my own eyes the existence of this jolly old man being pulled around by a group of flying reindeer were as unsuccessful as my attempts to accept wholeheartedly the equally incredulous stories from the Bible.

As I struggled with my doubts about God, I began to envy those biblical characters who saw firsthand the raising of Lazarus, tasted the wine that had been water only minutes before, or walked through the parted waters of the Red Sea. Their experiences easily informed and confirmed their beliefs. However, most of us who demand to see a miracle must be content with something a bit more indirect—in the same way that the police solve crimes with fingerprints or the proverbial "smoking gun" left behind at a crime scene.

In time I found answers to my questions. I eventually learned that we could see back in time almost to the extent of being a witness to God's first miracle, virtually fulfilling my childhood wish.

Through the advances of science, we can now see the smoke from the gun, so to speak, that points to the creation event Moses described in the very first verse of the Bible: "In the beginning, God created the heavens and the earth."[1]

But how can we see evidence of the beginning? And how can we know it was a miracle, not just a natural occurrence? The answer is an exciting story of scientific discovery—one that provides a compelling reason for Christians to know their faith is not blind. Let's begin with an explanation of the Big Bang—the event cosmologists agree was the beginning of time, space, matter and energy—and then see how we can look back to the dawn of time.

WITHIN ITS FIRST SECOND OF EXISTENCE, THE UNIVERSE UNDERWENT A RAPID INFLATION AND HAS BEEN EXPANDING EVER SINCE.

The Big Bang

In 1929, Edwin Hubble discovered that the universe is expanding—that is, the galaxies are flying apart from each other. What does this mean? Well, as Hubble realized, "this meant that there must have been an instant in time (now known to be about 14 billion years ago) when the entire universe was contained in a single point in space."[2] Within its first second of existence, the universe underwent a rapid inflation and has been expanding ever since.

[1] *The Holy Bible*, New International Version © 2011, Genesis 1:1. Moses wrote Genesis in ancient Hebrew. The Hebrew word for "create" used in this instance is *bara*. The claim that Moses makes is that God created everything from nothing. Subsequent verbs used throughout the Bible imply creation from preexisting materials (i.e., from the materials created in Genesis 1:1).

[2] "The Big Bang," *NASA*, http://science.nasa.gov/astrophysics/focus-areas/what-powered-the-big-bang/

The discovery that the universe had a beginning and is expanding from a point smaller than the period at the end of this sentence was derisively called the "Big Bang" by a scientist with a rival explanation.[3] To the chagrin of many, the name has stuck.

THE BIG BANG IS NOW THE DOMINANT THEORY EXPLAINING THE ORIGIN OF THE UNIVERSE, INCLUDING ALL MATTER, ENERGY, SPACE, AND TIME ITSELF.

Until 1965, the Big Bang theory competed with other theories that were based on the assumption of an eternally existing universe. However, when Arno Penzias and Robert Wilson discovered the cosmic background radiation predicted by Big Bang theorists (which we will discuss more later), these competing theories lost their support among most cosmologists.

The Big Bang is now the dominant theory explaining the origin of the universe, including all matter, energy, space, and time itself.

The Role of Astronomy in Observing the Past

While historians use documents and archaeology to tell us about the past, the artifacts they inspect are as stuck in the present as the objects that any group of scholars studies—except, that is, astronomers. Even those of us who do no more than appreciate a beautiful sunset are seeing those lingering rays from the sun as it *was*, not *is*, some eight minutes before.[4]

Because it takes time for light to travel—one second to travel 186,000 miles, to be precise—the farther away an object is, the longer the lag time between what we see and the present. On a starlit night when we gaze at the brightest and nearest stars in our Milky Way galaxy, we are seeing them as they *were* several years ago. When our eyes come to rest on the tiniest and most remote stars in our galaxy, we are seeing them as they *were* tens of thousands of years ago. With the aid of a telescope, we can see light from stars in the galaxy nearest to our own, the Andromeda galaxy. This light began its journey some 2.8 million years ago.[5] That is, we are essentially observing in the present what happened 2.8 million years ago.

[3] Fred Hoyle coined the term "Big Bang" in 1950. He used the phrase derisively to refer to what was then a rival theory to his own "steady state" theory. The steady state theory allows for an eternal existence of matter as well as its continuous creation. It therefore avoids the need for a beginning—and hence a Beginner. See "Big Bang or Steady State? Creation of the Elements," *American Institute of Physics*, http://www.aip.org/history/cosmology/ideas/bigbang.htm for a discussion of Hoyle and his opposition to the Big Bang.

[4] In other words, if the sun were to be instantly extinguished, we would not be visually aware of that fact for eight minutes. Because light travels at 186,000 miles per second, each photon emitted from our sun—which is 93 million miles away—requires just over eight minutes to reach our eyes. Because the moon is much closer (only about 240,000 miles from Earth), the light from the moon (which is reflected from the sun) takes less than two seconds to reach our eyes. For a discussion of the distance to the moon and how it is measured, see Fraser Cain, "What is the Distance to the Moon?" *Universe Today*, June 29, 2013, http://www.universetoday.com/103206/what-is-the-distance-to-the-moon/.

[5] See David Palmer, "Ask an Astrophysicist," *NASA Goddard Space Flight Center*, last updated April 20, 1998, http://imagine.gsfc.nasa.gov/docs/ask_astro/answers/980420c.html for a discussion of the distance to the nearest galaxy outside of our own and how this is determined.

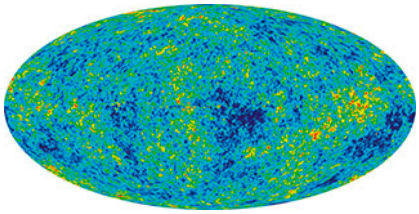
But seeing with our naked eye the most remote star in the billions that comprise our galaxy is only a very small step in our journey to observe "the beginning" to which Genesis 1:1 refers. In 2004 the Hubble telescope zoomed in on a patch of night sky about 1/100 the size of the moon in order to peer some 13 billion light-years away at stars that have long since burned out.[6] The resulting image is called the Hubble Ultra Deep Field. The light from those most distant stars began their journey when the universe was a "mere" 400 million years—about 2 percent of its present age.[7] Before that time, cosmologists say, there was no visible light.

Let There Be Light

What we see as light is a part of a spectrum of electromagnetic waves that is directly visible to our eyes.[8] By using another part of this electromagnetic spectrum, we can see even farther out into space and thus back in time—moving ever closer to Genesis 1:1.

As previously stated, in 1965 Arno Penzias and Robert Wilson discovered the cosmic microwave background radiation (CMBR) predicted by the Big Bang theory. Cosmic background radiation is the thermal radiation thought to be left over from the Big Bang. "The microwave radiation is only 3 degrees above Absolute Zero . . . and is uniformly perceptible from all directions. Its presence demonstrates that that our universe began in an extremely hot and violent explosion, called the Big Bang, 13.7 billion years ago."[9]

This discovery confirmed in the minds of most cosmologists that all matter, energy, space, and time itself began at a finite point in the past. The similarity with the claims of the first verse of the Bible did not go unnoticed by Penzias, as we'll discuss later.



Credit: NASA / WMAP Science Team

Just as a physician relies on ultrasounds to "see" a baby in the womb, astronomers can see the baby universe through a portion of the electromagnetic spectrum. From 2001 to 2011 the Wilkinson Microwave Anisotropy Probe (WMAP) gathered variations in the temperature of the cosmic microwave background radiation.[10] According to NASA, "WMAP's 'baby picture of the universe' maps the afterglow of the hot, young universe at a time when it was only 375,000 years old, when it was a tiny fraction of its current age of 13.77 billion years."[11]

6 "Hubble Digs Deeply, Toward the Big Bang" *NASA*, last updated March 9, 2004, http://www.nasa.gov/vision/universe/starsgalaxies/hubble_UDF.html.

7 The time from the creation event to when the stars first began to shine, causing visible light, has been estimated to be 400 million years. See "WMAP Produces New Results," *NASA*, last updated April 8, 2013, http://map.gsfc.nasa.gov/news/.

8 An excellent plain-language description of light as it relates to electromagnetic fields is discussed in William Harris and Craig Freudenrich, PhD, "How Light Works," *How Stuff Works*, http://science.howstuffworks.com/light.htm.

9 "The Large Horn Antenna and the Discovery of Cosmic Microwave Background Radiation," *American Physical Society*, http://www.aps.org/programs/outreach/history/historicsites/penziaswilson.cfm.

10 See "WMAP Facts," *NASA*, April 16, 2010, http://map.gsfc.nasa.gov/news/facts.html. To see the "baby picture," see "CMB Images," *NASA*, last updated April 14, 2014, http://map.gsfc.nasa.gov/media/121238/index.html.

11 "WMAP Produces New Results." Before this time, the universe was filled with free electrons that had not yet attached to protons to form the first atoms. Those free electrons and protons absorbed the electromagnetic radiation—that is, the photons—left over from the universe's beginning. After the universe cooled sufficiently, the electrons and protons combined to form atoms. This happened 375,000 years after the universe formed and is called the Recombination Era. The photons were then able to travel freely without being absorbed by electrons or protons; that is what we observe as the cosmic microwave background radiation.

Beyond the Splotches

No doubt the splotchy orange and yellow clumps in the WMAP image are a bit of a disappointment if you were expecting something akin to Michelangelo's *Creation of Adam* on the ceiling of the Sistine Chapel.[12] But just as a skilled pediatrician looking at an ultrasound of an expectant mother sees much more than a pulsing blob, a scientist who appreciates the significance of those splotches may be led—in the words of one astronomer—to see "the fingerprint of God."[13]

WHAT WE SEE AS LIGHT IS A PART OF A SPECTRUM OF ELECTROMAGNETIC WAVES THAT IS DIRECTLY VISIBLE TO OUR EYES.

George Smoot first mapped the CMBR with the Cosmic Background Explorer (COBE) satellite, which was a precursor to the WMAP satellite. After seeing the splotches on the CMBR map, he made a famous statement along the same lines: "If you're religious, it's like seeing God."[14]

Edwin Hubble's successor, astronomer Allan Sandage, expressed a similar feeling. Sandage actually came to a belief in God and ultimately faith in Christ by recognizing that the so-called Big Bang is indeed the creation event. Sandage said, "I find it quite improbable that such order came out of chaos. There has to be some organizing principle. God to me is a mystery but is the explanation for the miracle of existence, why there is something instead of nothing."[15]

The Smoking Gun

Arno Penzias and Robert Wilson shared the 1978 Nobel Prize in physics for their 1965 discovery of the background radiation that confirms the Big Bang cosmology. Penzias said of the significance of the find: "Astronomy leads us to a unique event, a universe which was created out of nothing, one with the very delicate balance needed to provide exactly the conditions required to permit life, and one which has an underlying (one might say 'supernatural') plan."[16]

In March 2014, the world of science took another step backward in time up to what the British publication *The Observer* heralded as the sighting of "indirect evidence of gravitational waves, or ripples in space-time, from the earliest moments of the universe."[17] These ripples support the claim that within the first second of the cosmic creation event, the universe underwent a rapid expansion. Our quest to "see" the beginning has reached its end. Scientists were quoted as claiming this as the "smoking gun" to support a particular model of Big Bang cosmology and with it, a beginning to space, time, energy, and matter.[18]

[12] You can see and learn more about this piece at "The Creation of Adam," *Michelangelo Gallery*, https://www.michelangelo-gallery.com/creation-of-adam.aspx.

[13] Hugh Ross, *The Fingerprint of God* (Orange, CA: Promise Publishing Company, 1991).

[14] George Smoot, *Wrinkles in Time* (New York: Avon Books, 1998), 289.

[15] J. N. Willford, "Sizing Up the Cosmos: An Astronomer's Quest," *New York Times*, March 12, 1991, p. B9.

[16] H. Margenau and R. A. Varghese, eds., *Cosmos, Bios, and Theos* (La Salle, IL: Open Court, 1992), 83. A list of similar quotes from astronomers on the theistic implications of the Big Bang can be found at Richard Deem, "Quotes from Scientists Regarding the Design of the Universe," *Evidence for God,* last modified June 21, 2007, http://www.godandscience.org/apologetics/quotes.html#n09.

[17] Ian Sample, "Gravitational waves discovery: 'We have a first tantalising glimpse of the cosmic birth pangs," *The Observer*, March 22, 2014, https://www.theguardian.com/science/2014/mar/23/primordial-gravitational-waves-tantalising-cosmic-birth-big-bang.

[18] Ibid.

A Supernatural Origin

Why would Penzias, Sandage, and other prominent scientists[19] conclude that Big Bang cosmology is evidence of something supernatural and not—as some Christians and all atheists claim—a naturalistic alternative to Genesis 1?[20] There are two lines of evidence that point toward a supernatural origin to the cosmos. The first employs simple logic; the second is an examination of an astounding example of fine-tuning.

A Beginning Requires a Beginner

The more logical side of the cosmological argument for the existence of God begins with the following statement: "Everything that begins to exist has a cause outside of itself."[21] It is difficult to argue with this since we know of no exceptions.[22]

"IF YOU'RE RELIGIOUS, IT'S LIKE SEEING GOD." —GEORGE SMOOT

If, as cosmologists now largely agree, all matter, energy, space, and time itself began with the Big Bang, then it, too, must have a cause outside of itself. If all of nature is composed of matter, energy, space, and time, then this cause is by definition supernatural (that is, outside of nature), eternal (not limited by time), and omnipotent (as powerful as the force expanding the universe).

The list of supernatural, eternal, and omnipotent "suspects" is short indeed.

[19] Quotes from other scientists on the theistic implications of fine tuning can be found at "Mind Expanding Quotes on a Fine-Tuned Universe & Biosphere," *Graduate Christian Union*, March 5, 2013, https://: https://ubcgcu.org/2014/08/22/mind-expanding-quotes-on-fine-tuning/.

[20] Some Christians oppose the concept of the Big Bang for either or both of two reasons. The first is that Big Bang cosmology requires a time span of approximately 14 billion years, whereas young earth creationists interpret the Bible to mean the universe is only 6,000 to 10,000 years old. The second reason is that they do not understand the theistic implications of the Big Bang and assume that it is offered as an alternative to the Genesis creation account. Traditionally, many atheists have opposed the Big Bang cosmology because they *do* understand the theistic implications. As evidence has mounted in support of the Big Bang, their counter to special creation is that while our universe has a beginning, there is some form of eternal generation of universes taking place; ours is special only because it supports life. Because there is no way to access universes beyond our own, even if they do exist, their explanation can be regarded as an act of faith.

[21] The cosmological argument for the existence of God comes in many forms. The Big Bang provides scientific support to what was originally a philosophical argument. For more information, see "Arguments for the existence of God (Part 2): Cosmological arguments," *That Religious Studies Website*, https://thatrswebsite.blogspot.com/2015/03/a-brief-review-of-arguments-for_13.html.

[22] One counter to the cosmological argument that atheists employ is the insistence to theists that they provide an explanation for the existence of God. It is usually posed as, "Who or what created God?" There are several lines of response; one involving science is presented by astronomer Hugh Ross. See Hugh Ross, "Q&A: Who Created God?" *Today's New Reason to Believe*, April 7, 2014, https://tnrtb.wordpress.com/2014/04/07/qa-who-created-god/. A more philosophical response draws upon the impossibility of actual infinity and concludes that there cannot be an infinite regression of causes. There must be, at some point, an Uncaused Cause. In this case, it is best to lead off the cosmological argument with the premise, "All things that *begin to exist* must have a cause outside of themselves." If we were to omit the phrase "begin to exist" we would arguably be including God in the list of things that need a cause. God is self-existent and eternal.

Finely-Tuned Expansion

Scientists have also stumbled upon a clincher in the argument that it must have been an intelligent designer who brought the universe into existence out of nothing. Following in the footsteps of Edwin Hubble, astronomers began to determine how quickly the universe is expanding and the significance of this rate of expansion.[23]

One way to understand the rapidly receding galaxies is to compare them to a hand grenade exploding and sending shrapnel in all directions. This misses several finer points, however, including the most compelling: how incredibly fine-tuned this "explosion" had to be to give us a universe of stars, planets, and an environment capable of sustaining life. If the expansion rate of the creation event were off by the tiniest amount, either gravity would have caused matter to become one big clump—resulting in the "Big Crunch"—or the force of the expansion would have been too much for the stars and galaxies to form and for life to be possible.[24]

HAD THE AMOUNT OF MATTER IN THE UNIVERSE DIFFERED BY MORE THAN ONE PART IN 10^{60}, THERE WOULD BE NO UNIVERSE CAPABLE OF SUSTAINING LIFE.

As noted above, within the first fraction of a second of the Big Bang, the universe underwent an even more rapid expansion called inflation. According to University of Oklahoma physicist Michael Strauss, "This mechanism, as yet incompletely understood, is likely a natural occurrence. Regardless, at the end of the brief inflation, the resulting amount of matter in the universe is estimated to correspond to the critical matter density to one part in 10^{60}."[25]

That is, had the amount of matter in the universe differed by more than one part in 10^{60}, there would be no universe capable of sustaining life. Remarking on this level of precision, astronomer Hugh Ross says: "This degree of fine tuning is so great that it's as if right after the universe's beginning someone could have destroyed the possibility of life within it by subtracting a single dime's mass from the whole of the observable universe or adding a single dime's mass to it."[26]

The Multiverse

Not all astronomers and cosmologists agree with either of these two arguments for a Creator. Some argue (with the full knowledge that they have no observational evidence) that there must be alternative or parallel universes—perhaps an infinite number—and we happen to be in the one where everything is just right.[27] The multiverse is the hypothetical set of infinite possible universes out there.

[23] A brief biography of Edwin Hubble and the significance of his discovery that our universe is expanding is provided at Nola Taylor Reed, "Edwin Powell Hubble: Biography," *Space.com*, May 12, 2012, https://www.space.com/15665-edwin-powell-hubble.html.

[24] Hugh Ross, *Why the Universe Is the Way It Is* (Grand Rapids, MI: Baker Books, 2008), 34–36.

[24] Hugh Ross, *Why the Universe Is the Way It Is* (Grand Rapids, MI: Baker Books, 2008), 34–36.

[25] Dr. Michael Strauss, personal communication, April 16, 2014.

[26] Ross, 35.

[27] For a discussion of the parallel or alternative universe concept, see Josh Clark, "Do parallel universes really exist?" *How Stuff Works*, https://science.howstuffworks.com/science-vs-myth/everyday-myths/parallel-universe.htm.

We know that there are parts of our universe that we cannot observe because of the time it takes for light to travel. Hence, new structures may exist whose light has simply yet to reach us. This version of the multiverse is reasonable and relatively uncontroversial.

However, other versions of the multiverse are "far out," both literally and in the sense that they are strange concepts. Perhaps the most far out is the hypothesis that there exists an infinite number of universes, each with a different set of physics and an infinite set of life-forms—including, some theorists contend, another you.

An Open Door

But in a more concrete way, we cannot only "see" the evidence of the creation event of Genesis 1:1, we can be assured that the scientific evidence provides a reasonable basis for believing the account to be true. To quote Arno Penzias, "The best data we have are exactly what I would have predicted had I had nothing to go on but the five books of Moses, the Psalms, the Bible as a whole."[28]

Jesus says in Matthew 7:7–8, "Ask and it will be given to you; seek and you will find; knock and the door will be opened to you. For everyone who asks receives; the one who seeks finds; and to the one who knocks, the door will be opened." God has provided such an open door for those who seek evidence to see what he has done and to believe.

[28] Quoted in Jerry Berman, PhD, "Arno A. Penzias: Astrophysicist, Nobel Laureate," *American Scientific Affiliation,* https://www.asa3.org/ASA/PSCF/1994/PSCF9-94Bergman.html.

[29] Photo Credit: Maarten Verstraete | Unsplash