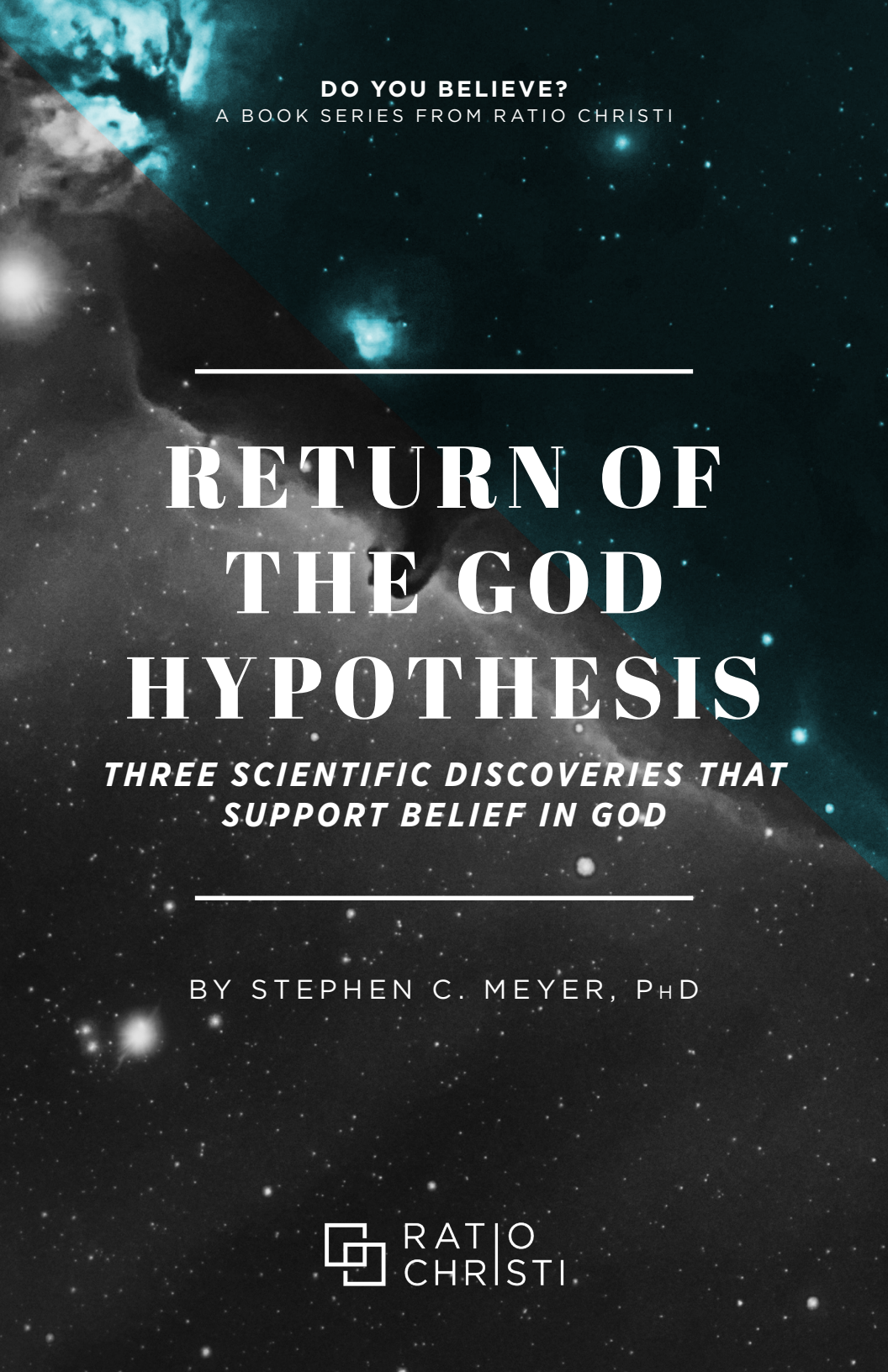
DO YOU BELIEVE?
A BOOK SERIES FROM RATIO CHRISTI
RETURN OF THE GOD HYPOTHESIS
THREE SCIENTIFIC DISCOVERIES THAT SUPPORT BELIEF IN GOD
BY STEPHEN C. MEYER, PhD
RATIO CHRISTI

FAITH & REASON are at odds in our culture. For many, faith has come to mean little more than wishful thinking and blind belief. Such a concept is completely foreign to the pages of Scripture and historical Christianity. As Edward Feser notes, "In short, reason tells us that there is a God and that he has revealed such-and-such a truth; faith is then a matter of believing what reason has shown God to have revealed. In that sense faith is not only not at odds with reason but is grounded in reason."

WHAT IS RATIO CHRISTI?

Ratio Christi, Latin for "the reason of Christ," wants to help reverse this trend of anti-intellectual Christianity. We organize apologetics clubs at colleges, universities, and even for high school groups in order to strengthen the faith of Christian students and faculty and challenge the rampant atheism and secularism on most campuses. Our mission is to fill the intellectual gap, to make Christianity something worth thinking about, both personally and in the public square.

RATIO CHRISTI IS HIRING APOLOGISTS.

Ratio Christi isn't just another apologetics organization. We use our theological training to share the Gospel on college and university campuses across the globe. We reach the people that nobody else can – and we need your help.

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NOTE: *Some of the content in this booklet may not necessarily represent the views of every person involved with, or the official position of, Ratio Christi. Ratio Christi's official statement of faith can be seen at ratiochristi.org/about/beliefs*

INTRODUCTION

I live and work in Seattle, where, a few years ago, a prominent professor of evolutionary psychology, David Barash of the University of Washington, authored a startling *New York Times* op-ed. He described "the talk" he gives each year to his students flatly informing them that science has rendered belief in God untenable. Or as he explained, "As evolutionary science has progressed, the available space for religious belief has narrowed: It has... undermined belief in an omnipotent and omnibenevolent God."[1]

Barash is not alone in popularizing this view. He follows in a long tradition dating back to the late 19th century. Since then, many powerful voices in Western culture—philosophers, scientists, historians, artists, and science popularizers—have attested to the "death of God." Of course, by this, they do not mean that God once existed and passed away. Rather, they mean any credible basis for belief in such a being has long since evaporated. And since 2006, "new atheist" writers—Richard Dawkins, Victor Stenger, Sam Harris, Christopher Hitchens, Daniel Dennett, Stephen Hawking, Bill Nye, and Lawrence Krauss—have advanced this view with even greater frequency and prominence.

The New Atheists and other science popularizers have explained the basis of their skepticism about the existence of God with admirable clarity. According to Dawkins and others, the evidence of design in living organisms long provided the best reason to believe in the existence of God because it appealed to publicly accessible scientific evidence. But since Darwin, Dawkins insists, scientists have known that there is no evidence of actual design, only the illusion or "appearance" of design in life. According to Dawkins and many other neo-Darwinian biologists, the evolutionary mechanism of mutation and natural selection has the power to mimic a designing intelligence without itself being designed or guided. And since random mutation and natural selection—what Dawkins calls the "blind watchmaker" mechanism—can explain away all "appearances" of design in life, it follows that belief in a designing intelligence is completely unnecessary.[2]

Dawkins allows that it is still possible that a deity might exist. Nevertheless, he insists there is absolutely no evidence for the existence of such a being, rendering belief in God effectively "delusional." Popular TV figure Bill Nye, the "Science Guy," has echoed this

perspective. In his book *Undeniable: Evolution and the Science of Creation*, he says, "Perhaps there is intelligence in charge of the universe, but Darwin's theory shows no sign of it, and has no need of it."[3]

Those who tout the loss of a rational foundation for belief in God do not just cite advances in biology. They also point to the advance of modern science and the study of nature in general. Dawkins again clearly explains the logic of such scientific atheism. He says, "The universe we observe has precisely the properties we should expect if there is, at bottom, no design, no purpose ... nothing but blind, pitiless indifference."[4]

All this high-profile science-based skepticism about God has percolated into the popular consciousness. Recent polling data indicate that in North America and Europe, the perceived message of science has played an outsized role in the loss of belief in God. In one poll, more than two-thirds of self-described atheists and one-third of self-described agnostics affirm that "the findings of science make the existence of God less probable."[5]

According to the same survey, the two most influential scientific ideas that have affected people's loss of faith are unguided chemical evolution (of the origin of life) and unguided biological evolution (of the development of life). According to these surveys, these two ideas have led more people to reject faith in God than suffering, disease, or death.

Other polls have shown a dramatic rise in "the nones"—religiously unaffiliated, agnostic, or atheistic respondents—among people eighteen to thirty-three. The rapid growth of this group occurred precisely during the recent decade in which the New Atheists gained prominence. Indeed, there are many indications that college students in particular have been deeply influenced by their message. Many of these students now cite arguments similar to those made by Dawkins, Krauss, Dennett, and Hitchens as their main reasons for rejecting faith in God.

But does science actually support this strictly materialistic or atheistic vision of reality? Is it true that "the universe we observe has precisely the properties we should expect if there is, at bottom, no design, no purpose ... nothing but blind, pitiless indifference"?

In fact, three major scientific discoveries during the last century contradict the expectations of scientific atheists. Instead, these discoveries point in a distinctly theistic direction—toward the existence of a transcendent, intelligent, and active creator.

THE RISE & FALL OF THEISTIC SCIENCE

Before discussing these discoveries, however, it might be helpful to provide a little historical background. Historians of science now recognize that Judeo-Christian thinking played a significant role in the rise of modern science. From the time of Robert Grosseteste and Roger Bacon in the late Middle Ages (1200-i== 1400AD) to the time of Johannes Kepler, Robert Boyle, and Sir Isaac Newton during the scientific revolution (1500-1700AD), ideas about the rationality of God and the order and intelligibility of nature inspired early scientists to study nature. They pursued their work for "the glory of God,"[6] as historian of science Rodney Stark put it. Additionally, many of the early scientists were not only inspired by their beliefs, they also detected empirical evidence of design in nature. As Isaac Newton wrote, the evidence of nature revealed "the counsel and dominion of an intelligent and powerful being."[7]

Nevertheless, much of 19th-century science took a decidedly materialistic turn. Scientific origins theories in particular seemed to support the materialistic vision of an autonomous and self-creating world. In astronomy, the French mathematician Laplace offered a theory known as the nebular hypothesis. This theory sought to account for the origin of the solar system purely by gravitational forces. In geology, Charles Lyell explained the origin of the earth's most dramatic topographical features—mountains and canyons—by reference to slow, gradual, and completely naturalistic processes. In astronomy and physics, a belief in the infinity of space and time obviated any need to consider the question of the ultimate origin of matter. Perhaps most significantly, Darwin's evolutionary theory sought to show that the blind process of natural selection acting on random variations could and did account for the origin of new life forms without any guidance. According to Darwin, living organisms only *appeared* to be designed by an intelligent creator. Nature itself was the real creator. As Francisco Ayala has explained, "The functional design of organisms and their features would ... seem to argue for the existence of a designer. It was Darwin's greatest accomplishment to show that the directive organization of living beings can be explained as the result of a natural process, natural selection, without any need to resort to a Creator or other external agent."[8]

These theories taken jointly suggested that the whole history of the universe could be told as a seamless unfolding of the potentiality of *matter and energy*. Thus, science increasingly seemed to support a materialistic or naturalistic worldview. Matter had always existed and could arrange itself without a pre-existent designer or creator.

With the rise of scientific materialism (or naturalism), many scientists, philosophers, and even theologians during the twentieth century began to see science and theistic belief as conflicting. Others disagreed. Nevertheless, they typically did so by portraying science and religion as such totally distinct enterprises that their teachings did not intersect.[9] Thus, some have seen science as hostile to belief in God, while others have attempted to cast it as entirely neutral. Few, however, have thought—in contrast to the founders of early modern science such Kepler, Boyle, and Newton—that the testimony of nature actually supports important tenets of a theistic worldview.

Nevertheless, a quiet but remarkable scientific shift has occurred over the last century. Discoveries about the origin of the universe and life now tell a different story than the scientific theories of the late 19th century. This booklet tells the story of some of those scientific discoveries and explains why they support the existence of a transcendent, intelligent, and active creator. It will develop this case by examining contemporary scientific discoveries in cosmology, physics, and biology and comparing the ability of four major worldviews to explain them. These worldviews are materialism, pantheism, deism, and theism.

Evidence of a Beginning to the Universe

General Relativity & the Big Bang Theory

In 1915-17, Albert Einstein shocked the scientific world with his theory of general relativity. Einstein's theory implied (as had Newton's theory of gravity) that the universe would collapse in on itself unless a contravening force was at work. According to general relativity, massive bodies alter the curvature of space (or more precisely "space-time") so as to draw nearby objects to them. (To illustrate, imagine placing a bowling ball on a trampoline covered with tennis balls.) Einstein's conception of gravity implied that all material bodies would congeal, and space would contract in on itself unless the effects of gravitation were continually counteracted by the expansion of space itself. Since such a contraction hasn't happened (at least not yet), and since the universe we observe today contains matter surrounded by empty space, Einstein thought something—some outward force of expansion—must be counteracting the effect of gravitation.

Thus, in his famous 1917 paper, "Cosmological Considerations in the General Theory of Relativity," Einstein posited a "cosmological constant" to describe a constantly

acting repulsive force countering the effects of gravitational contraction. He further assigned *a precise value* to the cosmological constant to ensure the strength of gravity and the repulsive force described by this constant were exactly balanced. This would sustain the universe in a kind of equipoised, static state, neither expanding outward from a beginning nor collapsing toward an end.

Einstein's choice of the value for the cosmological constant had no physical justification apart from his assumption of a static (eternally existing) universe. He favored this assumption for philosophical reasons, since the assumption of a static universe allowed him to conceive of it as eternal and self-existent—not coming into being by a Big Bang.

Immediately after Einstein published his cosmology paper, however, a series of mathematical results challenged his static universe. In 1922, the Russian physicist Alexander Friedmann solved Einstein's gravitational field equations. Friedmann's solutions and resulting equations included terms that allowed the density and radius of the universe to vary with time—a possibility that Einstein's arbitrary choice of the cosmological constant and initial conditions foreclosed.

Friedmann's equations—his solutions to Einstein's field equations describing how matter bends space—implied a dynamic universe for *almost all* values of the cosmological constant and choices of initial conditions. Consequently, though Friedmann did not disprove Einstein's static universe concept, his solutions to the field equations implied the need for an implausible degree of fine-tuning. Both the value of the cosmological constant and the initial conditions of the universe would need to be extremely precise in order to maintain a balance between the pressure of cosmic expansion and gravitational attraction.

Other discoveries and theoretical developments only highlighted this implausibility. In 1927, the Belgian priest and physicist Georges Lemaître independently produced the same solutions to the field equations. Like Friedmann, Lemaître showed that the field equations most naturally implied a dynamic universe. But he also went further. Using observational data about distant nebulae, he was able to formulate a definite cosmological model of the origin of the universe.

Specifically, he incorporated observations of the light from distant galaxies into his model. In 1912, a young astronomer named Vesto Slipher had shown that the light from what were then called "nebulae" typically exhibited spectral lines that were shifted *en masse* toward the red (longer wavelength) end of the electromagnetic spectrum. This evidence of "red-shift" suggested recessional movement, for the same reason that a train whistle drops in pitch and sound waves lengthen as a train moves away from a stationary observer. (You may recall learning about this so-called Doppler effect in science class.)

Then in 1924 another astronomer, Edwin Hubble, working with the 100-inch Hooker Telescope at Mt. Wilson in California, showed that Slipher's nebulae were in fact distant galaxies. By correlating Slipher's red-shift data with Hubble's 1924 measurements of the distances to other galaxies, Lemaître realized that the galaxies beyond our Milky Way were receding from Earth in all directions. He also determined that the galaxies that

were further away were receding faster than those that were closer, a relationship that Hubble would later formulate more precisely. In any case, this 'further the faster' relationship, later called "Hubble's law," suggested a spherical expansion of the universe in all directions, as if the universe were expanding from a singular explosive beginning—from a "big bang."

Einstein first learned about the red-shift evidence from Lemaître in a taxicab ride during a conference in Solvang, Belgium in 1927. To his credit, Einstein eventually publicly acknowledged the evidence for an expanding universe after visiting Hubble in Pasadena in 1931. He also later said that his postulation of an arbitrary value for the cosmological constant was "the greatest blunder of my life."[10]

During the remainder of the twentieth century, physicists and cosmologists formulated many alternatives to the new "Big Bang" cosmology, most of which attempted to restore the idea of an infinite universe. For example, in the late 1940s Fred Hoyle, Thomas Gold, and Hermann Bondi proposed the "steady state" model specifically to explain galactic recession without invoking the objectionable notion of a beginning. According to the steady state theory, as the universe expands, new matter is generated spontaneously in the space between expanding galaxies. The matter that comprises the Milky Way galaxy had spontaneously popped into existence in between other galaxies. And these galaxies, in turn, had emerged from the empty space between other galaxies, and so on. Hoyle, Gold, and Bondi further envisioned a universe of infinite extent in time and space without beginning or end—one that had *always been expanding* in the past and would always expand in the future.

By the mid-1960s, the steady state theory ran afoul of a decisive, if unintended, discovery by two scientists at the Bell Telephone Laboratories in New Jersey. According to the steady state model, the density of the universe must always remain constant. Hence, it affirmed the creation of new matter as the universe expands. But in 1965, two Bell Lab researchers, Arno Penzias and Robert Wilson, found what physicists believed to be the radiation left over from the universe's initial hot, extremely high-density state. Physicist George Gamow had predicted the existence of this "cosmic background radiation" as a consequence of the Big Bang model. Advocates of the steady state theory affirmed, however, that, given their model, such radiation should not exist. Thus, the discovery of this radiation with almost the exact wavelength (and a corresponding "blackbody temperature") predicted by Gamow proved decisive. By the 1970s, even Bondi, and Gold had abandoned their theory (though Hoyle never did).[11]

Following the demise of the steady state model in the mid-1960s, some physicists proposed an oscillating-universe model as an alternative to the finite universe. But as MIT physicist Alan Guth showed in 1984, our knowledge of thermodynamics suggests that an indefinitely bouncing universe is effectively impossible. According to the Second Law of Thermodynamics, the entropy (or disorder) of the matter and energy in the universe would increase over time in each cycle of oscillation. Guth showed that such increases in

entropy would result in less energy *available to do work* in each cycle. This would result in progressively longer and longer cycles of expansion and contraction since increasing disparity in mass-energy density throughout space would decrease the efficiency of gravitational contraction. If the duration of each cycle necessarily increases as we move forward in time, then it follows that each cycle in the past would have been progressively shorter. Since the periods of each cycle cannot decrease indefinitely, the universe—even on an oscillating model—would have had to have had a beginning.

Prior to the formulation of the oscillating universe theory, three physicists, Stephen Hawking, George Ellis, and Roger Penrose, published a series of papers between 1966 and 1970 detailing the implications of Einstein's theory of general relativity for the origin of space and time as well as matter and energy. Hawking and his colleagues showed that as one extrapolated back in time the curvature of space-time would approach infinity. But an infinitely curved space corresponds to a radius (within a sphere for example) of zero units and thus to no spatial volume. Since in general relativity space and time are inextricably linked, the absence of space implies the absence of time. Moreover, neither matter nor energy can exist in the absence of space. Thus, the resulting "Singularity Theorem" implied that the universe sprang into existence a finite time ago from nothing, at least nothing physical.

British physicist Paul Davies describes the implications with great clarity: "If we extrapolate this prediction to its extreme, we reach a point when all distances in the universe have shrunk to zero. An initial cosmological singularity therefore forms a past temporal extremity to the universe.... For this reason, most cosmologists think of the initial singularity as the beginning of the universe. On this view the big bang represents the creation event; the creation not only of all the matter and energy in the universe, but also of space-time itself."[12]

For this reason, general relativity and the Big Bang theory imply that any proposed cause of the universe must transcend (or exist separately from) space, time, matter, and energy.

Evidence of Fine Tuning of the Universe

Anthropic "Fine-Tuning"

As we have seen, evidence from cosmology points to a cause *beyond* the universe. In a complementary fashion, evidence from physics now suggests an *intelligent* cause of the universe. Since the 1950s and 60s, physicists have discovered that life in the universe depends upon a highly improbable set of physical forces and features as well as an extremely improbable balance among many of them. The precise strengths of the fundamental forces of physics, the initial arrangement of matter and energy at the beginning of the

universe, and many other specific features of the cosmos, such as its expansion rate, appear delicately balanced to allow for the possibility of life. If any one of these many properties were altered ever so slightly, complex life, human life, and even basic chemistry simply would not be possible.

Physicists now refer to the fortuitous values of these factors as "anthropic coincidences" (from the Greek *anthros* for "human") and to the fortunate convergence of all these coincidences as the "anthropic fine-tuning" of the universe.[13] The term "fine-tuning" in physics refers to properties of the universe that fall within extremely narrow and improbable ranges that turn out to be necessary for life.

The fine-tuning of these properties has puzzled physicists not only because of their extreme improbability but also because there doesn't seem to be any necessary physical or logical reason why they are as they are. Philosophers of science call such physical features of the universe "contingent" properties since they could conceivably have been different without violating either fundamental laws of physics or any necessary principle of logic or mathematics.

All told, we live in a kind of "Goldilocks universe" where dozens of these contingent properties have just the right strengths, values, or characteristics to make life possible. Many physicists have noted that this fine-tuning strongly suggests design by a pre-existent intelligence. As physicist Paul Davies put it, "the impression of design is overwhelming."[14]

To see why, consider the following illustration. Imagine a cosmic explorer has just stumbled into the control room of the universe. There she discovers an elaborate "universe creating machine," with rows of dials each with many possible settings. As she investigates, she learns that each dial represents some particular parameter that has to be calibrated with a precise value in order to create a universe in which life can survive. One dial represents the possible settings for the strong nuclear force. One represents the gravitational constant. One is for Planck's constant. One is for the ratio of the neutron mass to the proton mass. Another is for the strength of electromagnetic attraction, and so on. As our cosmic explorer examines the dials, she finds that the dials can be easily spun to different settings—that they could have been set otherwise. Moreover, she determines by careful calculation that even slight alterations in any of the dial settings would cause life in the universe to cease to exist. Yet for some reason, each dial sits with just the exact value necessary to keep a life-sustaining universe running. It's almost like finding a bank vault with its door open, its contents missing, and every dial set just right to make it possible to open the vault. What should someone infer about how such a propitious combination of dial settings came to be?

Not surprisingly, many physicists have been asking the same question about the anthropic fine-tuning of the universe. As George Greenstein muses, "the thought insistently arises that some supernatural agency, or rather Agency, must be involved.... Was it God who stepped in and so providentially crafted the cosmos for our benefit?"[15] Or as Fred Hoyle commented, "a commonsense interpretation of the facts suggests that a superintellect has monkeyed with physics, as well as chemistry and biology, and that there are no

blind forces worth speaking about in nature."[16] Indeed, for many physicists, the design hypothesis seems an obvious and intuitively plausible explanation for the fine-tuning. They argue—in effect—that the dials in the cosmic control room appear finely-tuned because someone carefully set them that way.

Alternative Explanations for the Fine-Tuning

Nevertheless, several alternative naturalistic explanations have been proposed. The first is called the "weak anthropic principle," which denies that the fine-tuning needs explanation. Second, some physicists have proposed that the fine-tuning might be the consequence of some yet to be discovered laws of nature. Other physicists and philosophers have proposed an exotic, but popular, explanation based upon chance. They propose that our universe represents the lucky outcome of a vast cosmic lottery that produced a multiplicity of other universes—what they call a "multiverse."

I've critiqued all three of these types of explanation at length in my book *The Return of the God Hypothesis*.[17] Nevertheless, it may be helpful to briefly examine some of the problems with the most popular of these naturalistic explanations: the multiverse hypothesis.

The Multiverse

To explain the vast improbabilities associated with the various fine-tuning parameters, some physicists have postulated not a "fine-tuner"—or intelligent designer—but the existence of a vast number of other universes parallel to our own. The multiverse concept also posits various mechanisms for producing these universes. Having a mechanism for generating new universes would, according to proponents of this idea, increase the number of opportunities for generating a universe capable of sustaining life. Thus, they portray our universe as something like the lucky winner of a cosmic lottery. They conceive of various universe-generating mechanisms as something like a roulette wheel or slot machine turning out either winners or losers with each spin or pull of the handle. Thus, these universe generating mechanisms spit out billions and billions of universes and ours just happens to be one of the few that can sustain life.

It's important to understand why proponents of the multiverse need a universe-generating mechanism to explain the origin of the fine-tuning. Most proponents do not think of the different universes that they postulate as interacting with each other. Nor do they expect to have any observational evidence of universes other than our own. Consequently, nothing that happens in one universe would have any effect on things that happen in another universe. Nor would events in one universe affect *the probability* of events in another. This means whatever events were responsible for setting the values of the fine-tuning parameters in another universe would have no effect on ours either.

Yet if all the different universes were produced by the same underlying causal mechanism, then it would be possible to conceive of our universe as the winner of a kind of cosmic lottery, one in which some winner eventually had to emerge. For this reason,

postulating a universe-generating mechanism could conceivably render the probability of generating a universe with life-conducive conditions quite high—thus, making it possible to explain the origin of the fine-tuning in our universe as the result of a random process.

Assessing the Multiverse

So, does the multiverse concept provide a better explanation of the fine-tuning than the hypothesis of an intelligent or theistic designer? I argue that it does not for several reasons.[18] Here are two:

First, as the Oxford philosopher Richard Swinburne has argued, the theistic design hypothesis constitutes a simpler and less *ad hoc* hypothesis than the multiverse hypothesis.[19] In saying this, Swinburne affirms the principle of Ockham's razor. Ockham's razor asserts that when attempting to explain events or phenomena we should, as much as possible, avoid "multiplying theoretic entities." In other words, we should prefer the simpler hypothesis with fewer such entities, all other things being equal.

Swinburne notes that the God hypothesis requires the postulation of only one explanatory or theoretical entity, an intelligent and powerful transcendent agent. Nevertheless, the theory posited by multiverse advocates requires multiple purely hypothetical entities—including a quasi-infinite number of causally separate universes and separate universe-generating mechanisms.

Philosopher of physics Bruce Gordon has amplified this argument. He points out that multiverse advocates must not only postulate many universes, but two distinct types of *universe-generating mechanisms*. The reason for this is that there are two different types of fine tuning and each of the proposed universe-generating mechanisms produces only one, but not the other, type of fine-tuning. One of the proposed universe generating mechanisms—one based on something called "inflationary cosmology"—could possibly explain the fine-tuning of the initial conditions of the universe. The other proposed universe generating mechanisms—one based on string theory—could possibly explain the fine-tuning of the laws and constants of physics.[20] But to explain both types of fine tuning requires appealing to both types of universe generating mechanisms.

And that's where this approach runs afoul of Ockham's razor. It turns out that each of these universe generating mechanisms presuppose multiple hypothetical entities or pure theoretical postulates. For example, string-theoretic cosmology presupposes the existence of "strings" of vibrating energy and extra dimensions of space. Inflationary cosmology postulates an "inflaton field" and a hypothetical process by which finely-tuned "inflaton shut off energies" would generate new universes. And to explain both types of fine-tuning mentioned above—initial condition fine-tuning *and* the fine-tuning of the laws and constants of physics—multiverse advocates must postulate two types of universe-generating mechanisms. But that means they must also postulate all the theoretical entities presupposed in these different physical theories as well as a quasi-infinite number of universes. Clearly, theistic design provides a simpler or more parsimonious explanation than the multiverse.

Second, both of the speculative multiverse cosmologies—the string-theoretic multiverse and the inflationary multiverse—invoke universe generating mechanisms that *themselves require prior fine-tuning*. In the inflationary multiverse, for example, the mechanism that generates new universes is called "an inflaton field." According to proponents of inflationary cosmology, the inflaton field and its "shut off energy" need to decay in a precisely finely-tuned way to produce new bubble universes.

In fact, physicists calculate that the "shut off energy" of the inflaton field would require fine-tuning of between one part in 10^{53} and one part in 10^{123} (depending on the inflationary model). Only then would an inflaton field produce a life-compatible universe.[21] Additionally, the shut-off interval of the inflaton field also requires precise fine-tuning. In current models, the inflationary epoch of rapid expansion of the universe begins around 10^{-37} seconds after the Big Bang and lasts until 10^{-35} seconds, during which space itself expands by a factor of 10^{60} or so (in one model). For the inflaton field to produce a life-sustaining universe, inflation must occur within just that narrow window of time. Thus, the inflationary multiverse presupposes the very thing it seeks to explain, namely, exquisite fine-tuning. (In Chapter 16 of my book *Return of the God Hypothesis*, I explain why the string-theoretic multiverse *also* requires exquisite fine tuning.)

Moreover, as philosopher of physics Robin Collins argues,[22] we have no experience of anything like a "universe generator" (that is not itself designed) producing finely-tuned machines or functionally-significant outcomes or processes. Yet we do have extensive experience of intelligent agents producing finely-tuned devices to produce random distributions of events (roulette wheels, for example) and plenty of experience of finely-tuned systems (circuits, software, and machines) that produce specific functional outcomes. Thus, Collins concludes, the postulation of "a supermind" to explain the fine-tuning of the universe constitutes a natural extrapolation from our experience-based knowledge of the causal powers of intelligent agency, whereas the postulation of multiple universes lacks a similar basis. Moreover, he argues, we know from experience that some machines (or factories) can produce other machines. But our experience also suggests that such machine-producing machines themselves require intelligent design. Thus, he concludes that theistic design ultimately provides a better explanation for the origin of the fine-tuning than the multiverse idea.

Evidence of Design in Life

Arguably, modern biology has revealed even more compelling evidence of design. In 1953 when Watson and Crick elucidated the structure of the DNA molecule, they made a startling discovery. The structure of DNA allows it to store information in the form

of a four-character code. Strings of precisely sequenced chemicals called nucleotide bases store and transmit the assembly instructions—the information—for building the crucial protein molecules that the cell needs to survive.

In 1958, Francis Crick developed this idea with his famous "sequence hypothesis." According to this hypothesis, chemical bases in DNA function like letters in a written language or digital symbols in a computer code. Chemists represent these four nucleotide bases with the letters A, T, G, and C (for adenine, thymine, guanine, and cytosine). Just as English letters can convey a particular message depending on their arrangement, specific sequences of chemical bases along the spine of a DNA molecule convey precise instructions for building proteins and protein machines. Indeed, the *specific* arrangement of the chemical characters in accordance with an independent symbol convention known as "the genetic code" determines the function of the sequence as a whole.

Moreover, DNA sequences do not just possess "information" in the strictly mathematical sense of the theory of information developed by famed M.I.T. scientist Claude Shannon in the late 1940s. Shannon's theory equated information with the reduction of uncertainty. He stipulated that the amount of information in a sequence was inversely proportional to the probability of the occurrence of the sequence in question. Yet, the arrangement of the bases in functional stretches of DNA are not just highly improbable. Instead, DNA contains "information" in the richer and more ordinary dictionary sense. Indeed, DNA contains "alternative sequences or arrangements of characters that *produce a specific effect*" as the dictionary defines "information." DNA base sequences convey instructions. They perform functions and produce specific effects. Thus, they do not possess mere "Shannon information," but instead what has been called "specified" or "functional information."[23] To see the difference between a sequence containing mere Shannon information and one exhibiting specified information, compare:

"iuinsdysk]idfawqnzkl,mfdifhs"
"Time and tide wait for no man."

Notice that the bottom string exhibits an improbable sequence of characters, but that the arrangement of those characters is also specified in order to perform a communication function. Whereas the top string, though equally improbable, is not specifically arranged to perform any discernable communication function. Indeed, like the precisely arranged zeros and ones in a computer program, the chemical bases in DNA convey instructions by virtue of their "specificity" of arrangement. Thus, Richard Dawkins notes that, "the machine code of the genes is uncannily computerlike,"[24] and software developer Bill Gates observes that "[h]uman DNA is like a computer program but far, far more advanced than any software we've ever created."[25] Similarly, biotechnology specialist Leroy Hood describes the information stored in DNA as "digital code."[26]

After the early 1960s, further discoveries revealed that the digital information in

DNA and RNA is only part of a complex information storage, transmission, and processing system in the cell. The entire system represents an advanced form of nanotechnology that both mirrors and exceeds our own in its complexity, design logic, and information storage density.

Where did the digital information in the cell come from? And how does the information necessary to build new forms of life arise during the history of life? In my books *Signature in the Cell* and *Darwin's Doubt*, I address these questions and show that materialistic theories of evolution (both chemical and biological evolutionary theories) have failed to explain the origin of the information necessary to build both the first living cells and new forms of animal life.[27] In this section of this essay, I will address the first of these two problems, the problem of explaining the origin of the information necessary to build the first living cell.

Chemical Evolutionary Theories of the Origin of Biological Information

The problem of the origin of the genetic information necessary to build the first living cell has proven particularly intractable for chemical evolutionary theories. During the late 19th century, many biologists thought of the cell as an extremely simple "little lump of mucus or slime."[28] They thought that such an entity could have formed readily from a few simple undirected chemical reactions without any designing hand involved.

As biologists gradually learned more about the complexity of the cell, evolutionary theorists devised increasingly more sophisticated theories of chemical evolution—theories that attempt to explain the origin of the first life from simpler pre-existing *chemicals*. Nevertheless, all such theories have failed to explain the information stored in DNA (and other crucial biomacromolecules such as RNA) at the very foundation of life.

Chance-based models of chemical evolution have failed to account for this information because the amount of specified information present in even a single protein or gene typically exceeds the probabilistic resources of the entire universe.

Models based upon "pre-biotic natural selection" (including popular RNA world scenarios) have failed as well. They presuppose the existence of a self-replicating system, yet replication systems in living organisms require *information-rich* biomolecules (either DNA and proteins or RNA replicators)—the very entities that required explanation in the first place.

Finally, self-organizational models have failed since the information content of DNA defies explanation by reference to the physical and chemical properties of its constituent parts.[29] Just as the chemistry of ink does not explain the specific sequencing of letters in a newspaper headline, so too the properties of the chemical constituents of DNA text—the four nucleotide bases—do not explain the specific sequencing of the genetic text.[30]

In my book *Signature in the Cell* and in a Ratio Christi booklet also titled *Signature in the Cell*, I explain in much more detail the problems with each of the above three

approaches to explaining the origin of the information necessary to the first life.

Even so, the scientists arguing for intelligent design do not posit design merely because materialistic evolutionary theories have failed to explain the origin of the information necessary to build new forms of life. Instead, they argue for design because we know from our uniform and repeated experience—the basis of all scientific reasoning about the causes of events in the past—that systems possessing functional or specified information invariably arise from intelligent causes. Indeed, the information on a computer screen was produced by a user or programmer. The information in a newspaper ultimately came from a writer. As the pioneering information theorist Henry Quastler observed, "information habitually arises from conscious activity."[31]

The causal connection between information and prior intelligence enables us to detect or infer intelligent activity from the effects of unobservable causes in the distant past. For example, archeologists infer the activity of intelligent ancient scribes from hieroglyphic inscriptions. Similarly, SETI's search for extraterrestrial intelligence presupposes that information imbedded in electromagnetic signals from space *would* indicate an intelligent source. As yet, radio astronomers have not found information-bearing signals from distant star systems. But closer to home, molecular biologists have discovered specified information in the cell, suggesting—by the same logic that underwrites the SETI program and ordinary scientific reasoning about other informational artifacts—an intelligent source for the information in DNA.

DNA functions like a software program. We know from experience that software comes from programmers. We know generally that information—whether inscribed in hieroglyphics, written in a book or encoded in a radio signal—always arises from an intelligent source. So, the discovery of information in the DNA molecule provides strong grounds for inferring that a designing intelligence played a role in the origin of life, even if we weren't there to observe it.

Thus, contrary to the claims of some critics, the argument for intelligent design in biology is not based upon ignorance or "gaps" in our knowledge. Instead, it's based upon recent scientific discoveries and standard methods of scientific reasoning in which our uniform experience of cause and effect guides our inferences about the past. This scientific method of reasoning is known as "inference to the best explanation."

Inference to the Best Explanation

I first began to study this method of reasoning during my Ph.D. research at Cambridge University in the late 1980s. At that time, I was examining how scientists investigating origins events developed their arguments. Specifically, I examined the method of reasoning that historical scientists use to identify causes responsible for events in the remote past. I discovered that historical scientists often make inferences with a distinctive logical form (known technically as "abductive inferences").[32] Paleontologists, evolutionary biologists, and other historical scientists reason like detectives and infer *past*

conditions or causes from *present* clues. As Stephen Jay Gould notes, historical scientists typically "infer history from its results."[33]

Nevertheless, as many philosophers have noted, there is a problem with this kind of historical reasoning. In particular, there is often more than one (past) cause that can explain the same effect. This makes reasoning from present clues tricky because the evidence can point to more than one causal explanation or hypothesis. To address this problem in geology, the 19th-century geologist Thomas Chamberlain delineated a method of reasoning he called "the method of multiple working hypotheses."[34]

Contemporary philosophers of science such as Peter Lipton have called this method "inference to the best explanation."[35] That is, when trying to explain the cause of an event or origin of a structure in the past, scientists often compare various hypotheses to see which would, if true, best explain it. They then provisionally affirm the hypothesis that best explains the data as the one most likely to be true.

But that raised an important question: exactly what makes an explanation "best"?

As it happens, historical scientists have developed criteria for deciding which cause, among a group of competing possible causes, provides the best explanation for some event in the remote past. The most important of these criteria is called "causal adequacy." This criterion encourages historical scientists, as a condition of a successful explanation, to identify causes that are known to have the power to produce the kind of effect, feature, or event that requires explanation.

In making these determinations, historical scientists evaluate hypotheses against their present knowledge of cause and effect. Causes that are known to produce the effect in question are judged to be better candidates than those that are not. For instance, a volcanic eruption provides a better explanation for an ash layer than an earthquake. Eruptions have been observed to produce ash layers. Earthquakes have not.

Even so, scientists must sometimes posit the existence of conditions or entities whose effects they have not, or cannot, directly observe. In such cases, their expectations about the observable consequences of a postulated entity will derive from more theoretical considerations. The philosopher of science Michael Scriven explained this concept in his description of inference to the best explanation (or what he called "retrospective causal analysis"). When scientists lack "previous direct experience of [a cause's] actual efficacy" in producing an event of the type in question, "there might be *theoretical* grounds for thinking it a possible cause," Scriven states. Other historians and philosophers of science have explained that extrapolation from the known causal powers of a "relevantly similar"[36] cause might also play a role in justifying such a postulated cause.

Competing Worldview Explanations

In any case, both philosophers of science and leading historical scientists have emphasized causal adequacy as the key criterion by which competing hypotheses are adjudicated. But philosophers of science also note that assessments of explanatory power lead to

conclusive inferences only when it can be shown that there is *only one known or plausible cause* for the effect or evidence in question. When scientists can infer a *uniquely* plausible cause, they can both avoid the fallacy of what logicians call "affirming the consequent"—that is, the error of confidently inferring one cause when other possible causes could have been responsible for the event in question.[37]

This method of reasoning can also be used to assess competing metaphysical hypotheses or worldviews. Metaphysics is the discipline of philosophy that addresses the fundamental nature of reality. Some philosophers describe comprehensive systems of thought that address metaphysical questions as "worldviews." They typically define a worldview as a comprehensive system of thought that answers basic questions about the nature of reality. The most fundamental question that a worldview must address is sometimes called "the prime reality question." It asks—'what is the entity or process from which everything else comes?' Notice that this is also a question about causation or "ultimate causes." Consequently, the method of reasoning that scientists and philosophers use to evaluate competing theories of causal origins—i.e., inference to the best explanation—is likewise suitable for assessing competing worldviews and the answers they give to questions about causal origins.

Indeed, since scientific theories of origins necessarily address questions about the cause(s) of the origin of life and the universe, they often have larger metaphysical implications. For example, if the origin of the first life can be explained by reference to strictly materialistic chemical evolutionary processes, such an explanation would tend to favor a materialistic worldview—one that affirms matter and energy as the prime realities or sufficient explanatory principles. Conversely, if explaining the origin of life or the universe requires positing the activity of an intelligent agent or mind, as argued above, that would tend to favor a worldview that affirms intelligent agency as a prime or ultimate reality.

Thus, scientific discoveries may favor one worldview over another depending on the extent to which the explanatory resources inherent in a given worldview enable the evidence at hand to be adequately explained. Put differently, analyzing scientific evidence or discoveries about life and the universe using the method of inference to the best explanation can help us assess competing worldviews.

HOW TO ASSESS COMPETING WORLDVIEWS

Having surveyed key scientific evidence about biological and cosmological origins, we are now in a position to examine the metaphysical implications of that evidence and to assess the explanatory power of competing metaphysical systems with respect to it. Philosophers recognize several main worldviews each of which offers different answers to the prime reality question (and posits different kinds of entities as explanations for questions of causal origins). Here are four of the most prominent:

1. "Naturalism" (or materialism) views matter and energy and the laws of physics as the prime realities. In its most basic form, it assumes that matter and energy have existed eternally and that all that currently exists (including life) has arisen as the result of an undirected, mindless process of evolution starting from eternal and self-existent elementary particles or energy fields.
2. "Pantheism" asserts the existence of an impersonal deity (or force) present in matter and energy as the prime reality.
3. "Theism" affirms a personal, intelligent, and transcendent God who acts within the creation.
4. "Deism" affirms a personal, transcendent, and intelligent God who does not act within the created order after its initial origin.

The key question is which of these frameworks best explains the three classes of evidence examined above. How can we best explain evidence suggesting that: (1) the physical universe of matter, space, time, and energy had a beginning, (2) the fundamental physical properties of the universe have been fine-tuned from the beginning of the universe to allow for the possibility of life, and (3) large amounts of genetic information (in an essentially digital form) have arisen on Earth to make possible the origin of life *after* the beginning of the universe?

THEISM AS AN INFERENCE TO THE BEST EXPLANATION

So let's compare the explanatory power of these competing worldviews starting with theism and naturalism, perhaps the two most influential worldviews in the West.

Theism provides a superior explanation to naturalism (or materialism) for a variety of reasons. The origin of the universe would seem to require—by the principle of causality or sufficient reason—a cause. Yet, according to naturalism, nothing exists except the natural world (i.e., the universe of matter, energy, space, and time). As astronomer Carl Sagan used to assert: "the Cosmos is all that is, or ever was or ever will be."[38] It follows that naturalism denies the existence of any entity separate from the universe that could function as the cause of the origin of the universe as a whole coming into existence.

Nevertheless, we have evidence that the universe *did* come into existence—i.e., that it had a beginning a finite time ago. Consequently, the evidence for the beginning of the universe thus raises a question that philosophical naturalists or materialists, almost by definition, cannot answer. Specifically, "What *caused* the whole of nature or the physical universe to come into existence?" For this reason, naturalism, in its basic form at least, does not qualify as a causally adequate explanation for the presumed fact, variously attested, of the beginning of the universe.

Many naturalists have in effect admitted the explanatory challenge the Big Bang poses to their worldview. Einstein, at a time when he was still a strict philosophical materialist, tacitly acknowledged this dissonance when he fine-tuned the value of his cosmological constant to maintain a static and infinite universe. Fred Hoyle admitted the challenge posed by a finite universe to naturalism when, for explicitly philosophical reasons, he proposed his steady state theory to retain the concept of an infinite universe[39]—despite its flagrant violation of the law of conservation of energy. The English astronomer and physicist Sir Arthur Eddington acknowledged this dissonance when he confessed that he found the idea of a beginning of the universe philosophically repugnant.[40]

The Hawking-Penrose-Ellis singularity theorems (mentioned above) and other developments in theoretical physics amplify the problems confronting materialistic

explanations for the origin of the universe.[41] If sometime in the finite past, either the curvature of space reached infinity and/or the radius and spatial volume of the universe collapsed to zero units, then at that point there would be no space and no place for matter and energy to reside. Consequently, the possibility of a materialistic (or naturalistic) explanation would also evaporate, since at that point neither material particles nor energy fields would exist. Indeed, since matter and energy cannot exist until space begins to exist, a materialistic explanation involving either material particles or energy fields—before space and time existed—makes no sense. As I used to tell my students, "If you extrapolate back all the way to a singularity, you eventually reach a point where there is no matter left to do the causing."

Theism, however, with its notion of a transcendent creator, provides a more causally adequate explanation for the evidence of the beginning of the universe than any fully naturalistic or materialistic explanations. Why? Naturalism denies the existence of any entity separate from the universe with causal powers capable of generating the universe. By contrast, theists posit the existence of an entity who does exist separately from the universe and possesses precisely the necessary kind of causal powers. The evidence for the Big Bang, in conjunction with General Relativity, implies a singular beginning for matter, space, time, and energy. Thus, it follows that any entity capable of explaining this singularity must transcend these four dimensions or domains. God, as conceived by theists, possesses precisely such attributes and transcendent causal powers. Thus, theism provides a better explanation than naturalism for the cosmological singularity and the astronomical evidence of a beginning to the universe.

Other classes of scientific evidence provide support for other attributes of a theistic God. As we have seen, intelligent design provides a highly plausible, and arguably the best, explanation for the exquisite fine-tuning of the laws and constants of physics, and the initial conditions of matter and energy at the beginning of the universe. Since the fine-tuning dates from the origin of the universe itself, this evidence suggests the need for a transcendent and intelligent cause for the origin of the universe. Since God as conceived by Judeo-Christian and other theists possesses precisely these attributes, theism can provide an adequate explanation of the origin of the cosmological singularity *and* the anthropic fine-tuning. Conversely, naturalism denies a transcendent intelligence or pre-existent mind and its best alternative explanation—the so-called multiverse—fails to explain the ultimate origin of the fine-tuning. As a result, it follows that theism provides a better, more causally adequate, explanation than naturalism for these two evidences—cosmic fine-tuning and the cosmological singularity—taken together.

Theism vs. pantheism

Theism also provides a better explanation for the origin of the universe than does the philosophy of pantheism for much the same reasons. Though a pantheistic worldview affirms the existence of an impersonal god, the god of pantheistic religions and philosophy

exists within, and is co-extensive with, the physical universe. God as conceived by pantheists cannot act to bring the physical universe into being from nothing (physical), since such a god does not exist independently of the physical universe. If initially the physical universe did not exist, the pantheistic god would not have existed either. If it did not exist, it could not cause the universe to come into existence.

Moreover, pantheism does not offer an adequate explanation for the fine-tuning of the universe. Pantheism affirms the existence of an impersonal god and denies the existence of a pre-existent intelligence. (Indeed, a completely impersonal intelligence is almost a contradiction in terms.) Hence, it too lacks causal adequacy as an explanation for the fine-tuning.

Thus, theism stands as the best explanation of the three major worldviews—theism, pantheism, and naturalism—for the evidence of the beginning of the universe and its fine-tuning.

Theism vs. deism

Admittedly, theism, naturalism, and pantheism are not the only worldviews that can be offered as metaphysical explanations for the three classes of evidences discussed above. Deism is also a candidate. And deism, like theism, can explain the cosmological singularity and the anthropic fine-tuning since deism conceives of God as both a transcendent and intelligent creator. Nevertheless, deism denies that God continues to participate within the creation, either as a sustaining presence or as an actor within it after the origin of the universe. Thus, deism would have difficulty explaining evidence of discrete acts of design or creation during the history of the cosmos (after the Big Bang).

Yet, as noted above, precisely such evidence now exists in the living world.

Current fossil evidence puts the origin of life on earth at 3.5-3.8 billion years ago. This is roughly 10 billion years *after* the origin of the universe. If the origin of the specified information necessary to produce the first cell provides compelling evidence of intelligent design (as argued above), then that suggests the need for an act of creative intelligence, or a period of creative activity, well after the origin of the universe.[42] On the other hand, theism conceives of God as an agent who may act within the natural order. The existence of such a Being can, therefore, explain specified biological information arising after the beginning of the universe. Deism, on the other hand, cannot account for evidence of such design after the origin of the universe, since it stipulates that God (the "absentee landlord") is not involved in the events or workings of the universe He created.

Panspermia?

Interestingly, some philosophical naturalists have postulated an immanent intelligence as an explanation for the origin of life on earth. Francis Crick and Richard Dawkins, for example, have each proposed the possibility of "directed panspermia."[43] This idea holds that life was intelligently designed (or seeded) on Earth by an intelligence within the

cosmos—a space alien or extra-terrestrial agent that evolved by purely naturalistic processes somewhere else in the universe.

Nevertheless, positing that life arose somewhere else in the cosmos does not explain how the information necessary to build the first life, let alone the first intelligent life, could have arisen. Instead, positing another form of pre-existing life only presupposes the existence of the very thing that all theories of the origin of life must explain—the origin of specified biological information.

Moreover, panspermia certainly doesn't explain the origin of the fine-tuning. Since the anthropic fine-tuning dates from the origin of the universe itself, any designing intelligence responsible for the fine-tuning must have had the ability to set the fine-tuning parameters and initial conditions of matter and energy from the moment of creation. Yet, clearly, no intelligent being (or alien) arising *after* the beginning of the universe could have set the initial conditions of the universe upon which its later evolution and existence would depend. Nor could such a being explain the origin of the universe itself.

CONCLUSION

In 1992, the historian of science Frederic Burnham stated that the God hypothesis "is now a more respectable hypothesis than at any time in the last one hundred years."[44] Burnham's comment came in response to the discovery of the so-called "COBE background radiation" that provided yet another dramatic confirmation of the Big Bang cosmology. Yet it's not only cosmology that has rendered the "God hypothesis" again respectable. As one surveys evidence from the natural sciences—from cosmology, physics, biochemistry, molecular biology, and paleontology—theism emerges as a worldview with extraordinary explanatory scope and power. Theism explains a wide ensemble of metaphysically significant scientific discoveries and theoretical results more simply, adequately, and comprehensively than other competing worldviews or metaphysical systems. This does not, of course, *prove* God's existence. It does suggest, however, that scientific evidence concerning cosmological and biological origins now provides strong evidential support for the existence of God and a theistic worldview.

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these cosmological models may have validity, they themselves have latent theistic implications. For example, on the standard Copenhagen interpretation of the so-called "collapse of the wave function," a wave function only acquires discrete values upon observation. Thus, if the universe initially could be represented as quantum wave function describing different possible spatial geometries and configurations of matter as quantum cosmologies suggest, the universe could not have acquired discreet characteristics until some "cosmic observer" had actualized one of its potential combination of states by observing it.

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