

Inflation, the Multiverse, and the Creator

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Abstract

The physical constants of the Universe are fine-tuned to support life, and a design inference logically follows. One can avoid this inference under the assumption that cosmic inflation has produced an inflationary multiverse comprising many universes, a few of which possess the conditions requisite for life. Thus this article first reviews the presuppositional bankruptcy of naturalism and then examines the scientific merits of both inflation and its consequent multiverse, as well as of the hypothesis that a quantum fluctuation produced the Universe. We find that, besides the *a priori* failure of naturalism in general, the hypothesized scenario is in tension with fundamental principles of science and functions rather as a modern origins myth.

Key Words: Fine-tuning, inflation, multiverse, Anthropic Principle

Introduction

The fine-tuning of the Universe for life has provoked significant discussion (e.g., Leslie, 1989; Barrow, 2002; Barnes, 2012). Fine-tuning is unsurprising given a Creator, but those who reject Him must seek alternatives. For this purpose, the theory of inflation is attractive: besides solving the flatness and horizon problems (see below), it is theoretically difficult for inflation to occur only once. Hence, our Universe could be but one of many inflation-generated universes (the entire collection being the “multiverse”), and each of these “pocket universes” could have different values for physical constants. Thus, it is argued, a more

scientific alternative to design is to posit *many* universes, one of which (ours) by pure chance possesses the conditions required for life.

This article examines, from a Biblical perspective, the argument above. Since multiple authors have advanced this line of reasoning (in various forms), we focus on the presentation by Lawrence Krauss (2012) in *A Universe from Nothing*. Krauss is by no means the first to present such arguments; for broadly similar proposals, see, e.g., Vilenkin (1982); Tegmark (2003a); Lapiedra and Morales-Lladosa (2015). However, Krauss’s book seems to have communicated to a broad audience, reaching the

New York Times best-seller list (“Nonfiction,” 2012).

Thus, we here first review the general relationship between science and revelation, which Krauss consistently pits against each other. We next consider the hypotheses of inflation and of an inflationary multiverse. (Note that a variety of multiverse theories exist; the Appendix briefly surveys four categories of these theories, including the inflationary type.) Thereafter we proceed to examine the proposal that the Universe/multiverse originated as a quantum fluctuation. We conclude by remarking on the similarity of these proposals to ancient origins myths.

Science and Revelation

In his first sentence, Krauss acknowledges that he is “not sympathetic” toward divine creation (p. xi), and the rest of the

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book fairly drips with scorn regarding it. He concludes, “If we are to be intellectually honest, we must make an informed choice, informed by fact, not by revelation” (p. 183), and this dichotomy appears to motivate much of his thinking. Here the word “fact” has become a proxy for “naturalistic”—because an infinity of unobservable universes qualifies as a potential fact, but a Resurrection with 500 eyewitnesses apparently does not. The Resurrection is (presumably) untenable because it requires supernatural intervention, whereas the multiverse qualifies as a scientific theory, as long as any discussion of it remains on strictly naturalistic grounds. This reasoning hence implicitly incorporates methodological naturalism into the definition of science: one might grant the bare possibility that “something” is out there—but science, one would say, must limit itself to naturalistic explanations.¹

Other works (e.g., Meyer and Nelson, 2017; Dilley, 2017) provide cogent responses to the assertion that methodological naturalism is definitional to science. We here restrict ourselves to brief consideration of naturalism as a worldview, noting that only a theistic worldview provides grounds to trust the power of science—so that science logically depends on revelation for confidence in its own effectiveness. (For more analysis see, e.g., Lewis, 1947; Bahnsen and Booth, 1996; Reed and Williams, 2011.)

First, science (like any field) assumes that rational thought is superior to irrational. The intrinsic superiority of rational thought is in fact inescapable—any attempt to prove the opposite defeats itself by giving *reasons* to distrust reason. But for a naturalistic worldview

there is no essential difference between rational and irrational thought: both a physicist’s conclusions and a lunatic’s ravings reflect (chance) interactions between the particles in their brains. Even a deep conviction of the superiority of scientific thought is the product of electrochemical reactions and thus no more rational (or irrational) than a forest fire or tornado. Since naturalism thus renders rationality meaningless, a rational argument for naturalism can succeed only in establishing its own meaninglessness—and thus defeating itself.²

Second, science implicitly assumes the Universe follows rational laws discernible through careful investigation. But what foundation can naturalism give for this assumption? One may not appeal to experience, because such appeals implicitly expect the future to be like the past—thus assuming lawlike temporal uniformity and begging the question. The laws of nature, for naturalism, can only be brute facts, with no reason to expect their existence now or their continuation in the future. Thus, in their work (which assumes these laws) naturalistic scientists implicitly deny naturalism—and they *must* do so, for naturalism cannot provide a presuppositional basis for science itself.

The Christian worldview, on the other hand, provides just such a foundation. The God who establishes His faithfulness in heaven itself (Psalm 89:2) upholds the Universe by His powerful Word (Hebrews 1:3), and the One in whom all things hold together (Colossians 1:17) is named the Logos (John 1:1)—i.e., rationality itself. It is the Christian worldview and (arguably) only the Christian worldview which can make sense of rationality and the laws of

science. It is therefore fundamentally incoherent to presuppose naturalism while lauding science or to argue that “scientific” explanations must exclude revealed truth.

Since, then, naturalism is flawed at the presuppositional level, we could legitimately end our analysis at this point and refrain from further discussion. However, the Word of God reminds us that “the things that have been made” reveal God sufficiently well to leave men “without excuse” (Romans 1:20). Therefore, no matter how deeply we probe the created order, we can be confident that testimony to God’s eternal power and divine nature will stubbornly persist.³ Therefore it is instructive to consider the theories reared on this (faulty) foundation of naturalism in order to demonstrate their own difficulties. We thus proceed to address the scientific arguments for an inflationary multiverse.

Inflation

We begin by considering the theory of *inflation*, which provides the initial conditions for the subsequent expansion of the Universe. Inflation, originally proposed by Alan Guth (1981), proposes that the Universe, when only about 10^{-36} seconds old, expanded by a factor of 10^{26} or more. This exponential expansion⁴ was extremely rapid, occupying less than 10^{-30} seconds. (It is difficult to express how fast this is: inflationary theory postulates that a patch of the Universe the size of a proton expanded to the size of the orbit of Venus, and it did so

1 This position is not uncommon; e.g., a college-level text (Bennett et al., 2012) asserts that “modern science seeks explanations for observed phenomena that rely solely on natural causes” (p. 72).

2 Since truth inheres in the nature of God (John 14:6), denial of God’s existence forfeits the ultimate ground for distinguishing truth from falsehood.

3 It follows that believers should probe creation as deeply as possible (Prov. 2:3–5; 25:2), both to see God’s glory for themselves (Ps. 19:1; Rom. 1:20) and to expose His glory to those who would hide from it (Jn. 8:12; Matt. 5:14–16).

4 Governed by $a \propto \exp Ht$, where a is the expansion factor and H is a constant.

in less time than it takes light to cross a proton today.)

At the end of inflation, the expansion began to decelerate, eventually slowing to its current rate.⁵ Some regard inflation as the instigation of the big bang itself, while others seem to assume pre-inflationary expansion (see, e.g., Siegel, 2019). In any case, the dominant model understands inflation to have provided the initial conditions for both the expansion of the Universe and the subsequent formation of structure.⁶

The rationale for inflation

Inflation provides an elegant solution to several puzzles, two of which are the horizon and flatness problems.

The *horizon problem* arises from the fact that the Universe is thermally smooth, exhibiting the same temperature (to one part in 100,000) in every direction—and that it seems to have achieved this near-equilibrium state without causal contact between its widely separated parts. Inflation solves this problem by allowing pre-inflationary contact between different regions which inflation has since driven apart.

The *flatness problem* refers to the fact that the large-scale spatial geometry of the Universe is nearly Euclidean, and that certain *a priori* considerations make it very difficult to achieve a flat Universe by chance. Inflation solves this puzzle by noting that such expansion would flatten pre-existing curvature (just as the Earth's curvature is less noticeable than that of a marble).

Inflation has the additional advantage of providing the type of statistical fluctuations we see in the cosmic micro-

wave background (CMB), which gravity could then amplify to produce the large-scale structure we observe today. Furthermore, the concept of inflation is not as outlandish as it might seem: certain types of scalar fields would be capable of driving it—if those fields exist; however, no such *inflaton* field has yet been observed.⁷

Difficulties with inflation

Because inflation tidily accounts for a variety of observations, it is the default explanation for the initial conditions of cosmic expansion. Nevertheless, inflation is not without its own difficulties, some of which we here note.

One difficulty is the lack of observational evidence for the putative inflaton field. This paucity of observational data has allowed a proliferation of inflationary models, although increasingly accurate measurements of the CMB have provided a few constraints (Planck Collaboration et al., 2020).

One prominent cosmologist who harbors significant doubts about inflation is Paul Steinhardt—ironically so, given his role in developing the theory (e.g., Guth and Steinhardt, 1992). He points out (e.g., Ijjas et al., 2014) that the “classical” inflationary theory—which most naturally solves the horizon and flatness problems—is disfavored by the observational data noted above. In order to repair the classical theory, one requires a high degree of fine-tuning combined with unlikely initial conditions. Furthermore, even with these repairs there is as yet no way to show that a universe like ours is a probable outcome. As Leslie (1989, p. 3) observes, “*Inflation could itself seem to have required fine tuning* for it to occur at all and for it to yield irregularities neither too small nor

too great for galaxies to form” (emphasis in original).⁸

Another prominent dissenter is Roger Penrose, who appeals to entropy and the second law of thermodynamics; he points out that the smoothness cited above (as part of the horizon problem) represents a very low-entropy state.⁹ According to the second law, inflation cannot decrease entropy, so it follows that any pre-inflationary state could have possessed no more entropy than the current Universe. Hence, inflation could result in a smooth universe (solving the horizon problem) only if it began with a smooth universe in the first place. Penrose estimates the probability of this state of affairs to be $1/10^{10^{124}}$, an incomprehensibly tiny number (Penrose, 2010, p. 127).

Falsifiability is another issue. In March 2014, researchers with the BICEP2 (Background Imaging of Cosmic Extragalactic Polarization) telescope in Antarctica announced the detection of *B*-modes from gravitational waves in the polarization of the CMB. Since inflation predicts such waves, this detection was hailed as “direct proof” of inflation (e.g., Moskowit, 2014). However, the peer-reviewed paper reporting these observations (BICEP2 Collaboration et al., 2014) backed away from the claimed discovery, noting that some or all of the signal might be due to dust in our galaxy. The next year, a joint analysis by the BICEP2 and *Planck* teams concluded that *all* of the *B*-mode signal was attributable to Milky Way dust (BICEP2/Keck Collaboration et al., 2015) so that

8 One might rephrase these objections to say that—for inflation to occur and to produce our Universe—it would need to be designed and guided, which of course is not an option for naturalists.

9 Since gravity tends to pull material into clumps, a smooth distribution of matter is unlikely and corresponds to low entropy.

5 Today it appears to be accelerating again under the influence of dark energy.

6 Note that inflation is not identical to the Big Bang framework itself; one can reject inflation while accepting the Big Bang, just as (say) one can reject Hydroplate Theory while accepting the overall Flood model.

7 The Higgs boson is a scalar field, but identifying the Higgs with the inflaton is problematic; see Steinwachs (2019) and Horn (2020) for discussion.

no primordial gravitational waves had been found.

As a result, one astrophysicist privately remarked to the author, “If detection of *B*-modes proves inflation, doesn’t non-detection falsify it?” In fairness, one might more accurately say that their detection would have confirmed the “classical” type of inflation theories, which the lack of detection has thus ruled out. However, the comment highlights the difficulty of disproving inflation in general, to the point that Ijjas et al. (2017) claim it has become “so flexible that no experiment can ever disprove it.” If inflation is thus virtually unfalsifiable, its status as a scientific theory is doubtful.¹⁰

Hence, while most cosmologists accept inflation (at least as a working assumption), there is a non-fringe minority which continues—with good reason—to be skeptical.

Inflation and Genesis

The most objectionable aspect of inflation is its naturalism: whatever the original intentions might have been, for Krauss (2012) it becomes a crucial part of unbelief’s attempt to explain all things apart from a Creator. As believers, we utterly reject such an antitheistic motivation.

On the other hand, there is nothing inherently unbiblical in postulating rapid expansion during creation. Sudden expansion plays a key role in some creationist cosmologies; for instance, Humphreys’ white hole cosmology (1994) postulates expansion by a factor of at least 10^{10} in a few days of Earth time. Though this rate is far from that

assumed by inflation, it is nevertheless conceptually similar.

Furthermore, a creationary treatment of the horizon problem would be welcome—why *do* distant regions of the Universe have essentially the same temperature? Appeals to inscrutable divine fiat are unhelpful given the lack of apparent reason for God to have done so: large-scale thermal smoothness seems utterly unconnected to the habitability of Earth. Might thermalization of the “deep” have occurred on Day 1, before rapid (God-driven and God-directed) expansion on Day 2 produced the “expanse”? As noted above, naturalistic inflation suffers from significant difficulties; however, if future observations unambiguously detect primordial gravitational waves, then it might be worthwhile to investigate whether a divinely driven/directed Creation-Week inflation might explain the data.

However, that day has not yet—and may never—come. Hence, even though rapid “inflation-esque” expansion might be compatible with Scripture, it is mandated neither by Scripture nor (at this point, it seems) by observations.

An inflationary multiverse

As inflation proceeded, any original matter and energy would have been diluted to almost nothing by the tremendous expansion; when inflation finally ended,¹¹ the vast potential energy of the inflaton field would have decayed into other particles. This decay process would have dumped a large amount of new matter and radiation into the Universe, and thus the end of inflation is denoted as “reheating.” Furthermore, quantum fluctuations in the inflaton field would result in slight over- and under-densities in this new matter/energy, and these fluctua-

tions could function as “seeds” for the formation of large-scale structure (see, e.g., Peacock, 1999; Dodelson, 2003).

However, these same quantum fluctuations can have another result: if the density variations are too large, inflation will end significantly earlier in some regions than in others. Consequently, volumes of space where inflation has ceased will be carried away from each other by the ongoing inflation in surrounding regions—a scenario denoted “eternal inflation.” The result is a virtually infinite collection of “pocket universes” (Guth, 1997, pp. 246–250), each one disconnected from the others—i.e., an (*inflationary*) *multiverse*.¹²

For Krauss (2012), the inflationary multiverse provides an explanation for the fine tuning of the Universe. For, if the different universes each have different values of the physical constants, some of them will (purely by chance) happen to have the right values to support life—and we, being alive, of necessity find ourselves in such a universe. How, then should we evaluate this multiverse theory?

We first note that these other universes are not directly detectable, being in fact causally disconnected from ours. At the very least, this fact should warrant caution in appealing to them to solve observational problems—or to explain away design.

Second, we note that the original rationale for inflation has now reversed. Theorists first posited inflation to explain observations. But if inflation in fact produces every conceivable type of universe, how could one possibly infer inflation from any given feature of *our* Universe? How could it *explain* anything? If on the other hand some

¹⁰ See also Penrose (2004), who recounts that proponents of inflation originally predicted a flat universe, then modified their models to allow for an open universe, and now “appear to have reverted to $K = 0$ as being a prediction of inflationary cosmology” (p. 1023).

¹¹ Or, more precisely, when the exponential (vacuum-dominated) expansion gave way to power-law (radiation-dominated) expansion.

¹² Other multiverse scenarios arise in the literature, but Krauss (2012) largely confines his attention to the inflationary variety. See the Appendix for a brief consideration of other multiverse scenarios.

universes are more probable than others, then we might be able to examine the set of life-sustaining universes to see if ours is typical. But there is no agreement on how to determine such probabilities (the “*measure problem*”): the most natural way of assigning probabilities yields a value of less than $10^{-10^{55}}$ for the type of universe we observe (Ijjas et al., 2014).

Third, multiverse explanations of fine-tuning rely on the fact that, given an infinite number of trials, any result with non-zero probability will eventually occur. In other words, anything that can happen will happen. This reasoning, however, cuts both ways: the “anything that can happen” seems per force to include *Boltzmann brain* scenarios, in which spontaneous vacuum fluctuations produce a functioning brain (with a coherent but fictitious string of memories); this brain exists long enough to have a moment of consciousness before fluctuating back into the vacuum.¹³ Given a universe effectively bounded in space and time, the probability of such an event is so small as to be utterly negligible; but given an infinite multiverse, it is—by the same reasoning which explains fine-tuning—bound to happen.

Even worse, the accelerating expansion of our universe seems destined to dilute matter and energy into a permanent vacuum state. This state would have an eternity to produce (eventually) an unbounded number of Boltzmann brains—far more than the number of conscious observers that have existed until now. Thus, by this reasoning, it is far more probable that we are Boltzmann brains rather than true observers of a real external universe. This conclusion strikes at the validity of science itself,

yet given a multiverse it seems difficult to avoid. As Brian Greene states (in Sample, 2020),

I am confident that I am not a Boltzmann brain. However, we want our theories to similarly concur that we are not Boltzmann brains, but so far it has proved surprisingly difficult for them to do so;

he writes elsewhere,

The deep skepticism that emerges from the possibility of spontaneous brain formation forces us to be skeptical of the very reasoning that led us to entertain the possibility in the first place (2020, p. 301).

Hence, multiverse reasoning seems dangerously prone to solipsism, destroying its own foundation.¹⁴

Fourth, even if one dismisses as absurd the possibility that *we* are Boltzmann brains, one must confront the fact that multiverse theories typically predict Boltzmann brains to be the most common observers.¹⁵ In other words, if a multiverse generator produces too narrow a variety of universes, it is likely to produce no life-permitting universes at all; but if it produces too many, than it produces a multiverse filled with Boltzmann brains, so that most “observers” (being Boltzmann brains) never truly see a life-sustaining universe. Thus, it seems difficult to explain our situation (presumably genuine observers of a life-supporting universe) without somehow fine-tuning the multiverse creation mechanism. Indeed, Penrose (2004, pp. 764–765) estimates that it is $10^{10^{23}}$ times more likely for an observer to see a universe similar to ours but only one tenth the diameter. (Note that this number has

more *digits* than there are particles in the observable Universe.) Thus, unless we fine-tune the multiverse itself, we are immensely more likely to produce only small pockets of low entropy than the Universe we see today. As Lewis and Barnes (2016, p. 319) state,

If Penrose’s argument is correct then—as before—most observers in the inflationary multiverse will be Boltzmann Brains, small islands of order in a sea of chaos. And so the theory seems headed for the dustbin.

It thus seems that multiverse proponents have not evaded fine-tuning at all, instead having only pushed it back into more poorly-understood territory. Other considerations lead to similar conclusions. For instance, an ensemble of two-dimensional universes would probably not support life (Tegmark, 1997), nor, presumably, would one containing only the gravitational force with no electroweak analogue. In short, the multiverse might need its own fine-tuning. And if the fine-tuning of the Universe demands explanation, surely a more comprehensive tuning of the multiverse would also. As Leslie notes,

It can often seem that some fundamental constant needs tuning for several different reasons, all of which very fortunately demand that it be tuned in the same way. A slightly different Fundamental Theory might have made it impossible for there to be even a single life-permitting combination of constants (1989, p. 57).

Finally, we note that resort to the multiverse hypothesis effectively excludes, from the outset, an entire category of explanation—namely, anything involving design.¹⁶ As Gonzalez and Richards (2004) explain,

¹⁴ As does naturalism in general; absolutization of spacetime seems in several ways to undercut the validity of scientific knowledge itself.

¹⁵ Lewis and Barnes (2016) refer to these problems as the “Boltzmann Me” and “Boltzmann Observer” problems, respectively.

¹⁶ Regarding the claim that fine-tuning itself constitutes evidence for a multiverse (e.g., Leslie, 1989; Tegmark, 2003a), see the conclusive refutation by White (2000), who demonstrates that any such reasoning

¹³ The name seems to originate with Albrecht and Sorbo (2004) and involves a *reductio* on Ludwig Boltzmann’s proposal (Boltzmann, 1895, 1897) that “the observed universe should be regarded as a rare fluctuation out of some equilibrium state.”

[Given a multiverse hypothesis,] *no amount of evidence for apparent design could ever count as evidence of actual design.* But if science is a search for the best explanation, based on the actual evidence from the physical world, ...how responsible is it to adopt a principle that makes one incapable of seeing an entire class of evidence? (p. 270, emphasis in original)

In summary, let us explicitly list the ingredients necessary to escape fine-tuning through an inflationary multiverse. First, inflation itself depends on speculative physics: no inflaton has ever been observed in a particle accelerator, nor is it likely to be, given the enormous energy scale at which inflation would operate. Second, we have seen prominent (secular) scientists who provide cogent reasons for skepticism about inflation in general. Third, there is no agreement on the details of inflation, to the point that its very falsifiability is questionable. Fourth, even if one could show that inflation would lead to a multiverse, the hypothesis that different pocket universes would have different values for the physical constants has not yet been established.¹⁷ Fifth, even with all of the preceding assumptions, there is as yet no way to show that this scenario is likely to produce the type of universe we observe (the measure problem). Sixth, it appears that a multiverse is more likely to support Boltzmann brains than genuine observers—so that even if one rejects as absurd a “Boltzmann Me” scenario, one must explain the fact that we (presumably non-Boltzmann

requires a prior preference for a multiverse over against design. He summarizes, “Our good fortune to exist in a life-permitting universe gives us no reason to suppose that there are many universes” (p. 274).

¹⁷ The argumentation here typically depends on string theory, which is not yet a secure framework for fundamental physics.

brains) are observing the Universe we do. Seventh, it seems that to escape fine-tuning, one must assume the existence of a multiverse-creation mechanism which can produce life-supporting universes without *itself* being fine-tuned. Finally, appeals to a multiverse appear to beg the question by assuming from the outset that design explanations are untenable.

Far too many would rather swallow all of these assumptions than seriously consider the Biblical testimony to special creation—preferring to accept an infinitude of unobservable universes than to bow to the Creator who has revealed Himself. Occam’s Razor cuts far too close for their comfort.

Quantum Fluctuations

Finally, let us examine the ultimate claim underlying Krauss’s presentation, namely that the Universe (and multiverse) originated as a vacuum quantum fluctuation.¹⁸ This idea dates at least to Tryon (1973), who argues, “our Universe is simply one of those things which happen from time to time.” Because any vacuum hosts continual, tiny fluctuations of energy, it is claimed (e.g., Krauss, 2012, p. 168) that the inflaton field could have taken one of these fluctuations and inflated it into our Universe (or a multiverse). Furthermore, the process would require no source of energy because the loss of gravitational potential energy would always balance the increasing matter/radiation energy of the Universe (Tryon, 1973; Krauss, 2012, p. 167). As Leslie (1989, p. 79) summarizes, “Inflation might quickly generate 10^{50} tons of universe from something weighing under 10^{-5} grams and measuring 10^{-33} cm or less.” Hence the Universe is, according

¹⁸ Thus, quantum fluctuations would be the multiverse-creation “mechanism” of the previous section.

to Alan Guth, “the ultimate free lunch” (Guth and Steinhardt, 1992, p. 54).

At the outset, we should note that this scheme is by no means *creatio ex nihilo*,¹⁹ for it assumes a pre-existing framework (whether spacetime, or something more fundamental) endowed with the elaborate laws of quantum field theory (plus speculative extensions like the inflaton field). The Bible, on the other hand, teaches that everything which exists and is not God was created by God—all spacetime, all matter and energy (including vacuum energy), all fields (classical or quantum), all laws of nature, etc. To call the quantum-fluctuation hypothesis “a universe from nothing” (the title of Krauss’s book) is mere wordplay. As Carroll (2012) writes concerning that book,

But it doesn’t, and doesn’t even really try to, explain why there is something rather than nothing—why this particular evolution of the wave function, or why even the apparatus of “wave functions” and “Hamiltonians” is the right way to think about the universe at all. And maybe you don’t care about those questions, and nobody would question your right not to care; but if the subtitle of your book is “Why There Is Something Rather Than Nothing,” you pretty much forfeit the right to claim you don’t care.

David Albert, professor of philosophy at Columbia University, elaborates, noting that today we recognize the fundamental “physical stuff” to be fields, not particles. He then explains,

Relativistic-quantum-field-theoretical vacuum states—no less than giraffes or refrigerators or solar systems—are particular arrangements of elementary physical stuff. The true relativistic-quantum-field-

¹⁹ Despite the fact that some (e.g., Barrow and Tipler, 1986, pp. 442–443) refer to it as such.

theoretical equivalent to there not being any physical stuff at all isn't this or that particular arrangement of the fields—what it is (obviously, and ineluctably, and on the contrary) is the simple absence of the fields! ... The fact that some arrangements of fields happen to correspond to the existence of particles and some don't is not a whit more mysterious than the fact that some of the possible arrangements of my fingers happen to correspond to the existence of a fist and some don't. And the fact that particles can pop in and out of existence, over time, as those fields rearrange themselves, is not a whit more mysterious than the fact that fists can pop in and out of existence, over time, as my fingers rearrange themselves. And none of these poppings—if you look at them aright—amount to anything even remotely in the neighborhood of a creation from nothing (2012).

Ikjyot Singh Kohli (2014, pp. 1–2) evaluates the approach of Krauss (2012) and others as follows:

The issue with all of these works is that on one hand, the authors claim that these proposals are universes *from nothing*, while on the other hand [they] assume at a minimum all of the complex machinery of variational principles, differential and pseudo-Riemannian geometry, topology, quantum field theory, and general relativity, while *never* addressing the deeper issue of where the latter come from. The other issue is that if all of this machinery is supposed to create universes from nothing, which is clearly not nothing in any sense of the word, then why do the authors go to such lengths to describe this machinery as nothing? (emphasis in original)

Why indeed, if not to provide a substitute for special creation? For though the quantum-fluctuation hypothesis does not give us *creatio ex nihilo*, it does

do away with an absolute beginning, obviating the need for a Beginner.²⁰

We have already noted that testimony to the Creator will stubbornly persist even under the closest investigation of creation. In this case, testimony to the bankruptcy of the quantum-fluctuation creation hypothesis comes from the twin ideas of energy and entropy, long familiar to creationists in the form of the first two laws of thermodynamics.²¹ We examine each in turn.

Energy

First consider the energetics of quantum fluctuations. The Heisenberg Uncertainty Principle prescribes the length of time a fluctuation can last; specifically,

$$\Delta E \cdot \Delta t \sim \hbar, \quad (1)$$

where ΔE is the uncertainty in energy measured over a time interval Δt , and is the reduced Planck's constant.²² The value of is extremely small, around 10^{-34} Joule-seconds. For reference, a tank of gasoline contains about 10^8 Joules of energy, so a fluctuation with a gas tank's worth of energy would last less than 10^{-42} seconds. So how (one might ask) could a fluctuation produce not just a tank of gas but an entire Universe, which (ac-

cording to Krauss) has lasted for billions of years?

The answer Krauss gives is that the total energy of the Universe might in fact be zero, because gravitational potential energy (which drives inflation) is negative. So, as the Universe inflates, it essentially “rolls downhill”; the gravitational potential energy becomes more negative, and the inflaton energy becomes more positive—while the total remains zero. Thus, if the net energy of the fluctuation/Universe is zero, there is no limit to how long it could last. He states,

Including the effects of gravity in thinking about the universe allows objects to have—amazingly—“negative” as well as “positive” energy. This facet of gravity allows for the possibility that positive energy stuff, like matter and radiation, can be complemented by negative energy configurations that just balance the energy of the created positive energy stuff. In so doing, gravity can start out with an empty universe—and end up with a filled one (p. 99).

However, this response suffers from multiple difficulties. First, it is not clear how one could show that the gravitational energy of the Universe *exactly* balances out its positive energy; remember that even a mismatch the size of a tank of gas presents an impossibly high barrier.

Second, even if the energy does balance, the question remains of how this state of affairs arose in the first place. If a powder keg explodes under my house, neither I nor the police will be satisfied with an explanation that says, “The loss of chemical energy in the powder balances out the kinetic energy gained by the fragments of the house, so there's nothing to explain—things like this just happen.” After all, if there is truly no energy cost to creating a universe, why do we not see new universes popping into

20 Even a universe with no beginning would require a Cause logically (if not temporally) prior to it, unless one argues that the Universe is its own ground of existence. Some such postulate (identifying a changing, contingent universe as the ultimate ground of reality) is necessary to evade the cosmological argument for God's existence.

21 ...and corresponding roughly to the cosmological and teleological arguments for the existence of God.

22 Contrary to some popular accounts, the system never violates energy conservation, although the mass of a virtual particle need not match its “normal” mass on short timescales.

existence daily?²³ Or if the pre-inflation state were somehow different—so that it was capable of producing universes while today’s vacuum is not—then how did the pre-inflation state come to be so precariously balanced?

Third, it is not obvious that one can assign a definite value to gravitational potential energy—which one must do to claim that the total energy vanishes. In classical mechanics of course, the zero point of the gravitational potential is arbitrary. In general relativity, while the notion itself can be ill-defined,²⁴ it is possible to define the total energy of an isolated system (Misner et al., 1973, pp. 451–459). However, it is not always possible to do so for the Universe as a whole; whereas Krauss claims, “There is one universe in which the total energy is definitely and precisely zero.... It is a closed universe” (p. 166), Misner et al. (1973) argue that such a statement is meaningless:

There is no such thing as “the energy (or angular momentum, or charge) of a closed universe,” according to general relativity, and this for a simple reason. To weigh something one needs a platform on which to stand to do the weighing.... These terms are undefined and undefinable. Words, yes; meaning, no” (pp. 457–458).

But what about quantum field theory? This brings us to a fourth problem with the zero-energy explanation, namely, that the proper way to incorporate gravity into quantum field theory remains unknown. Any rigorous demonstration that a universe could spontaneously pop into being by conver-

sion of gravitational potential energy to matter requires a self-consistent theory that handles gravity and quantum fluctuations together. As yet there is no such theory, and it follows that the zero-energy explanation is still speculation, not science.²⁵

In summary, to circumvent energy conservation, Krauss proposes that the Universe has zero total energy. But first, it is difficult to see how one could ascertain that the total energy vanishes exactly, which it must in order for this proposal to work; second, it does not explain the apparent instability of the pre-inflationary state; third, it is unclear that the notion of total energy is well-defined in this case; and fourth, there is no actual theory within which one can rigorously assess these claims. All experience to date—including the formalized experience known as science—assures us that (as much as we might wish otherwise) gas tanks do not spontaneously fill with gas. Much less do vacua give birth to universes.

Entropy

Entropy provides a second barrier to the production of the Universe from a quantum fluctuation. In discussions of life on Earth, evolutionists attempt to circumvent the second law of thermodynamics by appealing to the fact that the Earth is an open system. That appeal is not available for the Universe as a whole, and as a matter of fact cosmologists routinely appeal to entropy considerations when studying the expanding universe (e.g., Dodelson, 2003, p. 45).

Therefore, the problem cannot be avoided: how did the Universe come to have such low entropy when all natural processes *increase* net entropy? Recall Penrose’s calculation of one chance in $1/10^{10^{124}}$ —and recall that inflation only

exacerbates low-entropy difficulties. A quantum fluctuation is, after all, the very definition of a probabilistic process—and if odds this low do not rule out a hypothesis, is it truly falsifiable?

One possible response is anthropic, namely, that a low-entropy universe is necessary for life: if the Universe were high-entropy, then we would not be around to observe it, and since we *are* around to observe it, it is no surprise that we observe low entropy. But, first, this argument implicitly assumes a multiverse; as Krauss notes, “This argument, however, makes mathematical sense only if there is a possibility that many different universes have arisen” (p. 125). More seriously, this response fails to deal with how *very* low the entropy is. Even if we ignore Boltzmann brain scenarios, a low-entropy pocket of (say) 1 Gpc^3 should easily allow life to exist, and it would be vastly more probable than what we *do* observe. So the question remains: how could this extremely complex and yet low-entropy Universe have come into being by chance?

We conclude that both energetic and entropic considerations mitigate against the formation of the Universe from a quantum fluctuation in a vacuum. Why is there something—and, in particular, *this* something—rather than nothing? When all is said and done, there will never be a better answer than Genesis 1:1.

Conclusion

It is likely that everyone has at some point stood in awe of the ineluctable factuality and beauty of the Universe. It might seem incredible that anyone should believe it an overgrown vacuum glitch. And yet very intelligent men—who surely have admired their share of starry nights and sunsets—compose eloquent presentations of precisely that theory.

They are not the first to do so. Rodríguez (2015) provides a fascinating

²³ Or if a large activation energy is involved, why not at least around supernovae, active galactic nuclei, etc.?

²⁴ In general relativity, gravitational potential energy is not part of the energy-momentum tensor, having been absorbed into the geometry of spacetime.

²⁵ Ikjyot Singh Kohli (2014) provides a technical explanation of the problems with one such scheme.

review of ancient near-eastern origins myths, which frequently begin with a “nothingness” that is not quite *nothing* (“darkness and a limitless ocean or primeval waters ...[yet] a lifeless, motionless state of absolute inertness and nonexistence,” p. 295). From the potential within this not-quite-nothingness, everything spontaneously arises—first the forces of nature (personified as gods) and then, out of these forces, everything else. Today’s origins myths are much more sophisticated, adorned with brilliant mathematics, yet in the end they are strikingly similar to what pagans have believed for millennia.

We have here noted the presuppositional failures of the naturalistic foundation for one such modern myth. We have seen that inflation, to which it appeals, is more problematic now than when first proposed forty years ago. We have noted the difficulties of the inflationary multiverse hypothesis.

And in the end, this myth falls afoul of fundamental physical principles which dictate that one cannot get something—much less the extremely ordered something in which we live—out of true nothingness.

Why would sober scientists—well-versed in the concepts of energy and entropy—prefer an origins account that derives the Universe from a neopaganesque fluctuation in a sea of not-quite-nothingness?

Surely, in at least some cases, it is because the alternative—a transcendent, personal Creator and Judge—is to them abhorrent: “we will not have this Man to rule over us.” And thus their very wisdom leads them to folly, for the foolishness of God is wiser than men. Let us, then, who have seen the glory of God in the face of Christ be faithful to declare His glory, even among the sophisticated pagans of the twenty-first century.

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Appendix: Various Multiverse Theories

Max Tegmark (2003a) provides a useful taxonomy of multiverse theories, discussing the following four (nested) levels:

- Type I: multiple horizons within an infinite Λ CDM (Lambda-CDM or Lambda cold dark matter) universe.
- Type II: multiple “pocket universes” caused by chaotic inflation. (The main body of this paper deals with such a multiverse theory.)
- Type III: the “many worlds” postulated by the eponymous interpretation of quantum mechanics.
- Type IV: the grand collection of all self-consistent mathematical structures, each assumed to be a description of some reality.

We note that all of these scenarios are difficult to falsify given our current state of knowledge; therefore, presuppositional argumentation (see the second section of this paper) is supremely relevant in dealing with them.

Type I Multiverse Theories

Type I-multiverse theories start from the assumption of an infinite expanding universe with essentially random initial conditions. We, from our vantage point, are unable to observe outside our Hubble volume (beyond which the expansion of the Universe prevents light from reaching us). But if the Universe is infinite, there must also exist an infinity of such vantage points, situated within an infinity of disjoint Hubble volumes. This collection of volumes is a Type I multiverse.

It is crucial for these theories to assume spatial infinity and some degree of homogeneity, and these assumptions are extrapolations (rather than deductions) from our observations.²⁶ Tegmark deals with objections to infinite space by reviewing evidence for flatness as well as CMB (Cosmic Microwave Background) tests of topology; he deals with objections to homogeneity by reviewing evidence for large-scale uniformity: “assuming this pattern continues, space beyond our observable universe teems with galaxies, stars and planets” (2003a, p. 42). But he then extrapolates to $10^{10^{118}}$ m away—an extrapolation much more audacious than that of an ant who concludes that the Earth is flat. As Carroll notes, “Our observable patch of space is pretty uniform on large scales, it’s true. But to simply extrapolate that smoothness infinitely far beyond what we can observe is completely unwarranted by the data. It *might* be true, but it might equally well be hopelessly parochial” (2007, emphasis in original). These theories also typically make the philosophically-loaded assumption of stochastic initial conditions, so that the multiverse contents realize all possible configurations.

However, since each of the universes in a Type I collection obeys the same physical laws, such collections are not directly relevant to the issue of fine-tuning.

Type II Multiverse Theories

Type II-multiverse theories postulate an ensemble of post-inflation pocket universes, possibly governed by different physical constants. (Note that each pocket universe could potentially be an entire Type I multiverse.) The main body of the paper deals with this type of multiverse.

²⁶ Even a spatially flat homogeneous universe could be finite if endowed with a nontrivial topology (e.g., that of a 3-torus or an orbifold).

Type III Multiverse Theories

Type III-multiverse theories rely on the Many Worlds Interpretation (MWI) of quantum mechanics (QM), first advocated by Hugh Everett (Everett, 1956). According to MWI, observation of (say), Schrödinger's cat does not stochastically collapse the wavefunction into one of two eigenstates (alive or dead); instead, the wavefunction branches into two separate universes, the cat being alive in one and dead in the other. This continual bifurcation of reality produces an ensemble of parallel universes which collectively realize all possible outcomes.²⁷

We note first that there is no general consensus in favor of MWI or, for that matter, of any particular interpretation of QM:

Quantum theory provides a framework for modern theoretical physics that enjoys enormous predictive and explanatory success. Yet, in view of the so-called “measurement problem,” there is no consensus on how physical reality can possibly be such that this framework has this success. The theory is thus an extremely well-functioning algorithm to predict and explain the results of observations, but no consensus on which kind of objective reality might plausibly underlie these observations (Friederich and Evans, 2019).

Thus, neither theory nor evidence requires MWI (reminding us again of the importance of presuppositions).²⁸

²⁷ For this reason, Tegmark (2003a) comments that Type III-multiverse theories actually add nothing to Types I and II, since those types already span all possible outcomes.

²⁸ See Duwell (2007) regarding the claim of David Deutsch (e.g., 1997) that quantum computing depends on MWI; Duwell argues “that this view is not tenable” (p. 1007).

Second, even proponents of MWI disagree on the “reality” of these alternate universes. As Martin Gardner writes,

If all these countless billions of parallel universes are taken as no more than abstract mathematical entities—worlds that could have formed but didn't—then the only “real” world is the one we are in. In this interpretation of the MWI the theory becomes little more than a new and whimsical language for talking about QM. It has the same mathematical formalism, makes the same predictions. This is how Hawking and many others who favor the MWI interpret it. They prefer it because they believe it is a language that simplifies QM talk, and also sidesteps many of its paradoxes (2001, p.14).

Thus, to escape fine-tuning via MWI requires a double extrapolation from experimental science: only a realistic interpretation of MWI (which is itself an interpretation of QM) will yield an actual multiverse.

In addition, MWI seems to suffer from the same problems as radical skepticism—namely, that its advocates do not (cannot?) live according to it. For instance, Phillip Ball argues that proponents of MWI should have no reservations about a game of “quantum Russian roulette,” in which there is a 10^{-9} chance that they wake up with \$1 billion (and otherwise die)—because “you can be certain, in this view, that you'll wake up to be presented with the cash. Of course, only one of ‘you’ wakes up at all; the others have been killed. But those other yous knew nothing of their demise” (Ball, 2018). Yet presumably even the most ardent supporter of MWI would decline such a wager.

Finally, returning to the issue of presuppositions, note that Everett's argumentation (1956) for MWI assumes that the wave function—evolving in a deterministic fashion—is a complete description of reality (e.g., “the wave

function itself is held to be the fundamental entity, obeying at all times a deterministic wave equation,” p. 115). Neither chance nor human observers (nor divine sovereignty) collapses the wavefunction, since the wavefunction never collapses. As a result (at least in a realistic interpretation of MWI) there seems to be no room for providence or, for that matter, any expression of divine righteousness or goodness in the natural world—since all possible events occur. Few other interpretations of QM integrate naturalism so thoroughly.²⁹

Thus, ultimately there appears to be no reason (beyond philosophical and/or presuppositional ones) to prefer MWI to other interpretations, much less the realistic variant required for a Type III multiverse.

Type IV Multiverse Theories

Type IV is the most comprehensive—and speculative—level of multiverse, postulating the existence of universes collectively realizing every conceivable (non-contradictory) mathematical structure. These mathematical structures could describe not only systems of physical laws but also specific contents of a universe.³⁰ In essence, Type IV proposes that every conceivable state of affairs occurs—physical laws, physical constants, material contents, etc.—as long as that state is not actually self-contradictory. Tegmark employs phrases such as “complete mathematical symmetry” and

²⁹ For an overview of various interpretations (compared to the Relational Quantum Mechanics interpretation), see Laudisa and Rovelli (2021).

³⁰ For instance, my location on the couch typing on my laptop could in principle be expressed as a string of 1s and 0s, and thus part of a mathematical structure. One could also subsume quantum indeterminacy by rephrasing to state that all non-contradictory structures are realized in some Type III multiverse.

“radical Platonism” to describe such a state of affairs.

This multiverse concept is so far removed from observational support that one can reasonably invoke the adage that “he who asserts must prove,” reminding us that the burden of proof rests on those who propose Type IV, not on those who question it. Even Tegmark (2003a) provides in support only (1) the fact that mathematics is “unreasonably effective” (Wigner, 1960) in describing our universe, and (2) the generality and objectivity of abstract mathematics, which seems capable of describing any conceivable universe. He elsewhere adds (3) the claim that mathematical democracy “provides the only answer so far” to the question (attributed to Wheeler) “Why these particular equations, not others?”—and thus it “resolves the fine-tuning problem ...once for all” (Tegmark, 2003b).

The first two of these arguments (i.e., the effectiveness and generality of mathematics) are unsurprising in a specially created universe. The third argument requires a prior commitment to naturalism, dismissing out of hand any teleological answer to Wheeler’s question. In essence, Type IV takes an observed feature of our universe—namely, that not every abstract mathematical form corresponds to reality—and postulates (without evidence) that each of these forms *is* a reality in another universe (indeed, that they actually *constitute* those other universes). Rephrasing in theological terms, one can observe the freedom of the Creator (to create or not to create) in the existence of this particular “something” (rather than nothing, or a different “something”); Type IV denies this freedom by postulating that all self-consistent “somethings” exist. Stephen Hawking famously asked what breathes “fire into the equations and makes a universe for them to describe” (Hawking, 1988); Type IV, rather than admit a free Creator, supposes that equations generate their own fire.

The question also arises as to why these structures must be internally consistent—for if the laws of logic govern which structures can exist, then whence do these laws arise? It seems that mathematics here replaces God as the ultimate, self-existent reality³¹—but, unlike the Biblical God who wills, chooses, and creates, this god is pantheistic (or at least panentheistic—“all *in* God”) in that it simply constitutes all things. Once again we see the influence of presuppositions, which in this case dictate a preference for untethered speculation rather than acceptance of God’s revelation through Christ in Scripture.

Concluding Thoughts

We should also note that the *measure problem* (described in the body of the paper) bedevils all multiverse levels save the first. We note in addition that the most obvious objection to multiverse theories (of any type, but especially of Types II–IV) is their violation of the principle of parsimony (Occam’s Razor), which states that one should not postulate more entities than necessary to explain the phenomena.³²

Tegmark attempts to answer this objection—Lewis and Barnes (2016) provide a similar response—by noting that “an entire ensemble is often much simpler than one of its members”; for instance, an extremely simple algorithm can generate all positive integers, including arbitrarily large ones. Thus, he argues, “In this sense, the higher-

level multiverses are simpler” (Tegmark, 2003a, p. 51). But—while granting the principle—surely this application of it is specious. Is it more parsimonious to explain the existence of a red book on my desk by postulating an infinitude of universes containing a variety of books (of various colors, quantities, etc.) positioned on (under, beside, etc.) various pieces of furniture—or by concluding that someone put it there? Leslie concurs:

[P]hilosophy as such supplies no really good grounds for accepting many and varied universes. Indeed, it might actually supply grounds for rejecting them even after all due attention had been paid to the arguments of physicists and cosmologists. Simplicity is fairly powerfully advanced the fewer universes we believe in and the more we insist that any other universes must resemble ours (1989, p. 98).

Martin Gardner was no biblicist, yet his words provide an apt rejoinder to multiverse speculation:

The stark truth is that there is not the slightest shred of reliable evidence that there is any universe other than the one we are in.... Surely the conjecture that there is just one universe and its Creator is infinitely simpler and easier to believe than that there are countless billions upon billions of worlds, constantly increasing in number and created by nobody. I can only marvel at the low state to which today’s philosophy of science has fallen (2001, p. 16).

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31 Tegmark himself certainly seems to regard mathematics as the ultimate reality, entitling his 2014 book, *Our Mathematical Universe: My Quest for the Ultimate Nature of Reality*.

32 While Occam’s Razor is neither mathematical axiom nor physical law, it helps regulate speculative attempts to “save” a favorite theory through increasingly complex elaborations.

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