Did the Universe Have a Cause?

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1. Introduction

The Universe is the combination of all of the physical things there have ever been, that there are, and that there ever will be. The Kalam Cosmological Argument (KCA) is an argument for God's existence that makes use of the beginning of the Universe. The argument can be broken up into two stages. In Adam's opening statement, he offered the first stage, wherein he concluded that the Universe had a cause:

P1. Whatever has a beginning must have a cause.
P2. The Universe had a beginning.
So, C. The Universe had a cause.

The second stage involves an argument that the Universe's cause must be God. Adam tells us:

> Why do people think this cause is God? Many thinkers have concluded that the best explanation for this cause is some sort of a Supreme Being through abductive reasoning, that is, an inference to the best explanation. That's how we often think through things: something happens, and so we look for an explanation. We think through lots of possibilities of what could be the explanation or the cause, but what's the best explanation of it? That's the sort of abductive reasoning that I'll be using. For example, since the universe itself just is space, time, and matter, then those things didn't exist until the universe began. Therefore, it's reasonable to conclude that this cause, which existed prior to space, time, and matter, is spaceless, timeless, and immaterial. Also, it's reasonable to conclude that this cause is very powerful since it brought the universe into existence.

Our attention in this chapter will be on the first two premises of the first stage. To be sure, there is plenty to be said about the second stage as well – for example, if some recent ideas in theoretical physics turn out to be correct, the combination of all physics things may include more than space, time, and matter. But here we set aside our misgivings with the second stage. We will argue that there is no good reason to accept either premise of the first stage.

The KCA was proposed by John Philoponous, taken up by medieval Islamic thinkers such as Al-Kindi and Al-Ghazali, and was discussed by Immanuel Kant. In our era, the KCA's foremost defender is William Lane Craig. For that reason, much of our attention will be given to what Craig has said in defense of the two premises. Though we don't think the argument succeeds, we do think the argument raises two questions that should interest everyone regardless of their religious beliefs. First, questions about the nature of causation – including whether the Universe could have had a cause – and, second, questions about whether the Universe began to exist.

2. The Causal Principle

Causation is central to the KCA. For example, Adam's first premise – the *Causal Principle* – claims that whatever begins to exist must have a cause and concludes that the Universe had a cause. In this section, we show that the KCA makes assumptions about causation that are incompatible with a view of causation popular among philosophers of physics – *Neo-Russellianism*. As we will show, given Neo-Russellianism, one or the other of the KCA's premises is false. While the case for Neo-Russellianism isn't definitive, without strong reasons to reject Neo-Russellianism, we have no good reason to accept the KCA.

Many people see science as the hunt for causes. Adam certainly does; he has said that "one of the fundamental principles of science is that things don't begin or happen without a cause" and that "for science just is a search for causes".[1] Geologists hunt for the causes of various kinds of rock, while medical researchers hunt for the underlying causes of disease. However, in 1912, philosopher Bertrand Russell argued that when we mature to a sophisticated scientific understanding, we leave the hunt for causes behind.[2] Science, Russell claimed, seeks to explain natural phenomena but not in terms of causes.

For Russell, our most sophisticated science – physics – simply doesn't make use of causes. Instead, physics is written in terms of mathematics. Furthermore, the mathematical relationships physicists discover do not behave like the relationships between causes and their effects. Let's consider a few

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[1] Adam Lloyd Johnson, "The First-Cause Argument for God (Apologetics for Teens Part 1)". *YouTube*, March 11, 2024. https://www.youtube.com/watch?v=wRWmrVrnO48.

[2] Bertrand Russell, "On the Notion of Cause," *Proceedings of the Aristotelian Society* 13 (1912), pp. 1–26.

of the features that the relationship between causes and their effects is usually understood to have. To start, there's the *asymmetry of causal influence*: causes are not related to their effects in the same way that effects are related to their causes. Historians say that the assassination of Archduke Franz Ferdinand caused World War I. Ferdinand's assassination caused World War I, but World War I did not cause Ferdinand's assassination. Moreover, causes are *specific*. Many things happened before World War I that did not cause World War I. For example, the planet Mars was such and such many miles from Earth in 1790, but no historian would say the location of the planet Mars was just as much a cause of World War I as Ferdinand's assassination. Out of all the things that happened before World War I, we single out Ferdinand's assassination as *the* cause. The relationships physicists discover lack the asymmetry and the specificity of causal relations. For Russell, historians phrase their explanations in terms of causes only because our knowledge of history is not as technically sophisticated as our knowledge of physics. When history matures, Russell would argue, historians will stop appealing to causes.

Explanations vary in detail. A *macrophysical* description of a gas cloud uses pressure, volume, and temperature. A *microphysical* description focuses on the positions, masses, and velocities of the cloud's constituent particles. Both describe the same cloud at different levels of analysis.

Microphysical descriptions lack the asymmetry of causal influence; the laws and the microphysical state at any time determine both past and future states equally. While World War I was caused by Ferdinand's assassination, in microphysical terms, the assassination and the war are interdependent, with neither the cause of the other. Moreover, the microphysical description is not specific. Every past event, even Mars' position in 1790, equally influenced whether World War I happened. Microphysically, nothing at all singles out Ferdinand's assassination as *the* cause.

Without a microphysical asymmetry of causal influence, nothing microphysically distinguishes causes from effects. And since, microphysically, nothing at all singles out causes, events are determined by their entire past and future. The microphysical description is so radically unlike the macrophysical description that using words like 'cause' and 'effect' can only mislead us.

In 1979, another philosopher – Nancy Cartwright – provided a powerful argument that we need causation after all.[3] According to Cartwright, understanding causal relationships helps us identify effective strategies, like good strategies for avoiding cancer. Let's suppose – and we are making this up for the sake of the example – we discover that smokers are less likely to get cancer. Should we start smoking to avoid cancer? No, we might (for example) also find that smokers tend to exercise more often than non-smokers. When we compare groups carefully— comparing smokers who

[3] Nancy Cartwright, "Causal Laws and Effective Strategies," *Nous* 13 (1979), pp. 419-437.

exercise to non-smokers who exercise — we find that smoking increases the risk of cancer. The key to understanding why not smoking is a better strategy involves the recognition that smoking *causes* cancer. We need to recognize causal relationships – and not merely the correlations between variables – to identify effective strategies.

Neo-Russellians strike a balance between Russell and Cartwright. Neo-Russellians agree with Russell that science includes a level of description – the microphysical level – without causation. But Neo-Russellians also agree with Cartwright that we need causation to distinguish effective strategies from ineffective strategies.

Perhaps there is no microphysical causation. However, this doesn't imply events occur randomly or without explanation. An event can have an explanation without having a cause because some explanations do not involve causes. For instance, it's impossible to connect three houses to three utilities (water, gas, and electric) without two lines crossing. (Try it!) Instead of being explained by a cause, the fact that there is no way to connect three houses to three utilities is explained by a geometric principle: on a plane, three points cannot all connect to three other points without crossing lines. Moreover, theologians have long acknowledged that there can be non-causal explanations. Instead of being explained by a cause, God's existence, they say, is explained by God's essence. Perhaps all microphysical explanations are likewise non-causal.

Adam agrees that not everything needs a cause – "only things that have a beginning need a cause".[4] God, for example, wasn't caused but also isn't unexplained. Neo-Russellians can agree that everything has an explanation while denying that such explanations must always involve causes. Hence, the disagreement between Adam and the Neo-Russellians is not about whether anything can begin without any sort of explanation whatsoever. Instead, the disagreement concerns whether some beginnings can be explained in non-causal terms.

To reconcile Russell's idea that, at the deepest levels, causation is absent from physics with Cartwright's insight that causation is crucial for formulating effective strategies, Neo-Russellians need to explain how causation became part of our everyday, macrophysical perspective. And even if causation doesn't apply microphysically, we need to explain why we find descriptions in terms of causation useful.

Since the nineteenth century, a branch of physics – *statistical mechanics* – has shown how macrophysical states relate to microphysical states. Many microphysical states result in the same macrophysical state. Consider an analogy. Suppose that you know that, on average, students earned

[4] Johnson, "The First-Cause Argument".

85% in a course. If that's all you know, you wouldn't be able to determine the grade that any individual student earned. Many combinations of grades result in the same average. Likewise, there are many distinct configurations of the atoms in the air filling a room – many microphysical states – that result in the same volume, mass, pressure, and temperature – the same macrophysical state.

Some macrophysical states have fewer corresponding microphysical states than others. Suppose that, in one semester, the average was 0%. There is only one way for the average to be 0% – every student would have to have a 0%. Just as there are fewer ways for the average in a course to be 0% than there are ways for the average to be 85%, so, too, there are fewer ways to arrange atoms in one corner of a room than throughout the entire room. If the class average is 0% one semester, most likely, the class average will be different the following semester. Likewise, if a collection of atoms starts bunched into a corner of a room, following physical law, most of the ways that the collection could evolve involve spreading out over the room. So, most likely, the collection will spread out over the room.

The same could be true for causation. Just as we can use statistical mechanics to explain why gasses expand to fill a room, so, too, statistical mechanics explains the asymmetry of causal influence. Statistical mechanics explains why we can single out some small set of past events, e.g., Ferdinand's assassination, as mattering more for an event we want to explain, e.g., World War I. Though microphysical changes anywhere to the past of World War I matter for whether World War I happened, there are comparatively few *macrophysical* events to World War I's past that matter. Statistical mechanics also helps to explain why causation is useful for determining effective strategies. There are all sorts of ways we could have described our world. But we are embedded within our world in a way that makes causation useful. Though we don't have the room to explicate it here, much of this story has been worked out in technical detail in the academic literature.

Provided Neo-Russellianism is true, there are two possibilities. On the one hand, just as causation is a useful way to talk given our perspective embedded within the world, but not a feature of our world at the deepest level, that anything *begins to exist* could merely reflect a useful way to talk given our perspective embedded within the world. Crucially, many Neo-Russellians think that time is fundamentally undirected – our experience of a distinction between the past and the future arises in the macrophysical world but does not apply to the microphysical world. In that case, at the deepest level of analysis, the Universe didn't begin to exist in any sense that matters for the KCA; the second premise of the KCA is false. On the other hand, our notion that anything begins to exist might reflect more than a merely useful way to talk given our perspective embedded within the world. Perhaps, in the deepest description of our world, some things *do* begin to exist. In that case, in the microphysical description, nothing that begins has a cause; the Causal Principle is false. Either way, the KCA makes implicit assumptions incompatible with Neo-Russellianism.

We don't think this argument is completely decisive. After all, despite the view's popularity, not all philosophers are convinced that Neo-Russellianism is correct. We take a modest position. Our position is that, without a good enough reason to reject Neo-Russellianism, we don't have a good enough reason to accept the KCA.

Objection: Okay, maybe some things can begin without causes. That doesn't mean the Universe can begin without a cause.

On the one hand, this objection confuses the premises of the KCA with its conclusion. The KCA's first premise claims that anything that begins to exist must have a cause. We don't need to refute the idea that the Universe has a cause to throw this premise into doubt. On the other hand, if, as many Neo-Russellians argue, causation is explicable in terms of lower-level physical phenomena, then, just as there cannot be non-physical water, so, too, there cannot be non-physical causes. In that case, nothing – including God – could have caused the Universe.

Objection: Neo-Russellians do not actually deny the Causal Principle because their view is consistent with positing necessary conditions for anything to begin to exist.

Some philosophers reject the Causal Principle because – the claim goes – some quantum events happen without being determined by anything prior. This claim is based on a controversial interpretation of quantum mechanics; moreover, there is no need for the Neo-Russellian to accept that any events happen without being determined. Nonetheless, Adam might offer a similar response to Neo-Russellianism as the one William Lane Craig has offered to objections based on indeterministic versions of quantum mechanics. Craig argues that indeterministic quantum events "cannot properly be said to be uncaused" because they have "many physically necessary conditions".[5] Craig may reply that just as indeterministic quantum events are not uncaused because they have physically necessary conditions, Neo-Russellians aren't really claiming that there are uncaused microphysical events because, in their view, all microphysical events have physically necessary conditions.

Craig is wrong that physically necessary conditions are causes. For example, Gillian cannot be the only female child out of three offspring unless she has two brothers. Gillian's two brothers were a necessary condition for, but not the cause of, her being the only female out of three children.

[5] William Lane Craig, "The caused beginning of the universe: A response to Quentin Smith," *British Journal for the Philosophy of Science*, 44, no. 4 (1993): 627.

Likewise, a condition that necessitates some other occurrence is not generally the cause of that occurrence. A box cannot have a right side without also having a left side, but neither side causes the other. Furthermore, David Lewis,[6] Mark Colyvan,[7] Steven French and Juha Saatsi[8] have argued that there are examples in physics where, in the complete absence of causes, a system is constrained to evolve in such a way that some other entity – such as a white dwarf star or a molecule – comes to exist.

Objection: If something can begin without a cause, why don't we see this happening all the time?

Some philosophers have claimed that without the Causal Principle, there is no explanation at all for why entities begin at specific places, times, in some specific number, or why only certain kinds of things begin to exist. For example, Craig wonders why, if things can begin without causes, raging tigers and Italian villages do not pop into existence for no reason all over the place. Furthermore, the entities that could pop into existence in front of me over the next second seem to vastly outnumber those that do. If things can begin without causes, why isn't our world overrun by vast numbers of entities inexplicably beginning over the next second?[9] This objection confuses something happening for *no reason* and something happening *without a cause*. While Neo-Russellians think that, microphysically, all sorts of events take place without causes, Neo-Russellians do not claim that things happen for no reason at all.

We don't need causation to explain why entities do not begin just anywhere, just any when, or in just any number or kind. Recall the three utilities puzzle. Suppose the first two houses are already connected to all three utilities, the third house is already connected to water and gas, and no two connecting lines have crossed. Independent of whether anything can begin without a cause, an uncrossed connecting line cannot begin between the third house and electric. Even if things can begin without causes, whatever already exists constrains what could begin to exist next.

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6 David Lewis, "Causal Explanation." In *Philosophical Papers*, vol. 2 (Oxford: Oxford University Press, 1987), 214–240.

7 Mark Colyvan, "Causal Explanation and Ontological Commitment." In *Metaphysics in the Post-Metaphysical Age: Papers of the 22nd International Wittgenstein Symposium,* ed. Uwe Meixner & Peter Simons (Austrian Ludwig Wittgenstein Society, 1999).

8 Steven French and Juha Saatsi, "Symmetries and Explanatory Dependencies in Physics." In *Explanation Beyond Causation: Philosophical Perspectives on Non-Causal Explanations*, ed. Alexander Reutlinger and Juha Saatsi (Oxford: Oxford University Press, 2018), 185–205.

9 W. Norris Clarke, *The One and the Many: A Contemporary Thomistic Metaphysics* (Notre Dame: University of Notre Dame Press, 2001); William Lane Craig and James Sinclair, "The Kalam Cosmological Argument." In *The Blackwell Companion to Natural Theology*, ed. William Lane Craig and J. P. Moreland (Oxford: Wiley-Blackwell, 2009), 101–201; Edward Feser, *Five Proofs of the Existence of God* (San Francisco: Ignatius Press, 2017).

David Hume is sometimes thought to have denied causation, though for different reasons than Russell. Hume was concerned with a puzzle about possibility: can the existence of any one thing necessitate the existence of some independent thing? In other words, for any two things – where both exist together in reality – is it possible for one to exist without the other? Hume argued that events are independent, with no necessary connection between them, so that any event could have existed without any other. Since a cause and its effect are independent, Hume thought that a cause (like Ferdinand's assassination) could possibly occur without its effect (World War I) and vice versa. For Hume's followers, even though raging tigers never pop into existence for no reason at arbitrary places and times, it's nonetheless possible for one to do so. For that reason, Hume would say that – even if all things that begin to exist in reality have causes – it's false that anything that begins to exist *must* have a cause.

Other philosophers deny that for any two things – where both exist together in reality – it is possible for one to exist without the other. They believe in necessary connections. For example, some philosophers believe that natural laws are explained by the essences of the entities they govern. The essence of something defines what it is, and according to essentialists, entities like electric and magnetic fields must behave in certain ways because of what they are. Neo-Russellianism is independent of whether there are necessary connections. Hence, Neo-Russellians can accept that while the fields' behavior isn't caused, the fields' essences determine what happens next. In that case, there are necessary connections between independent things, and raging tigers must not spontaneously pop into existence at arbitrary places and times.

3. Did the Universe begin to exist?

Let's turn to the KCA's second premise, viz, that the Universe began to exist. KCA proponents defend this premise in two ways: first, by drawing upon science, and second, by drawing upon purely philosophical arguments. We first consider what it means for the Universe to have had a beginning and then consider both cases in turn.

3.1. What does it mean for the Universe to begin?

One might think that "the Universe began to exist" merely means it has a finite age. However, philosophers and physicists have good reason to think the idea is more complicated. For example, some propose that, in the deepest description, time doesn't have a direction. Just as statistical mechanics was able to explain why processes tend to happen in only one direction, perhaps statistical mechanics can explain why, in our ordinary experience, time seems to have a direction from the past to the future. Provided the direction of time is not part of the deepest description of our world, beginnings or endings won't be part of the deepest description either. Other philosophers maintain that if time does not objectively pass, nothing really begins.[10] If so, philosophers who think the passage of time is merely a powerful illusion have good reason to reject the KCA. For the sake of argument, we set these issues aside.

Some KCA proponents have views that make it difficult to understand what it would mean for the Universe to begin. For example, Craig argues that God is in time and entered time by creating time. Nothing, including God, has existed for more time than there has ever been. If time is finite, then – since God entered time some finite number of years ago – God is finitely old. Yet God is beginningless. If Craig is right, some things with a finite age – like God – are beginningless; in that case, to make a good case for the beginning of the Universe, Craig needs to show that the Universe is not only finitely old but is one of the finitely old things with a beginning. Most arguments for the beginning of the Universe – including Craig's – only attempt to show that the Universe is finitely old. Hence, if Craig is right that some finitely old things are beginningless, most arguments for the beginning of the Universe do not succeed.

3.2. The Scientific Case

Setting aside what it may mean for the Universe to have a beginning, is there a good case to be made that the Universe has a finite past? In our view, science cannot tell us whether the Universe has a finite past. You might be perplexed. "Surely," I can imagine you saying, "Science has shown that the Universe originated in the Big Bang!" We agree with the scientific consensus: the largest visible

[10] Craig and Sinclair, "Kalam", 183-184; William Lane Craig, "Creation and Divine Action," In *Routledge Companion to Philosophy of Religion*, ed. Chad Meister and Paul Copan (New York: Routledge, 2007): 318–328; William Lane Craig, "God and real time," *Religious Studies,* 26, no. 3 (1990): 337-338; William Godfrey-Smith, "Beginning and ceasing to exist," *Philosophical Studies, 32*, no. 4 (1977): 393–402; Bradley Monton, *Seeking God in Science: An Atheist Defends Intelligent Design* (Peterborough: Broadview Press, 2009): 94; David Oderberg, 2003. "The Beginning of Existence". *International Philosophical Quarterly* 43, no. 2: 146; Ryan Mullins, *The End of the Timeless God* (Oxford: Oxford University Press, 2016): 135-136, 143, 147; Ryan Mullins, 2011. "Time and the Everlasting God," *Pittsburgh Theological Journal* 3 (2011): 43; Felipe Leon, "On Finitude, Topology, and Arbitrariness," In *Is God the Best Explanation of Things? A Dialogue* (Palgrave Macmillan, 2019):. 53-70.

portion of the Universe is expanding and the largest visible portion was once much hotter and denser. But there is no scientific consensus as to whether the Big Bang was the beginning of everything physical. Cosmologists navigate a sea of conjecture and speculation; for some, the Universe has a finite past, but others disagree.

Adam has a different understanding of the science. Adam claims that the Einstein Field Equation – the central equation in Einstein's theory of gravity – leads inexorably to the conclusion that the Universe originated in a singularity. He also claims that Einstein introduced the cosmological constant to avoid a beginning.[11] Both the science and the history are more complex.

On the scientific side, the Einstein Field Equation has some solutions that represent the universe expanding out of a singularity, but also includes solutions – compatible with all scientific data – where the visible universe, while expanding, did not expand out of a singularity. In any case, as we will see below, we have good reason to think that the Einstein Field Equation is only approximately true and only in contexts less exotic than those near the putative singularity. Hence, even if the equation did entail an initial singularity, we have no good reason to think that entailment is true.

On the historical science, Einstein had motivations other than ensuring the Universe is beginningless. Einstein followed nineteenth century researchers – such as Hugo von Seeliger – who had tried to solve some mathematical problems in Newtonian gravitation through an analogous method.[12] Einstein's was also motivated by his desire to explain matter.[13] Einstein thought that a future theory, one that supplanted his field equation, would explain matter and remove singularities.

Adam also claims that "no living scientist" thinks the Universe is beginningless.[14] Scientific opinion is currently divided on whether the Universe had a beginning, with physicists making strong claims on both sides. Alexander Vilenkin writes that the "proof" is "now in place" and "cosmologists can no longer hide behind the possibility of a past-eternal universe".[15] Meanwhile, Sabine Hossenfelder writes, "if you read yet another headline about some physicist who thinks our universe could have

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[11] Both claims appear in Johnson, "The First-Cause Argument".

[12] John Norton, "The Cosmological Woes of Newtonian Gravitation Theory", In *The Expanding Worlds of General Relativity* (*Einstein Studies*, vol. 7), ed. Hubert Goenner, Jürgen Renn, Jim Ritter, Tilman Sauer (Boston: Birkhauser, 1999): 271-322.

[13] John Earman and Jean Eisenstaedt, "Einstein and Singularities", *Studies in History and Philosophy of Science Part B: Studies in History and Philosophy of Modern Physics* 30, no. 2 (1999): 185-235.

[14] Johnson, "The First-Cause Argument".

[15] Alex Vilenkin, *Many Worlds in One: The Search for Other Universes* (New York: Hill and Wang, 2007): 176

begun this way or that way, you should really read this as a creation myth written in the language of mathematics. It's not wrong, but it isn't scientific either."[16] Our view aligns with Sean Carroll,[17] and the majority of physicists, who say that we simply don't know. When we try to extrapolate our physical theories backward to the exotic conditions at the Big Bang, we are extrapolating our theories beyond the domain where we have any confidence in their applicability.

Since all cosmological models, whether they have a finite past or not, are speculative, controversial, and subject to criticism, we wouldn't bet on any specific model. Instead, our view aligns with Robert Geroch's: "the mere existence of a [model] having certain global features suggests that there are many models – some perhaps quite reasonable physically – with very similar properties".[18] Even unrealistic models can illustrate features the Universe might possesses.

This highlights a mistake commonly made in arguments either for the conclusion that the Universe began or that the Universe was beginningless. The probability that any individual lottery ticket wins may be very low, but we shouldn't conclude that, most likely, no ticket will win. Compare this fact about lotteries to one of Craig and Sinclair's arguments.[19] They argue that since individual cosmological models with an infinite past are improbable, probably, the Universe doesn't have an infinite past. On the contrary, just as the fact that no individual lottery ticket is likely to win doesn't show that, probably, no ticket will win, so, too, the fact that no individual cosmological model with an infinite past is probable doesn't show that, probably, the Universe doesn't have an infinite past. The situation is completely symmetric for models with a beginning. No specific cosmological model with a beginning is probable, but this does not entail that a beginning is improbable.

To argue for a beginning, one needs to either show that some specific cosmological model with a beginning is probable or else that the disjunction of all possible beginningless models – even models no one has thought of – is improbable. We don't see a way that one could succeed at either.

Though the situation may change in the future, current physics provides two compelling reasons for thinking we cannot know whether the Universe began with the Big Bang.

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[16] Sabine Hossenfelder. "We Don't Know How the Universe Began, and We Will Never Know." *Backreaction*, August 27, 2022. https://backreaction.blogspot.com/2022/08/we-dont-know-how-universe-began-and-we.html

[17] Sean Carroll, *From Eternity to Here: The Quest for the Ultimate Theory of Time* (Dutton, 2010): 50-1.

[18] Robert Geroch, "Space-Time Structure from a Global Viewpoint." In *General Relativity and Cosmology*, ed. B. K. Sachs (New York: Academic Press, 1971), 78.

[19] Craig and Sinclair, "Kalam"; William Lane Craig and James Sinclair, "On Non-Singular Space-Times and the Beginning of the Universe." In *Scientific Approaches to the Philosophy of Religion*, ed. Yujin Nagasawa (London: Palgrave Macmillan, 2012), 95–142.

The first compelling reason is the physics horizon. Scientific theories typically apply to some limited domain and break down outside it. Engineers still use Newtonian physics to build bridges because bridges are neither small enough for quantum mechanics to matter nor large enough for General Relativity to matter. But Newtonian physics breaks down when we turn to atoms, where we need quantum mechanics, or black holes, where we need General Relativity. Scientific theories typically don't indicate where they might break down; typically, we need to look beyond the theory itself for that information.

Present-day physics is different. The theory that describes particles smaller than atoms – the standard model of particle physics – and the theory we use to describe gravity – General Relativity – both include internal hints about where they might fail. They are said to predict their own demise.

We need both theories to extrapolate the Universe backward to the Big Bang. The standard model of particle physics likely fails at very high energies. General Relativity likely fails at very high energy densities and extreme space-time curvatures. When we use these theories to extrapolate the Universe backward in time, we encounter increasingly large energies, densities, and curvatures. This marks the conditions where our current theories likely breakdown, creating a boundary between what we understand and what we don't—the *physics horizon*.[20]

As Ellis[21] and co-authors[22] point out, the physics horizon presents a unique problem. If we can't trust our physical theories beyond the physics horizon, where will a new theory come from? The conditions beyond the physics horizon exceed those available in any experiment. We can't use cosmological data to test new theories while also using those theories to explain the Universe's evolution. Thus, the physics horizon represents a limit to our understanding and a boundary to the physics we can independently verify.

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[20] George Ellis, "Before the Beginning: Emerging Questions and Uncertainties," *Astrophysics and Space Sciences* 269 (1999): 693-720; George Ellis, "On the philosophy of cosmology," *Studies in History and Philosophy of Science Part B: Studies in History and Philosophy of Modern Physics* 46 (2014: 5-23; Ellis, G.F.R. 2018. "The Standard Cosmological Model: Achievements and Issues". *Foundations of Physics* 48: 1226-1245; George Ellis, Roy Maartens, and Malcolm MacCullum, *Relativistic Cosmology* (Cambridge: Cambridge University Press, 2012): 530-532.

[21] George Ellis, "Before the Beginning", 705-6.

[22] George Ellis, Roy Maartens, and Malcolm MacCullum, *Relativistic Cosmology* (Cambridge: Cambridge University Press, 2012): 531.

Jacobus Erasmus – one prominent KCA proponent – has replied that "the fact that [General Relativity] may not describe the Planck epoch [i.e., the high energy conditions near the Big Bang] does not imply that we cannot trust the prediction of a beginning of the universe."[23] Erasmus continues by arguing that General Relativivty and quantum gravity must describe reality at two different levels, so that, if General Relativity predicts a beginning, so, too, must quantum gravity. Erasmus is mistaken.

On the one hand, Erasmus's claim appears to go both ways – if one item is described at different levels, then the beginning described at any level should appear at the other levels. Consider that General Relativity, itself, supplanted Newtonian gravity. In the Newtonian description of the Big Bang, there is no beginning. Hence, a beginning described at any level does not generally appear at the other levels.

On the other hand, Erasmus's claim seems to be motivated by a false assumption concerning the relationship between a theory and its successor. While a successor does need to reproduce all of the observational and experimental successes of its predecessor, the successor can make sweeping changes. For example, as we increase the mass of an object, there are ever greater differences between the predictions made by Newtonian gravity and General Relativity. Neutron stars and black holes are large, massive objects that differ dramatically from anything Newton could have predicted. In the exotic conditions at the Big Bang, whatever happened could be radically unlike anything predicted by General Relativity.

Let's move on to the second compelling reason for thinking we cannot know whether the Universe began with the Big Bang – the Malament-Manchak theorem and related results. First, some background. Since no signal can travel faster than light, I can only receive signals from a specific region of space-time known as my *past light cone*. This applies to any observer. The full set of observations made by all observers in space-time forms a collection of these past light cones. If we were to construct another space-time model that includes all the same past light cones as the original, any observer in the original has a counterpart in the new model who makes all of the same observations. As a result, no observation in the universe described by the original model could distinguish between the two.

The global properties of space-time are those that space-time as a whole possesses. To know whether space-time as a whole has a beginning, we need to know its global properties. We can only see a small part of spacetime. Perhaps we have evidence that the small part to our past includes a beginning, the objection from the physics horizon notwithstanding. There are space-time models

[23] Jacobus Erasmus, *The Kalām Cosmological Argument: A Reassessment* (Springer, 2018): 153.

where there is no universal direction of time, so that there are no objective beginnings, but that include regions where, according to the direction of time in the region, the region had a beginning. For all we know, we could be in a spacetime like that.

As David Malament[24] conjectured and J.B. Manchak[25] proved, given any set of past light cones from almost any space-time model, we can construct another space-time model that includes the same past light cones but with distinct global properties. No observation could favor the first model over the second. Space-time models with an overall direction of time, and so with the possibility of an objective beginning, have an observationally indistinguishable counterpart without an overall direction of time and without the possibility of an objective beginning.

Maybe we've moved too quickly. Couldn't we extrapolate from the largest observable part of our Universe to infer that the rest of the Universe probably has the same properties? Philosopher Nelson Goodman distinguished between law-like generalizations, which can be projected into new circumstances, and accidental generalizations, which usually cannot.[26] For example, if previously examined bits of copper are electrically conductive, we can infer that unexamined bits of copper will likely be as well. However, if all previously examined coins from my pocket are nickels, this doesn't mean unexamined coins will also be nickels. Law-like generalizations can be projected because confirming their instances increases the probability that they apply to unexamined cases.

Law-like generalizations are typically based on local properties. When we use generalizations based on local properties to infer the properties of space-time, as a whole, we limit ourselves to space-time models that fit those local properties. However, even with these restrictions, it's possible to construct different space-time models with the same set of past light cones but a distinct global structure.[27] Some law-like generalizations – namely, those involving a phenomenon called *quantum entanglement* – are not based on local properties. Quantum entanglement won't allow us to receive signals from outside our past light cones, so it doesn't help us to discover space-time's global structure, either. Therefore, we cannot infer from the largest observable part of our Universe that the rest of the Universe probably has the same properties.

[24] David Malament, "Observationally Indistinguishable Space-Times." In *Foundations of Space-Time Theories*, vol. VIII of *Minnesota Studies in the Philosophy of Science*, ed. John Earman, Clark Glymour, and John Stachel (Minneapolis: University of Minnesota Press, 1977): 61–80.
[25] J.B. Manchak, "Can we know the global structure of spacetime?," *Studies in History and Philosophy of Science Part B: Studies in History and Philosophy of Modern Physics* 40, no. 1 (2009), pp. 53-56. For a less non-technical discussion, see J.B. Manchak, "The universe is unknowable from within it," *IAI News* (2025).
https://iai.tv/articles/the-universe-is-unknowable-from-within-it-auid-3057
[26] Nelson Goodman, *Fact, Fiction, and Forecast*, 4th Edition (Harvard University Press, 1983): 73.
[27] Manchak, "Can we know": 55.

Objection: Don't the singularity theorems show that the Universe began to exist?

We can understand a singularity as a boundary of space-time beyond which space-time cannot extend. This isn't a precise definition—the definition is still up for scientific and philosophical debate[28]—but it suits our purposes. If we could show that a specific kind of singularity exists in the past of every space-time point, as in some Big Bang models, we would know the Universe's past isn't infinitely long. Three theorems—one by Stephen Hawking and Roger Penrose,[29] another by Arvind Borde, Alan Guth, and Alexander Vilenkin,[30] and a third by Aaron Wall[31] — have been claimed to show that space-time is singular in this sense.

We don't have room to explicate these theorems here. However, no known singularity theorem escapes the physics horizon or Malament-Manchak results. Regarding the physics horizon, the predicted singularity lies within the region where known physics likely doesn't apply. Regarding Malament and Manchak's results, even if we somehow knew there was a singularity in our past, we couldn't infer that it's to the past of all spacetime points. So, the singularity theorems are no help in determining whether the Universe began.

Objection: Doesn't the second law of thermodynamics show that the Universe is past finite?

On the largest observable scales, entropy is on the rise. If the Universe has been around forever, shouldn't the Universe have reached thermodynamic equilibrium? First, the Universe may conceivably lack an equilibrium state altogether, forever increasing in entropy, e.g., Carroll and Chen.[32] Second, some cosmological models suggest a mechanism for resetting a large region of

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[28] John Earman, *Bangs, Crunches, Whimpers, and Shrieks* (Oxford: Oxford University Press, 1995); Erik Curiel, "The analysis of singular spacetimes," *Philosophy of Science*, 66 (1999): S119–S145; Erik Curiel, "Singularities and Black Holes." In *The Stanford Encyclopedia of Philosophy* (Spring 2021 ed.), ed. Edward N. Zalta (Stanford, CA: Metaphysics Research Lab, Stanford University, 2021). https://plato.stanford.edu/archives/spr2021/entries/spacetime-singularities/; Pankaj Joshi, "Spacetime Singularities." In *Springer Handbook of Spacetime*, ed. Abhay Ashtekar and Vesselin Petkov (Berlin: Springer, 2014): 409–436.
[29] Stephen Hawking and Roger Penrose, "The singularities of gravitational collapse and cosmology," *Proceedings of the Royal Society A* 314, no. 1519 (1970): 529–548.
[30] Arvind Borde, Alan Guth, Alexander Vilenkin, 2003. "Inflationary spacetimes are incomplete in past directions". *Physical Review Letters,* 90, no. 17 (2003): 1–4.
[31] Aaron Wall, "The generalized second law implies a quantum singularity theorem," *Classical and Quantum Gravity* 30, no. 16 (2013): 1-35.
[32] Sean Carroll and Jennifer Chen, "Spontaneous Inflation and the Origin of the Arrow of Time" (2004). https://arxiv.org/abs/hep-th/0410270

spacetime, like the largest observable region, to a low entropy state.[33] The lesson from the Malament-Manchak theorem still applies: even if the largest region we can observe has a low entropy boundary in its past, it doesn't follow that the Universe, as a whole, has a low entropy boundary.

Again, we do not claim that any specific model is probable; we doubt that any specific model is probable. We offer these examples to illustrate features a more realistic model might, for all we know, include and to show that a finite age for the Universe doesn't inevitably follow from the second law of thermodynamics.

3.2. The Purely Philosophical Case

As we've argued, there's little hope for a scientific case for premise 2. But premise 2 has also been defended through purely philosophical arguments. We will consider two such arguments: the *Hilbert's Hotel argument* (HHA) and the *successive addition argument* (SAA). We find both unconvincing. Moreover, we will draw a general lesson concerning attempts to demonstrate the impossibility of an infinite or beginningless past.

Hilbert's Hotel

Let's start with the HHA:

1. An actual infinite cannot exist.
2. An infinite temporal regress of events is an actual infinite.
3. Therefore, an infinite temporal regress of events cannot exist.

Craig supports the first premise – that an actual infinite cannot exist – through thought experiments like Hilbert's Hotel. Hilbert's Hotel has infinitely many rooms. In an ordinary hotel, if

[33] Nikodem Popławski, "Cosmology with torsion: An alternative to cosmic inflation," *Physics Letters B*, 694 (2010): 181–185; Nikodem Popławski, "Universe in a Black Hole in Einstein–Cartan Gravity," *The Astrophysical Journal*, 832 (2016): 1–8; Paul Steinhardt and Neil Turok, N. (2002). "Cosmic evolution in a cyclic universe," *Physical Review D*, 65, no. 12 (2002): 1–20; Paul Steinhardt and Neil Turok, *Endless universe: Beyond the Big Bang-Rewriting Cosmic History* (New York: Broadway Books, 2007); Anna Ijjas and Paul Steinhardt, "Fully stable cosmological solutions with a non-singular classical bounce," *Physics Letters B* 764, no. 10 (2017): 289–294; Anna Ijjas and Paul Steinhardt. "Bouncing cosmology made simple," *Classical and Quantum Gravity* 35, no. 13 (2018).

every room is occupied, no additional guests can be accommodated. Not so for the infinite hotel. By shifting guests around—moving the guest in room 1 to room 2, the guest in room 2 to room 3, and so on—a new guest can be accommodated. Any number of new guests can be accommodated.[34]

Craig exploits a counterintuitive property of infinite sets. In a finite hotel, there are fewer even-numbered rooms than total rooms. Not so for infinite sets. Although not all counting numbers are even, there are as many counting numbers as there are even numbers. Mathematicians say that infinite sets can include a proper subset that has the same size (or cardinality) as the entire set.

Absurdity

Metaphysical possibility refers to what is possible in the broadest sense, even if it doesn't exist in the actual world. Craig argues that the "absurdity" of Hilbert's Hotel helps to establish that an actual infinite is metaphysically impossible:

> Hilbert's Hotel is absurd. But if an actual infinite were metaphysically possible, then such a hotel would be metaphysically possible. It follows that the real existence of an actual infinite is not metaphysically possible.[35]

What does Craig mean by 'absurd'? Perhaps 'absurd' means strange. But something being strange does not entail being metaphysically impossible. As Alexander Pruss notes, the possibility of the strange "is proved by the strangeness of the platypus".[36]

If Craig could prove that the existence of an actual infinite leads to a contradiction, he would demonstrate its impossibility. Craig sometimes appears to argue that Hilbert's Hotel leads to contradictions. He claims that when guests check out, absurdities arise because subtraction or division, applied to infinite collections, produces contradictory results. For example, when all the guests with room numbers greater than three check out, we are left with three guests, while, if all the guests with room numbers greater than five check out, we are left with five guests. Nonetheless, "in both cases we subtracted the identical number of numbers from the identical number of numbers and yet did not arrive at an identical result".[37] The idea is clear. Subtracting numbers means mentally removing them from a collection. However, the devil is in the details.

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[34] William Lane Craig, *The Kalam Cosmological Argument* (Wipf and Stock, 1979): 84-5.
[35] Craig and Sinclair, "Kalam": 110.
[36] Alexander Pruss, *Infinity, Causation, & Paradox* (Oxford: Oxford University Press, 2018): 12.
[37] Craig and Sinclair, "Kalam": 112.

Craig is careful to note that the purely abstract mathematical systems describing the infinite are perfectly consistent:

> While such a system may be perfectly consistent in the mathematical realm, given its axioms and conventions, I think that it is intuitively obvious that such a system could not possibly exist in reality.[38]

In the way mathematicians usually describe the infinite – Cantorian transfinite cardinal arithmetic – there is no such thing as subtraction. Therefore, in the abstract realm, the cases Craig imagines — where subtracting infinity from infinity leads to inconsistencies — do not occur. However, for Craig, this rule is just a convention mathematicians created to ensure consistency and cannot be enforced in the real world. When considering an infinite library, Craig writes,

> While we may correct the mathematician who attempts inverse operations with transfinite numbers, we cannot in the real world prevent people from checking out what books they please from our library.[39]

Craig mistakenly assumes that removing guests from Hilbert's Hotel or withdrawing books from an infinite library only involves "subtraction". Craig is mistaken. Instead, such cases involve *relative complements*. The relative complement of set A in set B is everything in B that isn't in A. For example, if A = {2, 3, 4} and B = {1, 2, 3}, the relative complement of A in B is {1}. Similarly, if A is the numbers greater than 3 and B is the counting numbers, the relative complement of A in B has only three members; if A is the set of numbers greater than 5, the relative complement of A in B has five members. No contradiction results.

We can consistently describe Craig's thought experiments, whether they concern hotels, libraries, or whatever, using relative complements. We can describe the behavior of Hilbert's Hotel mathematically, including guests checking out, etc., and never arrive at contradictory results.

While an actual infinite may not involve a contradiction, philosophers often argue something is metaphysically impossible without identifying a strict contradiction. Unfortunately, as Craig admits, there are no "clean, decisive markers of what is [metaphysically] possible or impossible." Instead, philosophers rely on "intuitions and conceivability arguments," which are "much more

[38] Craig, Kalam: 82.
[39] William Lane Craig and Quentin Smith, *Theism, Atheism, and Big Bang Cosmology* (Oxford: Oxford University Press, 1995): 15.

subjective" than strictly logical arguments. Yet, these arguments "cannot be refuted by facile observations" that a strict logical impossibility hasn't been shown.[40]

Two replies. First, if Craig is right, and appeals to metaphysical impossibility end up in subjective appeals to intuitions, then Craig's case is quite weak. Even if, before studying the infinite, your intuitions align with Craig's, not everyone's will. And what about our intuitions *after* we study the infinite? As Graham Oppy notes, "these allegedly absurd situations are just what one ought to expect if there were large and small denumerable physical infinities".[41] Thus, in this context, appeals to intuition are unconvincing.

Second, plausibly, our intuitions may be reliable for familiar matters but unreliable for exotic scenarios. As Ladyman and Ross note,

> [...] proficiency in inferring the large-scale and small-scale structure of our immediate environment, or any features of parts of the Universe distant from our ancestral stomping grounds, was of no relevance to our ancestors' reproductive fitness ... there is no reason to imagine that our habitual intuitions and inferential responses are well designed for science or for metaphysics.[42]

Appeals to intuition are inherently weak and there are good reasons not to rely on intuition concerning exotic scenarios. If Craig's premise can only be defended by intuition, we can be perfectly rational in not buying his premise.

Perhaps, by "absurd", Craig means that Hilbert's Hotel, itself, is metaphysically impossible. If so, we'd expect a reductio argument in support. In a reductio argument, a proposition is shown to imply a contradiction and we are led to infer that the proposition is impossible. Sometimes, Craig seems to offer a reductio. For example, he writes, "it is ontologically absurd that a hotel exists which is completely full and yet can accommodate untold infinities of new guests just by moving people around".[43] The idea seems to be that anything that is full cannot accommodate new guests, Hilbert's Hotel is full, yet Hilbert's Hotel can accommodate new guests. So, we have a contradiction.

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[40] Craig and Sinclair, "Kalam": 106.

[41] Graham Oppy, *Philosophical Perspectives on Infinity* (Cambridge: Cambridge University Press, p. 48).

[42] James Ladyman and Don Ross, *Every Thing Must Go: Metaphysics Naturalized* (Oxford: Oxford University Press, 2007): 2.

[43] Craig and Sinclair, "Kalam": 111.

But this argument equivocates between two meanings of the word 'full'. If 'full' means all the rooms are occupied, then, while Hilbert's Hotel is full, being full does not entail being unable to accommodate new guests. Clearly, Hilbert's Hotel can have all its rooms occupied and still make room for new guests. On the other hand, perhaps 'full' means no new guests can be accommodated, but then Hilbert's Hotel isn't full because it can accommodate new guests.

Another way to argue that Hilbert's Hotel is metaphysically impossible involves showing that Hilbert's Hotel contradicts a metaphysically necessary principle. Craig proposes Euclid's Maxim (EM) as a candidate for a metaphysically necessary principle. According to EM, the whole is greater than any proper part. Hilbert's Hotel violates EM because one of the hotel's proper parts – the even-numbered rooms – has just as many members as the entire hotel. However, whether any principle, including EM, is metaphysically necessary is controversial. Since we know that abstract collections, like counting numbers, violate EM, Craig argues that EM only applies to concrete things. If something is concrete, Craig claims, EM applies. We propose a simpler and less controversial alternative: if something is finite, EM applies. Our proposal has the advantage of being a basic mathematical fact: for finite collections, proper parts are smaller than the whole, but not necessarily for infinite collections. Absent any argument that EM is metaphysically necessary – and Craig doesn't offer one – we are back to mere appeals to intuition.

The successive addition argument

According to the Successive Addition Argument (SAA), time can't stretch back infinitely because the past is formed through a process called *successive addition*. Events move from the future, to the present, and then into the past, one at a time. As time passes, past events accumulate gradually, like counting numbers one by one. According to the SAA, this step-by-step process could never result in an infinite past.

Here's the SAA:

1. A collection formed by successive addition cannot be an actual infinite.
2. The series of past events is a collection formed by successive addition.
3. Therefore, the series of past events cannot be an actual infinite.

Craig believes that the second premise requires the objective passage of time.[44] Many philosophers would reject the second premise because they think time does not objectively pass. Moreover, even if time does objectively pass, and events are added one by one to the past, proponents of an infinite

[44] Craig and Sinclair, "Kalam": 124.

past may doubt the past *formed* by successive addition; after all, if the past is infinitely long, there never was a time when the past *grew* to be infinitely long. Instead, events were only ever added to an already infinite past. We set both objections aside.

Our objections target premise 1, i.e., a collection formed by successive addition cannot be actually infinite. To see things clearly, counting up should be distinguished from counting down. Let's begin with counting up. Craig writes:

> The impossibility of the formation of an actual infinite by successive addition seems obvious in the case of beginning at some point and trying to reach infinity.[45]

Imagine George is counting numbers, one number per second. Supposing nothing stops George from counting, George will count to any arbitrarily large natural number. But George's counting always remains finite. Successive addition can only yield finite results.

One of us (Alex) has recently updated an important objection to this point due to Dretske.[46] If George never stops counting, for every number, George will (eventually) count that number. And that means the *number* of numbers George will count is infinite. That is, George will count every member of an actually infinite collection.

Does this constitute a counterexample to premise 1 of the SAA? George's future includes infinitely many counting events, each added one at a time. Thus, the collection of George's future counting events is an actually infinite collection formed by successive addition. If so, premise 1 is false.

Craig could object that there will never come a time when George reaches an infinitieth number; the set of numbers George has counted will never be infinite. If so, isn't the collection of numbers George will count only potentially infinite, that is, a collection that, while always finite, grows towards infinity as a limit? This objection confuses the set of numbers George *will* count with the set of numbers George *will have* counted at various points in the future. Suppose the set of numbers George will have counted will never be infinite. Unlike potential infinities, the numbers George will count do not grow towards infinity as a limit; instead, the set of numbers George will count is successively *subtracted from* as each number is successively removed from the future and added to the past. So long as George never stops counting, the numbers George will count form an

[45] Craig and Sinclair, "Kalam": 117.

[46] Fred Dretske, "Counting to infinity", *Analysis* 25 (1965): 99–100; Alex Malpass, "All the time in the world", *Mind* 131, no. 523: 788-806.

actually infinite collection. (We have set aside, e.g., Malament-Hogarth space-times[47] which allow, in some sense, someone to have already counted to infinity.)

Craig might object that just because each member of a collection has a certain property, the entire collection need not share that property. For example, every student in a class has a biological parent, but there is no biological parent all the students share — the students aren't siblings. Similarly, Craig could argue that just because George will count each number, it doesn't mean he will count all of them. Craig is mistaken. While we can't always infer from each to all, in some cases, we can. If each child has a mother, no child is motherless. Similarly, if George counts each number, no number is left uncounted. The full collection of George's future counting events is actually infinite.

Thus, we think it is debatable whether premise 1 of the SAA is true when we consider counting up.[48] What about counting down? Imagine encountering George, who says, "3, 2, 1 … Phew, I've just finished counting down through all the numbers." Such a scenario is certainly strange and not a physically realistic possibility. But is such a scenario metaphysically impossible?

The mirror principle.

Let's assume, for argument's sake, that counting up toward infinity can never produce an actual infinite. It's tempting to conclude that the opposite process — a beginningless series of additions with an endpoint — is also impossible. Craig asks, "If one cannot traverse the infinite by moving in one direction, how can one traverse it by moving in the opposite direction?"[49]

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[47] John Earman and John Norton, "Forever is a Day: Supertasks in Pitowsky and Malament-Hogarth Spacetimes," *Philosophy of Science* 60, no. 1 (1993): 22-42; Oppy, *Infinity*: section 4.6; J.B. Manchak, "On the Possibility of Supertasks in General Relativity," *Foundations of Physics* 40 (2010): 276-288; J.B. Manchak, "Malament-Hogarth Machines," *The British Journal for Philosophy of Science* 71, no. 3 (2020b): 1143–1153.

[48] Although, for an interesting response, see Mohammad Saleh Zarepour, "Counting to infinity, successive addition, and the length of the past," *International Journal for Philosophy of Religion* 92, no. 3 (2022):167-176.

[49] Craig and Sinclair, "Kalam": 118.

This idea seems to assume a "mirror principle" — that if an endless series is impossible, so is a beginningless one.[50] However, several philosophers have recently challenged the mirror principle.[51]

The issue with counting to infinity is that there's no "final number" to reach. But an infinite countdown, though beginningless, does have an endpoint. If there's a problem with the countdown, it's not due to a lack of an endpoint.

Craig sometimes puts the argument another way. An infinite count-up is a potential infinite, always growing but never actually infinite. As Craig notes, "a potential infinite cannot be turned into an actual infinite by any amount of successive addition since the result of every addition will always be finite".[52] If the mirror principle held, this would also rule out infinite countdowns.

However, an infinite countdown doesn't involve converting a potential infinite into an actual one. At every point in the past, George has already counted down infinitely. No conversion is needed. Thus, we can dismiss the mirror principle.

The Principle of Sufficient Reason.

Instead of appealing to a mirror principle, Craig sometimes appeals to the apparent violation of the principle of sufficient reason.

> We could ask, why did he not finish counting yesterday or the day before or the year before? By then an infinite time had already elapsed, so that he has had ample time to finish. Thus, at no point in the infinite past should we ever find the man finishing his countdown, for by that point he should already be done![53]

Yesterday, George had already spent an infinite amount of time counting down; he should have been done by then. While this has some initial plausibility to it, we think it contains an obvious error. Compare the following:

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[50] This idea is also discussed in J. P. Moreland, "The Kalam Cosmological Argument." In *Philosophy of Religion: Selected Readings*, 2nd ed., ed. Michael Peterson, William Hasker, Bruce Reichenbach, and David Basinger (New York: Oxford University Press, 2001), 196–208.
[51] Felipe Leon, "Moreland on the Impossibility of Traversing the Infinite: A Critique," *Philo* 14, no. 1 (2011): 32-42; Wes Morriston, "Infinity, Time, and Successive Addition," *Australasian Journal of Philosophy* 100, no. 1 (2022): 70-85; Malpass, "All the time in the world".
[52] Craig and Sinclair, "Kalam": 118.
[53] Craig and Sinclair, "Kalam": 121-2.

A) If George is finishing an infinite countdown today, then there have been infinitely many past counting events.
B) If there have been infinitely many past counting events, then George is finishing an infinite countdown today.

To us, (A) seems obviously true. Supposing the counting events are regularly spaced out in time, his finishing the task now means he must have been doing it forever.

In contrast, (B) is not obvious. Just because an infinite amount of time has passed doesn't mean that anyone is finishing a countdown right now. The fact that there 'has been enough time' already doesn't mean that it has happened. The amount of time that has passed is enough for an infinite countdown to be finishing now, but it's not a strict logical requirement.

But surely, there is no *reason* why George is finishing now rather than yesterday or tomorrow. If so, this would violate the principle that all contingent facts have a sufficient reason.

A great deal hangs on what's meant by 'sufficient reason'. Does a sufficient reason have to entail what the reason explains? If not, what is the relationship exactly? This pushes the discussion too far afield for present purposes, but there is a lively debate on this topic in the literature.[54]

However, one thought is that we can provide strong sufficient reasons in the following manner. George finished today rather than yesterday (etc.) for two reasons: (i) yesterday, he was counting 2, and (ii) George counted one number per day. George's finishing today is logically entailed by these two reasons. Craig needs to tell us why this is not explanation enough.

Drawing a general lesson

We can learn a general lesson from thought experiments that aim to show the impossibility of an infinite past, which we'll call finitist thought experiments. These include examples like Hilbert's Hotel, counting up to infinity, or converting a finite series into an infinite one, as well as others not covered here.[55] Finitist thought experiments typically follow two approaches: one tries to show that

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[54] See, e.g., Pruss Alexander Pruss, *The Principle of Sufficient Reason: A Reassessment* (New York: Cambridge University Press, 2006); Wes Morriston, "Infinity, Time, and Successive Addition", *Australasian Journal of Philosophy* 100, no. 1 (2022): 70-85.
[55] See, for example, the Grim Reaper thought experiments described in Koons 2014, 2017. Robert Koons, "A New *Kalam* Argument: Revenge of the Grim Reaper". *Noûs* 48, no. 2 (2014), pp. 256–267; Robert Koons, "The Grim Reaper Kalam Argument: From Temporal and Causal

an infinite past leads to a contradiction, while the other argues that it violates a metaphysically necessary principle. The success of the latter depends on showing that the principle is indeed metaphysically necessary, but we'll set that point aside for now.

Both strategies face a key objection: they show, at most, that certain combinations of conditions lead to a contradiction. This means the conditions can't all be true together, but it doesn't mean any single condition is to blame.[56] You should not conclude that your existence is impossible just because a scenario involving the combination of your existence and non-existence is impossible. Similarly, the fact that thought experiments involving an infinite past lead to contradictions doesn't show that an infinite past is impossible.

Fans of finitist thought experiments could reply that the fact that various finitist thought experiments entail a contradiction is best explained by the impossibility of an infinite past. We remain unconvinced. A simpler explanation is that contradictions arise because the conditions in the thought experiments can't all be true at once. Alternatively, friends of finitist thought experiments might reply that had an infinite past been metaphysically possible, various finitist thought experiments would also have been possible. But we are equally unconvinced by this reply. Again, the fact that your existence is possible does not imply that your existence, conjoined with your non-existence, is possible.

Conclusion

The Kalam Cosmological Argument states: (P1) whatever begins to exist has a cause, (P2) the Universe began to exist, and therefore, (C) the Universe has a cause. No good reason has been offered to accept either premise. First, contemporary philosophy of physics casts doubt on the assumptions the argument implicitly makes concerning causation. Second, the scientific and philosophical cases for (P2) are unconvincing. The scientific argument relies on an extrapolation far beyond the domain where we can have reasonable confidence. The various philosophical defenses

Finitism to God." In *The Kalam Cosmological Argument: Philosophical Arguments for the Finitude of the Past*, ed. Paul Copan and William Lane Craig (New York: Bloomsbury Academic, 2017).
[56] Similar points have been made in Nicholas Shackel, "The Form of the Benardete Dichotomy," *The British Journal for the Philosophy of Science* 56, no. 2: 397–417; Landon Hedrick, "Once more to the hotel," *Religious Studies* 58, no. 1 (2005): 18–29; Troy Dana and Joseph Schmid, "Grim Reaper Paradoxes and Patchwork Principles: Severing the Case for Finitism," *Journal of Philosophy* (Forthcoming); Joseph Schmid and Alex Malpass, "Benardete Paradoxes, Causal Finitism, and the Unsatisfiable Pair Diagnosis," *Mind* (Forthcoming).

of (P2) are not persuasive, either. We concluded by drawing a general lesson about the limitations of thought experiments in arguments against an infinite past.

For all that we've said, both of the KCA's premises may be true, but no compelling reason has been provided to support them. Until persuasive reasons are offered, we remain humble and withhold our assent. Nonetheless, the KCA introduces two philosophical questions worthy of further investigation: first, whether the nature of causation allows for the Universe to have had a cause and, second, whether the Universe began to exist. Here, we encounter the deepest of cosmic mysteries. As T.H. Huxley wrote in 1887, "The known is finite, the unknown infinite; intellectually we stand on an islet in the midst of an illimitable ocean of inexplicability. Our business in every generation is to reclaim a little more land."[57] We encourage readers, whatever their current beliefs, to join us in pursuing both questions.

[57] Thomas Henry Huxley, "On the reception of the 'Origin of Species'." In *The Life and Letters of Charles Darwin*, Vol. 1, ed. Francis Darwin. (Dodo Press, 2008): 568