Int J Philos Relig (2007) 62:89–101
DOI 10.1007/s11153-007-9134-9

Closed systems, explanations, and the cosmological argument

Kevin Davey · Mark Lippelmann

Received: 27 February 2007 / Accepted: 21 June 2007 / Published online: 1 September 2007

Abstract Examples involving infinite suspended chains or infinite trains are sometimes used to defend perceived weaknesses in traditional cosmological arguments. In this article, we distinguish two versions of the cosmological argument, suggest that such examples can only be relevant if it is one specific type of cosmological argument that is being considered, and then criticize the use of such examples in this particular type of cosmological argument. Our criticism revolves around a discussion of what it means to call a system closed, and what it means to call an explanation complete. Our analysis makes no suppositions about the nature of the infinite, and is therefore independent of many of the issues around which contemporary discussions of the cosmological argument have tended to revolve.

Keywords Cosmological argument · Explanation · Closed systems · Causation · First cause · Efficient cause · Causation *in esse*

Introduction

In this article, we begin by distinguishing two versions of the cosmological argument that we think have not been distinguished with sufficient care in the literature.[1] The first version of the cosmological argument aims to show that without God, there is *something* that remains unexplained. By contrast, the second version of the cosmological argument aims to show that in some sense (to be spelt out shortly), *all* things remain unexplained without God.[2] A number of problems have been pointed out with the first version of the argument—for instance, it is often said to commit the 'fallacy of composition'. It is far less clear whether the second version of the argument commits this or any closely related fallacy, and for this

[1] In what follows, we will focus on *deductive*, rather than *inductive* cosmological arguments.
[2] The first version seems to have received more attention from modern philosophers, while the second version received more attention from the medievals.

K. Davey (✉) · M. Lippelmann
Department of Philosophy, University of Chicago, 115 E 58th St., Chicago, IL 60637, USA
e-mail: kjdavey@uchicago.edu

reason, we think it deserves closer examination. This second version of the cosmological argument will therefore be the focus of our article. Our main point will be that even if this second version of the argument avoids the mistakes often associated with the first version of the argument, it fails for other reasons that have been less discussed by philosophers of religion—specifically, reasons involving the nature of explanation and closed systems.[3]

Let us review a traditional version of the cosmological argument. Given an object, event or proposition X_1, one can ask what the cause of X_1 is.[4] Of course, there are many senses in which one might talk about causes. (There are material causes, efficient causes, and so on.) Because our aim is to capture a general form of argument, we will leave the type of cause unspecified, and consider specific types of causes later. Now, unless X_1 is an uncaused causer, it will have been caused by some X_2. And unless X_2 is an uncaused causer, it will have been caused by some X_3, and so on. If no X_n is an uncaused causer, one can even take the *set* $X_\omega = \{X_1, X_2, X_3, \ldots\}$, think of it (somehow) as an object, event or proposition, and ask what X_ω caused *it*. Given this setup, the cosmological argument then runs as follows:

> Let $\{X_1, X_2, X_3, \ldots\}$ be a (possibly transfinite) sequence of objects, events or propositions, such that each element in the sequence is either the cause of the element prior, or the cause of the set of all elements prior. Let us also assume that this list is as long as possible—so that whenever causes exist, they are included in the sequence. If this sequence has a final element, then either this final element is an uncaused causer, or it has no cause. If, on the other hand, this sequence does not have a final element, then the sequence itself has no cause (else it would have been appended to the sequence). Either way, unless there are uncaused causers, there are things (or sequences of things) on our list without causes. Because everything has a cause, it follows that the sequence must end with an uncaused causer.

This is really just a sketch of an argument, and there are all sort of ways to flesh out the details. Regardless of how one does this, the thrust of the argument is that without God, there is *something* that remains unexplained.[5]

A famous problem with this argument is that it assumes that if the sequence $\{X_1, X_2, X_3, \ldots\}$ is infinite, then in order for us to avoid having something unexplained, we must identify some sort of cause of the set $\{X_1, X_2, X_3, \ldots\}$ distinct from the set $\{X_1, X_2, X_3, \ldots\}$ itself (and distinct from the conjunction of its elements). The most straightforward thing that might be meant by the claim that the set $\{X_1, X_2, X_3, \ldots\}$ has a cause in this sense is that X_1, X_2, X_3, ... share a *common* cause. But there is no reason to think that infinite sequences (or even finite sequences) of events must have common causes, and thus, the assumption made in the above version of the cosmological argument is surely too strong. (This sort of error is sometimes called the *fallacy of composition*, though whether this is really an apt description of the error is a question we will leave open.)

In order to defend the cosmological argument against this criticism, one sometimes sees an analogy employed. Imagine a very long chain suspended in the air, extending vertically farther than we can see. Suppose we ask how the bottom link—call it Link_1—is supported, and are told that it is supported by Link_2 immediately above it. Suppose we then ask how Link_2 is supported, and are told that it is supported by Link_3 immediately above it. In general,

[3] An exception to this is the excellent discussion of explanation in Swinburne (2004).

[4] In some versions of the cosmological argument X_1 will be an *object*, in others it will be an *event*, and in others still the focus will be on *propositions*. Because we want our discussion to be general enough to cover all these cases, we will not specify which we mean here.

[5] One problem one might have with this argument is that it assumes that everything has a cause. Whether this is an incorrect assumption is a tricky question that we will not discuss here.

suppose that when we ask what supports Link_n, we are told that it is supported by Link_{n+1} immediately above it. After being told all this, it is natural to think that some crucial piece of information is still missing—namely, information about how the chain 'as a whole' is supported. Because the chain has no center of mass, there is actually no conceptual problem with such a chain remaining supported on its own (though there are some interesting technicalities here that we will not discuss.) But how did the chain as a whole get into this configuration? Where did the chain get its 'supportedness' from? Did a team of infinitely many workers build it, making sure that each link was in the appropriate initial state before letting the chain stand on its own? If so, what supported them as they did so? Until this cluster of questions is addressed, we surely cannot claim to understand even how Link_1 comes to be supported.

The defender of the cosmological argument then claims that causation is like physical support in this regard. Just as pointing out that each link is supported by the one above leaves open the question (to put it loosely) of where all the 'supportedness' comes from; so too does pointing out that in the set $\{X_1, X_2, X_3, \ldots\}$ each X_n is caused by X_{n+1} leave open the question (to put it loosely) of where all the 'causedness' comes from.[6] Exactly how this analogy is supposed to work is far from clear (as is the precise claim being made about the supported chain); we shall try to elucidate all this as best we can in later sections of the article. For now, however, we simply point out that if this idea can be made to work, then the cosmological argument avoids committing the fallacy of composition or incorrectly assuming the existence of common causes.

If the chain analogy is to be of help, however, we must be careful. We *do* have an explanation of how the chain is supported, because we have an explanation of how each link is supported. What we lack (if we lack anything) is a complete explanatory story about how any individual link (e.g., Link_1) *ultimately comes* to be supported. Thus, the analogous claim about causation that will need to be made if the cosmological argument is to work is that pointing out that in the set $\{X_1, X_2, X_3, \ldots\}$ each X_n is caused by X_{n+1}, fails to give us a complete explanatory story about how any element of the set (e.g., X_1) *ultimately ends up* becoming caused.

But if this is the route that the defender of the cosmological argument wants to take, then he will have to present a slightly different cosmological argument from the one we have been considering. In particular, the cosmological argument will now have to go something like this:

> Let $\{X_1, X_2, X_3, \ldots\}$ be a (possibly transfinite) sequence of objects, events or propositions, such that each element in the sequence is either the cause of the element prior, or the cause of the set of all elements prior. And let us assume that this list is as long as possible – so that whenever causes exist, they have been provided. If this sequence has a final element, then unless this final element is an uncaused causer, we cannot claim to have a complete explanatory account[7] of how X_1 ends up caused. If, on the

[6] Another example that is often given is the train with infinitely many carriages. Let us imagine a train composed of Carriage_1, Carriage_2, Carriage_3, …, extending infinitely to the right. Let us also suppose that the train, as a whole, moves to the right, and that there is friction on the tracks, so that energy must constantly be supplied to the train to keep it moving. Imagine asking what moves Carriage_1, and being told that the pulling force that Carriage_2 exerts on Carriage_1 is what moves Carriage_1. Imagine then asking what moves Carriage_2, and being told that the pulling force that Carriage_3 exerts on Carriage_2 is what moves Carriage_2. Suppose this conversation continues indefinitely. At the end of this infinite conversation, we still do not understand *how* Carriage_1 ends up moving, because we still have no idea where all this motion comes from—specifically, we have no idea where the energy required to move the train against friction comes from.

[7] Our notion of a 'complete explanation' is similar to that discussed in Chap. 4 of Swinburne (2005), but not exactly the same. As will be discussed later, our notion of complete explanation revolves around

other hand, this sequence does not have a final element, then we equally well lack a complete explanatory account of how X_1 ends up caused. And so, unless there are uncaused causers, we cannot have a complete explanatory account of how X_1 ends up caused. Therefore, there are uncaused causers.

This cosmological argument is quite different from the one first considered. Its thrust is that if we want to be able to explain completely *how anything* is caused, then we need there to be an uncaused causer. Loosely speaking, the argument shows that without God, *all* things remain unexplained.

Our point thus far is that if one wants to appeal to suspended chain analogies in order to defend the cosmological argument against the accusation that it commits the fallacy of composition, one has to be advancing a 'without God, *all* things remain unexplained' cosmological argument, rather than a 'without God, *something* remains unexplained' cosmological argument.[8]

Whether a 'without God, *all* things remain unexplained' cosmological argument successfully avoids the usual problems (such as those associated with the fallacy of composition or the positing of common causes) by invoking an analogy with the suspended chain is not clear. But even if it does, it does so at a price, because 'without God, *all* things remain unexplained' cosmological arguments fail for other reasons. Those other reasons will be the subject of this article.

Isolating the error

In order to isolate the error that we think this sort of cosmological argument commits, we first note that this argument requires (at least) the following two principles:

Principle 1: If $\{X_1, X_2, \ldots, X_n\}$ is a sequence such that:
X_1 is caused by X_2 which is caused by X_3. . . which is caused by X_n,
then the fact that:
X_1 is caused by X_2 which is caused by X_3 . . . which is caused by X_n
does not give a complete explanation of how X_1 ends up caused, unless X_n is an uncaused causer.
Principle 2: If $\{X_1, X_2, X_3, \ldots\}$ is an infinite sequence (of order type ω) such that
X_1 is caused by X_2 which is caused by X_3 . . .
and for each n, the fact that:
X_1 is caused by X_2 which is caused by X_3 . . . which is caused by X_n
does not give a complete explanation of how X_1 ends up caused, then the fact that:
X_1 is caused by X_2 which is caused by X_3 . . .

Footnote 7 continued
the idea of a *closed system*, while Swinburne's notion of complete explanation involves explanation in which all facts invoked cannot be explained in terms of other factors operative at that time. These different notions may coincide in many cases, but whether they always coincide is unclear.

[8] We do not mean to suggest that *all* cosmological arguments must be either 'without God, *all* things remain unexplained' or 'without God, *something* remains unexplained' cosmological arguments, as we have defined them. For instance, the Kalam Cosmological Argument (see Craig 2000) and Swinburne's Inductive Cosmological Argument (see Swinburne 2005) fit into neither category—the former because it does not explicitly discuss causation, and the later because it is an explicitly inductive argument.

does not give a complete explanation of how X_1 ends up caused either.[9]

Without Principle 1, we would not be able to rule out the possibility that, for instance, knowing what the cause of X_1 is (e.g., knowing what X_2 is) provides us with a complete explanation of how X_1 ends up caused, regardless of whether X_2 is itself an uncaused causer. And without Principle 2, we could not rule out the possibility that, even though for each n, knowledge of $\{X_1, X_2, \ldots, X_n\}$ does not provide us with a complete explanation of how X_1 ends up caused, knowledge of the infinite set $\{X_1, X_2, X_3 \ldots\}$ might somehow constitute a complete explanation of how X_1 ends up caused. Both of these principles (and possibly others) are therefore needed in order for a 'without God, *all* things remain unexplained' cosmological argument to work.

Many discussions of cosmological arguments have focused on issues surrounding the concept of infinity—such as whether actual infinities or infinite causal regresses are possible, and what light Cantor's set theory sheds or fails to shed on such matters. In the type of cosmological argument we have been discussing, all the potentially controversial claims about the infinite are located in Principle 2, where it is stated that if no *finite* causal chain beginning with X_1 explains how X_1 ends up caused, then no *infinite* causal chain (of order type ω) can do so either. Principle 1, on the other hand, does not make any claims about the infinite, and so it is fair to say that in our presentation of the argument, matters about infinity have been isolated to Principle 2.

The main task of this article will be to argue that Principle 1 is false, and therefore that 'without God, *all* things remain unexplained' cosmological arguments fail for reasons that have *nothing to do* with infinity. In this way, we dodge the thorny set of issues involving infinity that have bogged down many discussions of cosmological arguments.[10]

The precise way in which a theist might argue for Principle 1 will be unimportant for our criticism. One possibility is that the argument for both Principles 1 and 2 is first and foremost an argument by analogy involving the supported chain.[11] A second possibility is that Principles 1 and 2 are supposed to be independently plausible, and that the chain provides us with an example of these principles in action. Seeing that Principles 1 and 2 get the case of the chain right then adds to their plausibility. A third possibility is that there are arguments for Principles 1 and 2 that do not involve the supported chain at all. In this case, the supported chain is merely an illustration that does not carry any argumentative weight. Rather than investigating the problems with these three approaches individually, we will assume the burden of proof ourselves, and simply argue that Principle 1 is false.

In the next section of the article, we will discuss what makes an explanation complete or incomplete. We will examine the supported chain, and try to understand the ways in which we might or might not have a complete explanation of how $Link_1$ ends up supported. This will help to give us criteria with which we will be able to judge (in some cases at least) whether a particular explanation is complete or not. In the sections that follow, we will then apply those criteria to argue against Principle 1 as applied to *efficient* causation, and will then extend our discussion to cover causation *in esse*.

[9] Both Principles 1 and 2 can be viewed as special cases of a more general transfinite principle. It will be helpful in what follows, however, to focus only on the more particular Principles presented here.

[10] For a nice discussion of the role of infinity in such arguments, see Conway (1983).

[11] This seems to be the approach taken in Chap. 3 of Joyce (1922), though things are not completely clear there.

Closed systems and the supported chain

Complete explanations and closed systems

In this section, we would like to start by making some general observations about explanation, which we will then apply to the case of the supported chain.

We will focus at first on a textbook case of explanation. Why are there tides? The usual answer is that the tides are the effect of the moon's gravitational pull on the oceans. This explanation is complete because, for the purposes of explaining the tides, the earth and moon form a closed system. There are no forces on the oceans involving objects outside the earth–moon system that could be relevant to the production of tides. A discussion of objects and events not relevant to the production of tides cannot render an incomplete explanation of the production of tides complete. Therefore, either the explanation of the tides in terms of the earth–moon system is complete, or there is no complete explanation of the tides.

One might wonder whether questions about objects outside the earth–moon system are truly irrelevant to the production of tides. For instance, one might ask: how did the moon happen to acquire the significant weight that it has relative to the earth? Why has the moon not been knocked out of its orbit by wandering asteroids? Why are there moons at all? Any adequate answer to these questions will surely involve reference to objects outside the earth–moon system. Doesn't this mean that objects outside the earth–moon system might turn out to be relevant to a complete explanation of how tides are produced after all?

In order to justify a negative answer to this question, let us distinguish *internal* and *external* questions about closed systems. One can ask questions about how mechanisms at play *within* the earth–moon system lead to the production of tides. These are *internal* questions about the earth–moon system. One can also ask questions about why the earth–moon system had the initial conditions we take it to have had, or why it hasn't been interfered with in various ways. These are *external* questions about the earth–moon system. Internal questions about a closed system are questions about how mechanisms *within* the system work. External questions about a closed system are questions that are not internal—they will typically be questions about why the system has the initial conditions it does, or why things *outside* the closed system have or have not conspired to give or deprive the system of the nature it has.

We maintain that internal questions can be *completely* answered without addressing external questions. To understand how the mechanisms within a closed system produce a particular phenomenon, there is no need to understand why the system has the initial conditions it has, or why some object outside the closed system has not interfered with the closed system. External questions may sometimes be very provocative, but it does not follow that answers to them are needed before answers to internal questions can be deemed complete. We take external questions to be genuinely distinct questions, and maintain that failure to answer such questions does not constitute grounds for asserting that complete answers to internal questions have not yet been found.

We have argued that explanations in terms of closed systems can be complete. Conversely, we claim that (in physics at least) complete explanations of phenomena tend to involve the identification of closed systems, a discussion of how various mechanisms within the closed systems operate, and an argument that these mechanisms produce the phenomena in question.

A complete explanation of the tides that involves a discussion of mechanisms in the earth–moon system, and how they lead to the production of tides, fits this model. A complete explanation of why some particular star has the rough mass it does, that proceeds in terms of facts about stellar formation and facts about the abundance of certain types of matter in the

galaxy containing the star also fits this model (in this case, the galaxy is the closed system.)[12] And a complete explanation of why a certain piston exerts a certain pressure on a gas that proceeds by describing the engine in which the piston lives and then uses the laws of thermodynamics also fits this model, where the engine is the closed system. One can certainly ask external questions about these closed systems; for instance, one can ask why the earth has a moon, or why the initial conditions of the galaxy were what they were, or where the energy to start the engine originally came from. These are good questions, but we are not compelled to answer them in order to make complete the explanatory accounts of the phenomena in these examples.

Some remarks about closed systems

In response to this analysis of the completeness of an explanation, one might worry that *no* physical system is truly closed—and therefore, that *no* explanation of a phenomenon can be complete—unless it involves a discussion of the entire universe. For instance, the most distant galaxy exerts a gravitational force on the oceans, and so the *precise* nature of the tides will depend on objects well outside the earth–moon system. Doesn't this mean that the earth–moon system is *not* closed, and that our explanation of the tides is not complete until we answer a whole host of questions that we have been calling external?

We think that answer to this question is no. If we are only interested in a rough, qualitative understanding of the tides, then the gravitational force exerted by distant galaxies on the oceans is irrelevant for our purposes, and the earth–moon system may be treated as closed. The fact that the earth–moon system is not closed in any more absolute sense does not mean that our rough explanation of the tides is incomplete—it just means that things that are irrelevant when explaining one fact about the tides may be relevant when explaining other facts about the tides.

The general point here is that, for a given purpose, forces exerted by objects outside a system can sometimes be ignored, and the system treated (in an idealized way) as closed.[13] Explanations in terms of these closed systems then stand a chance of being complete.

One reason that this can work is that the external forces acting on a system might not be strong enough to affect the internal mechanisms of the system relevant to an explanation of the phenomenon in question. But there are other cases in which such forces can be ignored. For instance, there are cases in which such external forces, even if they are very strong, fail to have any effects relevant to the phenomenon in question.

For instance, suppose billiard balls hit each other lightly on a surface with very little friction. In order to explain the way in which these billiard balls move, it suffices to think of the billiard balls themselves as a closed system—that is, it suffices to completely ignore the effects of gravity, and the normal force exerted by the table on the balls. The reason we can do this is because all facts about the horizontal components of forces, positions, velocities and accelerations of the balls can be explained in terms of other facts about the horizontal components of forces, positions, velocities and accelerations of the balls; and all of these facts can ultimately be explained in terms of the horizontal components of the initial conditions of the system consisting solely of the billiard balls.[14] Consequently, we can obtain a complete

[12] Obviously we are not talking about the star having the exact mass it has, but rather its having a mass *within a certain range* that is being explained.

[13] This happens all the time in physics. Indeed, it is difficult to see how we could have a complete understanding of *any* everyday physical process were this not possible.

[14] Of course, in some cases—such as when there is friction, or the balls are lightly bouncing—we will not be able to ignore the effects of gravity. In such cases it would be inappropriate to treat the set of billiard

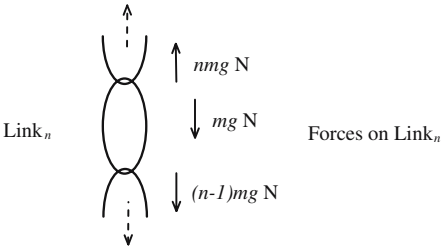

Fig. 1

explanation of the rough position of all the billiard balls, at any moment of time not too far into the future, without any information about the strength of gravity.

It is because it is possible, in situations like this, to treat a system *as if* it were closed that the concept of a closed system is so important in physics, and complete explanations of physical phenomena are possible, in spite of the fact that few (if any) systems are literally closed.

Closed systems, supported chains, and falling chains

Having developed an account of what makes an explanation complete or incomplete, let us go back to the supported chain that we considered in the introduction. With the case of the chain in mind, we formulated Principles 1 and 2. Given what we have now said about complete explanations, how does our earlier analysis of the chain fare? And more importantly, how do these Principles fare (especially Principle 1, which is our main concern)? We address the case of the chain now, and Principle 1 in the remaining sections of the article.

Consider the physics of the supported chain. Each Link$_n$ is acted on by three forces: (i) the force of gravity (with magnitude -mg N, where m is the mass of a link, and g the acceleration due to gravity), (ii) the weight of the $n-1$ links below it, pulling it down (with magnitude $-(n-1)mg$ N), and (iii) a normal, upwards directed force exerted by on it by Link$_{n+1}$(the link immediately above it) that stops it from falling (with magnitude nmg N)(Fig. 1).

Although Link$_2$ supports Link$_1$, the fact that Link$_2$ supports Link$_1$does not constitute a complete explanatory account of how Link$_1$ ends up supported. Link$_1$ and Link$_2$ do *not* form a closed system, because Link$_2$ has a force exerted on it by Link$_3$. Without discussing Link$_3$, we can hardly claim to have a complete explanation of why either Link$_2$ or Link$_1$ are supported. For precisely the same reason, *no* set of links {Link$_1$, Link$_2$, . . ., Link$_n$} form a closed system, and the fact that:

Link$_1$ is supported by Link$_2$. . . which is supported by Link$_n$

does not give us a complete explanation of how Link$_1$ ends up supported. Thus, the claim about the supported chain that inspired Principle 1 is correct. This is good news for the Cosmological Argument in question.[15]

If we turn to an example that is only slightly different, however, things change. In this regard, we introduce the example of the *falling* chain. Imagine a very long chain, extending

Footnote 14 continued
balls as a closed system. But that is perfectly compatible with the possibility of treating the billiard balls as a closed system, for a given purpose, in other sorts of situations.

15 The claim about the supported chain that inspired Principle 2, however, does not fare as well, but because we want to show that our version of the Cosmological Argument fails for reasons that have nothing to do with infinity, we do not discuss this point here.

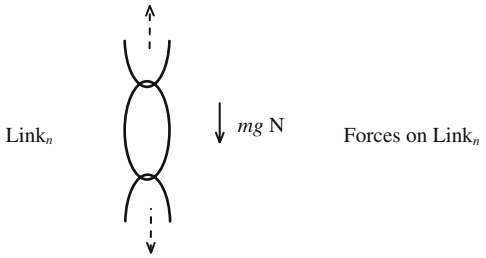

Fig. 2

vertically farther than we can see, that is falling. Suppose we ask why the bottom link—$Link_1$—is falling. Imagine that we are told that $Link_1$ is falling because it is acted on by gravity, and that furthermore, because $Link_2$ is also falling, $Link_2$ can't hold $Link_1$ up. When we ask why $Link_2$ is falling, we are told that $Link_2$ is falling because it too is acted on by gravity, and that because $Link_3$ is also falling, $Link_3$ can't hold $Link_2$ up. In general, let us suppose that we are told that $Link_n$ is falling because it is acted on by gravity, and that because $Link_{n+1}$ is also unsupported, $Link_{n+1}$ can't hold $Link_n$ up.

In the case of the supported chain, we argued that:

$Link_1$ owes its supportedness to $Link_2$, … which owes its supportedness to $Link_n$

fails to explain how $Link_1$ ultimately ends up supported. Is it also true that in the falling chain:

$Link_1$ owes its unsupportedness to $Link_2$, … which owes its unsupportedness to $Link_n$

fails to explain how $Link_1$ ultimately ends up unsupported?

To answer this, consider the physics of the falling chain. Assuming that the falling chain has no tension in it, there is only one force on each $Link_n$—the force of gravity (of magnitude -*mg* N)(Fig. 2).

Note that each individual link (and in particular, $Link_1$) is a closed system. Because of this, to say that $Link_1$ falls because it is acted on by gravity is to provide a complete explanatory account of how $Link_1$ ends up falling. To ask why $Link_2$ fails to support $Link_1$ (i.e., to ask why $Link_2$ is falling) amounts to asking why $Link_2$ is not a part of the smallest closed system containing $Link_1$. This is an external question about the closed system consisting of just $Link_1$. It is therefore a genuinely new question, and does not need to be answered in order to render our explanation of why $Link_1$ is falling complete. So, one can provide a complete explanatory account of how $Link_1$ ends up falling without explaining why $Link_2$ falls. This is in contrast to the supported chain case, in which one *cannot* provide a complete explanatory account of how $Link_1$ ends up supported, without explaining why $Link_2$ is supported.

Thus, whether examples of chains provide us with good motivation for Principle 1 depends on whether we are considering supported chains or falling chains. That this is so is a little troubling for Principle 1. At this point, we clearly need to examine Principle 1 in its own right, forgetting about falling or supported chains. This will be the job of the remainder of the article.

Efficient causation

The cosmological arguments described in the introduction are really just *schemata* for cosmological arguments, insofar as one needs to specify what sort of causality is being considered

before one has a fully fleshed cosmological argument. The same point applies for Principles 1 and 2. How good the resulting cosmological argument is—and how plausible the resulting forms of Principles 1 and 2 are—will depend on the type of causation under consideration.

A number of instances of the 'without God, *all* things remain unexplained' argument schema have received special attention. Let us suppose that when one asks what causes an object X, one is asking for an explanation of how X was *brought into existence,* in the way that a sculptor brings a sculpture into existence, or an electron and positron, upon collision, can bring a photon into existence. (This concept of causation is something like Aristotle's notion of *efficient* causation.) The resulting 'without God, *all* things remain unexplained' argument aims to show that we cannot have a complete explanatory account of how *any* particular object came into existence, unless we can trace it back to an uncaused causer. This argument is Aquinas' second way.[16]

Is a 'without God, all things remain unexplained' cosmological argument that uses *efficient* causation any good? That will depend on whether Principles 1 and 2, applied to efficient causation, are any good. As promised, our analysis will steer clear of issues involving infinity, and will therefore focus only on Principle 1. Principle 1, applied to efficient causation, reads:

Efficient Principle 1: If $\{X_1, X_2, \ldots, X_n\}$ is a sequence such that:
X_1 was brought into being by X_2 . . . which was brought into being by X_n,
then the fact that:
X_1 was brought into being by X_2 . . . which was brought into being by X_n
does not constitute a complete explanation of how X_1 ended up being brought into being, unless X_n is an uncaused causer.

We shall argue that this principle is false. Let us focus on the case $n = 2$, for simplicity:
Efficient Principle 1 (n=2): If X_1 was brought into being by X_2, then the fact that X_1 was brought into being by X_2 does not constitute a complete explanation of how X_1 ended up being brought into being, unless X_2 is an uncaused causer.

The kinds of considerations developed in the previous section show that this is false. If the question of what brought X_2 into being turns out to be an external question about some closed system containing $X_1$and X_2, then the fact that X_1 was brought into being by X_2 may well constitute a complete explanation of how X_1 ended up being brought into being, regardless of whether X_2 is an uncaused causer.

For instance, consider a sculptor on a desert island, carving a statue. A combination of the sculptor, and the resources available on the island, bring the statue into being. Let X_1 be the statue, and let X_2 be the set of objects consisting of the sculptor, and all the resources of the island prior to the creation of the statue. Then the fact that X_2 brings X_1 into being constitutes a complete explanatory story of how X_1 ends up being brought into being, even though we may not have a story about how X_2 was in turn brought into being. To ask how X_2 is brought into being is to ask an *external* question about the closed system consisting of the desert island and the sculptor. Whether we know how to answer this external question in no way affects the completeness of our explanation of how the statue ended up being brought into being.

So Principle 1 applied to efficient causation is false. What this means is that sequences of efficient causes are quite *unlike* links in a suspended chain. Studying the physics of the *n* lowest links in a supported chain *cannot* yield a complete explanation of how the bottom link is supported, unless one of these *n* links is an unsupported supporter. This is because if

[16] We take Aquinas' argument to be a 'without God, *all* things remain unexplained' cosmological argument, rather than a 'without God, *something* remains unexplained' cosmological argument, though we will not defend this historical claim here.

none of the *n* links is an unsupported supporter, then they do not form a closed system. By contrast, a finite sequence of objects, each of which is an efficient cause of the next, *can* form a closed system. An analysis of the properties of the final *n* objects in a sequence of efficient causes is therefore capable of yielding a complete explanation of how the final object came into being. Because of this fundamental disanalogy between sequences of efficient causes and links in a suspended chain, a 'without God, all things remain unexplained' cosmological argument that uses efficient causation is not any good.

Causation *in esse*

Suppose instead that when one asks what causes an object X, one is asking for an explanation of what X *depends on for its continuing existence,* in the way that a sculpture relies for its existence on the metal that composes it, or perhaps in the way that human life relies on the atmosphere for its continued existence. This notion of causation is often called causation *in esse*. The resulting 'without God, all things remain unexplained' argument aims to show that we cannot have a complete explanatory account of how the existence of any particular object is sustained, unless we have shown how its existence is ultimately sustained by an unsustained sustainer. Unsatisfied with cosmological arguments that revolve around efficient causation,[17] this sort of cosmological argument was advanced by Avicenna, Scotus, and other medievals.[18] This argument has also received some attention in modern times.[19]

There are, however, at least two different types of causation *in esse* that must be distinguished. The thing out of which some X is composed is a cause *in esse* of X, insofar as nothing could exist without the thing that composes it. In this sense, the thing that composes an X sustains X's existence, and is therefore a cause *in esse* of X. We shall call this an *internal* cause *in esse* of X. So, an internal cause *in esse* of me is the organic material that composes me; the internal cause *in esse* of this organic material is the set of molecules out of which it is composed, and so on.

When we talk about the way in which my existence depends on air, food and water, we are, however, talking about a different sort of sustenance entirely. In this case, we are talking about things *distinct* from me that must be present in order to keep me existing. Let us call these *external* causes *in esse*. So, an external cause *in esse* of me is the food that nourishes me, an external cause *in esse* of this food is whatever it is in the atmosphere that stops it from decomposing, and so on.

It is difficult to see why all objects *must* have a cause *in esse*, be it internal or external. It is also difficult to see why an unsustained sustainer (be the sustenenace internal or external) ought to be identified with God, as traditionally conceived. But let us put these worries aside.

One might think that a 'without God, all things remain unexplained' cosmological argument that uses causation *in esse* (either internal or external) would be resistant to the sort of attack we launched on the corresponding argument that used *efficient* causation. This is because one might think that although the object that created some X need not be part of a closed system containing X, any object that sustains X's existence *must* be part of any closed system containing X. Thus, much like the supported chain, a finite sequence of causes *in*

[17] The problem Avicenna and Scotus had with cosmological arguments that revolve around efficient causation was different from the problem developed in the previous section. Their concern was rather that, in some sense, infinite regresses of causes *in esse* are problematic, while infinite regresses of efficient causes are not.

[18] For a modern discussion, see Brown (1966).

[19] See Chap. 3, Part I. of Joyce (1922).

esse will not explain how the existence of the final element of this sequence has its existence sustained, unless one of the elements of the sequence is an unsustained sustainer. In other words, Principle 1 might seem to be much more attractive when it comes to causation *in esse*.

But in fact, we do not think that Principle 1 is true of either internal or external causation *in esse*. In this case, Principle 1 reads:

In esse Principle 1: If $\{X_1, X_2, \ldots, X_n\}$ is a sequence such that:
X_1's existence is sustained by X_2... whose existence is sustained by X_n,
then the fact that:
X_1's existence is sustained by X_2... whose existence is sustained by X_n
does not constitute a complete explanation of how X_1's existence is sustained, unless X_n is an unsustained sustainer.

As before, we focus on the case $n = 2$:

In esse Principle 1 ($n = 2$): If X_1's existence is sustained by X_2, then the fact that X_1's existence is sustained by X_2 does not constitute a complete explanation of how X_1's existence is sustained, unless X_2 is an unsustained sustainer.

If we are focusing on *external* causation *in esse*, then this principle is false. This is because the object that externally sustains X_2's existence might turn out to lie outside the closed system that, for all intents and purposes, X_1 and X_2 form. For instance, consider again a sculptor on a desert island, who has carved a statue. Let us suppose now that the sculptor must continually maintain his statue, in order to combat a particularly vicious form of erosion. A combination of the sculptor, and the resources available on the island, externally sustain the existence of the statue. Now, let X_1 be the statue, and let X_2 be the collection consisting of the sculptor, and all the resources of the island. Then the fact that X_2 sustains X_1's existence constitutes a complete explanatory story of how X_1's existence is sustained, even though we may not have a story about how X_2's existence is sustained. To ask how X_2's existence is sustained is to ask an *external* question about the closed system consisting of the desert island and the sculptor. Whether we know how to answer this external question in no way affects the completeness of our explanation of how the statue's existence is sustained.

So Principle 1 applied to external causation *in esse* is false. Again, this means that sequences of external causes *in esse* are quite *unlike* links in a suspended chain. A finite sequence of objects, each of which externally sustains the existence of the next, *can* form a closed system, unlike a finite stretch of links in a chain, none of which is an unsupported supporter. Consequently, a 'without God, all things remain unexplained' cosmological argument that uses external causation *in esse* will not be any good.[20]

Let us turn our attention to *internal* causation *in esse*. What we have been looking for are complete explanations of how some X_1 comes to be caused. What could this amount to in the case of internal causation *in esse*? We must be looking for a complete explanation of how X_1 comes to be internally sustained. But it is difficult to see what this amounts to. That X_1 is suspended, brought into being, or externally sustained is in each case the result of forces and activities that we can ask questions about. (Indeed, the very idea of a cosmological argument is to try and derive substantive metaphysical conclusions by asking questions about such forces and activities.) But that X is internally sustained is not the result of any force or

[20] One might wonder whether Principle 1 might be true when applied to *specific types* of external causation *in esse*. For instance, the way in which a moving object is moved by some other moving object is a type of causation *in esse*. The resulting 'without God, *all* things remain unexplained' cosmological argument is then something like Aquinas' first way. Our discussion thus far does not entail that such an argument fails—arguments revolving around specific types of external causation *in esse* must be considered one by one. We do not pursue this task here.

activity in any straightforward sense. We therefore find it difficult to locate any real meaning in the question of how X_1 comes to be internally sustained. Insofar as a 'without God, all things remain unexplained' argument using internal causation *in esse* presupposes that such a question must have an answer, we do not see how such an argument could be of much use to the theist.[21]

Concluding remarks

In summary, we think that considerations involving supported chains do nothing to help traditional cosmological arguments. Instead, they introduce new complications that end up doing more harm than good. It is worth noting that cosmological arguments that try to take advantage of the supported chain example fail even if we concede that everything has a cause (in whichever sense of cause applies), even if we concede that an uncaused causer would be godlike, and even if we allow the theist to adopt whatever views about infinity he desires. These arguments fail for reasons quite unlike the traditional ones given against cosmological arguments.[22,23]

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[21] One might think that we are stubbornly failing to see the real philosophical problem here—namely, the problem of how *anything* can so much as *exist*, without there being internal sustainers that are not themselves internally sustained. But this problem seems misguided. From the fact that an object exists, it follows that its parts, the parts of its parts, and so on, all exist, and where appropriate, internally sustain each other. So X is able to internally sustain Y in virtue of the fact that the Z that X and Y compose *exists*, and it is difficult to see what sense of mystery about the possibility of internal sustenance remains once this point is granted.

[22] Our general conclusions here are more or less compatible with those given in the brief but excellent discussion of Aquinas and Scotus in the appendix to Chap. 4 of Swinburne (2004). Swinburne does not, however, consider the question of whether the supported chain example can help to salvage such arguments, which is the main concern of this paper.

[23] Thanks to Alexander Pruss for discussing an earlier draft of this paper.