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The Beginning of Existence

ABSTRACT: Central to recent debate over the Kalam Cosmological Argument, and over the origin of the universe in general, has been the issue of whether the universe began to exist and, if so, how this is to be understood. Adolf Grünbaum has used two cosmological models as a basis for arguing that the universe did not begin to exist according to either of them. Concentrating in this paper on the second ("open interval") model, I argue that he is wrong on both counts. I give metaphysical considerations for rejecting Grünbaum's interpretation of the second model and offer a definition of the beginning of existence of an object that improves on prior formulations and that is adequate to show how the universe can indeed be seen to have begun to exist. I conclude with a more general metaphysical discussion of the beginning of the universe and of the Kalam Cosmological Argument.

1. INTRODUCTION

In recent debates concerning the origin of the universe, one of the topics that has received significant if still insufficient attention has been the very concept of the beginning of existence itself. This is particularly so in the debate over the Kalam Cosmological Argument (KCA) between William Lane Craig and Adolf Grünbaum.[1] Since supporters of the KCA rely crucially on the premise that the universe began to exist (and hence had a cause, given the premise that whatever begins to exist has a cause of the beginning of its existence), it is incumbent upon them not only to defend this premise but to supply a definition of "*x* begins to exist" that is wholly general and of which the beginning of existence of the universe is but a special case. The aim of this paper is to show that such a definition can be provided.

[1]See the following: A. Grünbaum, "The Pseudo-Problem of Creation in Physical Cosmology," in *Philosophy of Science* 56 (1989): 373–94; "Creation as a Pseudo-Explanation in Current Physical Cosmology," in *Erkenntnis* 35 (1991): 233–54 (these two articles overlap substantially); "Some Comments on William Craig's 'Creation and Big Bang Cosmology,'" in *Philosophia Naturalis* 31 (1994): 225–36; "A New Critique of Theological Interpretations of Physical Cosmology," in *British Journal for the Philosophy of Science* 51 (2000): 1–43; W. L. Craig, "The Origin and Creation of the Universe: A Reply to Adolf Grünbaum," in *British Journal for the Philosophy of Science* 43 (1992): 233–40; "Creation and Big Bang Cosmology," in *Philosophia Naturalis* 31 (1994): 217–23; "A Response to Grünbaum on Creation and Big Bang Cosmology," in *Philosophia Naturalis* 31 (1994): 237–49; "Prof. Grünbaum on the 'Normalcy of Nothingness' in the Leibnizian and *Kalam* Cosmological Arguments," in *British Journal for the Philosophy of Science* 52 (2001): 371–86.

The most recent discussion has revealed the extent to which the KCA relies heavily on the existence of tensed facts.[2] Any formulation of a definition of "*x* begins to exist" must, it appears, either presuppose the "objectivity of temporal becoming" (to use Craig's phrase) or else contain an explicit clause to the effect that an object's beginning to exist is a tensed fact. Craig opts for the latter move. But the problem that I wish to address concerns an unrelated matter, in respect of which Craig's most recent formulation[3] is not an improvement on his earlier ones. It is the matter of what a definition must look like if it is to satisfy one of the cosmogonical models Grünbaum proposes, one that seems to allow both for the universe's having a finite existence and yet not having literally begun to exist.

2. GRÜNBAUM'S FIRST COSMOLOGICAL MODEL

First, however, we must briefly look at another of Grünbaum's models, one in which there is a singularity t_0 that represents the first state of the universe from which the expansion of space-time derived. According to him, it is invalid to argue from the existence of t_0 to the proposition that the universe began to exist since this would rely on the prior existence of temporal instants at which the singularity did not exist. His assumption is that to say that the universe began to exist is to say that there were moments at which it did not exist and later moments at which it did. Since there were, by definition, no moments of time before t_0, the universe cannot be said to have begun to exist on this model.

The problem with Grünbaum's objection is that it misconstrues the concept of *x*'s beginning to exist at *t*. The claim that an object begins to exist at a time does not entail that there were instants prior to that time at which it did not exist. Suppose, for instance, that one were a relationalist about time and that one accepted the timeless existence of a universe consisting of changeless matter. Suppose also that the first event was the spontaneous emergence of a particle. Since, on a relationalist account, there was no time prior to the emergence, does it follow that the particle did not begin to exist? Why must there have been prior events and hence prior instants? An adequate definition of the beginning of existence should not rule out the possibility of such a state of affairs. Second, suppose the universe is to end in a Big Crunch that involves its collapse back into a singularity at t_n, so that time ceased at t_n. Does it follow that whatever cosmological events were occurring up until the Big Crunch did not literally finish? Or that the universe and the objects within it did not literally come to an end? If not, then why did the universe not literally *begin* at t_0? If the end of a thing's existence (even if that thing is the entire universe) does not require (and in the case of the universe could not allow) the existence of moments of time after which it no longer exists, it is difficult to see why its beginning requires moments of time prior to which it does not exist.

It is Grünbaum's misunderstanding of the concept of a *beginning* that is at the heart of his misconceived notion that the beginning of the universe requires the intelligibility of enquiring into how things stood before it. A return to the Aristotelian

[2]Grünbaum, "A New Critique"; Craig, "Prof. Grünbaum on the 'Normalcy of Nothingness.'"

[3]Craig, "Prof. Grünbaum on the 'Normalcy of Nothingness," p. 384.

conception is instructive here, for we find that at *Metaphysics* V (Δ) 1012b34 Aristotle defines "beginning" as "that part of a thing from which one would move first, e.g., a line or a road has a beginning in either of the contrary directions."[4] (Note that this is Aristotle's primary definition of "beginning"; he goes on to give various secondary senses.) Although there may look to be a circularity ("begin" [ἀρχή] defined in terms of "move first" [κινηθείη πρῶτον, which Ross inaccurately translates as "start first"]), this is only apparent. It is the concept of *firstness* that is central to the definition. The beginning of something is its *first* point, the point with spatial, temporal, positional, or serial priority over another thing or things considered as a group ordered along some dimension (space, time, number, etc.). The beginning of something is its *origin*. Aristotle says nothing about the line or road's being embedded in a larger space in which that line or road does not exist; in the natural order, lines or roads are embedded in larger spaces, but it is not part of the concept of a road that it is so embedded. The same applies to a line. Given a co-ordinate system with certain boundaries, the system can still have an *origin* even if the system is so defined that it makes no sense to speak of what is "beyond" the origin. If no embedding or additional co-ordinate system is defined beyond the origin, it is still the case that the system has an origin. Consider, for example, the number line consisting of the natural numbers and zero at the origin. Before the definition of negative numbers, when it made no sense to speak of what lay "beyond" zero, was it false that the number line had an origin, or a beginning? (I leave aside questions of Platonism here.) Zero had serial priority over all the other numbers, even though it made no sense to ask what was "beyond" zero. Similarly, Grünbaum is confused when he asserts that because it "makes no sense" to ask what happened before t_0, the universe did not have a beginning, or an origin.

Craig's initial proposal[5] for a definition of "*x* begins to exist at *t*" is therefore correct insofar as it takes on board considerations such as these:

> (B_1): *x* begins to exist at $t =_{df}$ *x* exists at *t* and there is no time immediately prior to *t* at which *x* exists.

Two points, however, should be noted about this proposal. First, if time is continuous, there will never be a time immediately prior to that at which a thing exists, and this makes it trivially true that if *x* exists at *t* then *x* begins to exist at *t*. Secondly, if the possibility of intermittent existence is allowed (as I think it should be), the word "immediately" needs to be removed since otherwise the definiens would be satisfied where *x* did not *begin* to exist even though there was a time prior, but not immediately prior, to *t* at which it existed. Craig's new definition[6] takes intermittent existence to be a case where an object does begin to exist, in the sense of "come into being," after the interval during which it is non-existent; but this is to trade on the ambiguity of "begins to exist" as between "comes into being for the

[4]Translation adapted from *Aristotle's Metaphysics*, ed. W. D. Ross (Oxford: Clarendon Press, 1928).
[5]Craig, "The Origin and Creation of the Universe," p. 238.
[6]See note 3 above.

very first time" and "comes into being after a period of existence followed by non-existence." Since our primary concern is the beginning of existence of the universe, it is the concept of coming into existence for the very first time that is our main focus and that needs to be given its separate formulation. Intermittent existence can then be formulated as an adjunct to the primary definition.

3. GRÜNBAUM'S SECOND MODEL

Further problems, though, arise with another cosmogonical model proposed by Grünbaum in which "matter has always existed, despite the finitude of the age of the universe."[7] Here t_0 is not the first physical state of the universe but rather a *limit* beyond which the cosmic time interval cannot go, being open in the past. There is, he claims, no first state of the universe since for any state t_i there is another t_k such that $t_0 < t_k < t_i$, even though the universe is nevertheless finite. "Thus," he concludes, "we can say that the Big Bang universe *always* existed, although its age is only 15 billion years."[8] Needless to say, there is an air of paradox about this model of the beginning of the universe: matter has always existed, but only for a finitely long time. If the model is correct, the universe does not begin to exist according to (B_1); but what this suggests is that the definition of "*x* begins to exist at *t*" requires modification. Unfortunately Craig's response is to say that although on this model the universe has always existed in the sense that for any time at which it exists there is a prior time at which it exists, it has not always existed in the sense that it is not *permanent*—it has existed for a finitely long time.[9] But it is not clear—and Craig offers no assistance—how we are supposed to understand the notion of non-permanence, given this distinction.[10] This is not to say that the distinction is incorrect, highlighting as it does the difference between reading "always" in a metrical sense (an infinitely long period of past time) and in a topological sense (a period of time with no first instant). What Grünbaum misleadingly does is to proffer the topological reading as though it were able to assuage our concern at the thought that a *metrically* finite universe did not in fact begin to exist. Craig realizes that it does not allay our concern, but his introduction of the concept of permanence makes it look as though he denies the highly plausible idea that every non-permanent thing begins to exist and everything that begins to exist is non-permanent. Rather, what we need to do is to set aside Grünbaum's topological reading of "always" as a red

[7]Grünbaum, "Creation as a Pseudo-Explanation," p. 242.

[8]Grünbaum, "Some Comments," p. 227.

[9]Craig, "The Origin and Creation of the Universe," p. 239.

[10]Quentin Smith, in "A New Typology of Temporal and Atemporal Permanence" (*Noûs* 23 [1989]: 307–30), proposes a definition of "permanent" as follows: "x is permanent $=_{df}$ There is no time t that is both later than x's existence and separate from x's existence by a finite number of nonoverlapping temporal intervals of equal length" (p. 316). Unfortunately, this definition does not directly or indirectly address the sort of case envisaged by Grünbaum's second model, and so is of no use in the debate on that model as far as it concerns whether the universe is permanent. Further, however, at pp. 309–10 he offers three definitions of "begins to exist" whereby it looks as though, on the relevant (second) definition, the universe did begin to exist because it satisfies the definiens of being "located at the earliest time." But then, to complicate matters, such a universe also oddly ends up being, on Smith's definition of "sempiternality," sempiternal in the past ("x exists at some time t and at every time earlier and later than t")!

herring and concentrate instead on the metrical finitude of the universe. Such finitude does indeed render the universe non-permanent, and in this sense it is hard to see how it could not thereby have begun to exist. But it is this notion of "begins to exist" in the sense of non-permanence that awaits the elaboration that Craig has not provided.

And there are good metaphysical reasons for rejecting Grünbaum's claim that on his "open interval" model the universe does not begin to exist. For on this model (as on any plausible one) the universe *could* have been older or younger than it in fact is, just as—to take a spatial analogy—a line of finite length could have been longer or shorter than in fact it is. Why isn't this modal property enough to ground the thought that the finite universe, as much as the finite line, has a beginning? The thought is comprehensible without having to conceive of either the universe or the line as embedded in a larger spatio-temporal framework. Further, what if it turned out to be the case that events *within* the universe satisfied the same model proposed by Grünbaum for the universe as a whole? What if, according to some as-yet-unknown feature of the best physical theory, no event had its first existence at "an actual moment of time"[11] but possessed only a *limit* beyond which the event time interval did not go? Would this mean that events did not literally begin? If this would seem implausible for events, then so it should for the universe itself (where the universe is thought of as a series of maximally large events involving transitions from one state to the next). At a more fundamental level, however, is the observation that while Grünbaum's model might preclude the universe's having begun to exist *at a time*, it is not clear how it precludes the universe from having begun to exist *simpliciter*. The proposition "*x* begins to exist at *t*" may entail "*x* begins to exist," but we should not be hasty in assuming that the reverse also holds. If it does not, then although Craig's definition might not work, we may be able to find one that does.

4. DEFINITIONS

So, how are we to formulate a definition of "*x* begins to exist" that allows for the sort of open interval model that Grünbaum proposes as at least a cosmological possibility? A previous proposal of mine was inadequate for not taking seriously the need to go beyond minor modification of Craig's initial formulation rather than opting for a radical rethinking of what the definition must look like.[12] Unfortunately Craig's latest proposal[13] does not address the problem at all and, if anything, is a regression from his earlier formulation (B_1 above) since it merely defines the beginning of a thing's existence in terms, *inter alia*, of the phrase "the first time at which *x* exists," which is, if anything, even less precise than the earlier definiens.

What is required instead, I submit, is that we focus on the concept of a thing's beginning to exist *during an interval*. And we need to consider two cases. First, a

[11]Grünbaum, "Creation as a Pseudo-Explanation," p. 242.

[12]D. S. Oderberg, "Adolf Grünbaum and the Beginning of the Universe," in *Philosophia Naturalis* 36 (1999): 187–94.

[13]See note 3 above.

thing might begin to exist during a *closed* interval $[t_0, t_n]$. In such a case its beginning to exist during that interval consists in its existing at every moment within the interval but at no time prior to it.[14] Hence existing at no time prior to the interval is logically equivalent to existing at no time prior to t_0. If we are dealing with a *left-open* interval $(t_0, t_n]$, where there is no actual instant t_0 within the interval, we can say that an object (in the case of Grünbaum's model, the universe) begins to exist during the open interval in virtue of its existing at every moment within the interval and at no moment prior to the interval. But in this case we must add that the object exists at no time prior to *or including* t_0.

In addition, we need to distinguish between two further senses in which an object can be said to begin to exist during an interval. To take a simple example, suppose that we take the beginning of the United States to have occurred on 4 July 1776. Suppose you are asked the admittedly unusual question (as far as ordinary parlance is concerned): "During which period of time did the United States begin to exist?" You would, presumably, answer that the question was uninteresting since the U.S.A. began to exist during numerous (indeed an infinity of) intervals—between 1734 and the present, between 3000 B.C. and the present, between A.D. 250 and 1921, and so on. Indeed from an historical point of view these are all uninteresting answers to an uninteresting question. But it is metaphysics that is our concern here, not history, and from the metaphysician's point of view the interesting answers are those that focus on any period of time between 4 July 1776 and some other date, or more precisely any period such that the U.S.A. existed at every time during that period. In other words, if you take some point at which the U.S.A. exists and trace backwards in time, you come to a date, 4 July 1776, before which there was no U.S.A. And that gives you a period, one of a (possibly uncountable) infinity, during which the U.S.A. came into existence. We can then speak of a "loose" and a "strict" sense of "*x* begins to exist during an interval." The strict sense can be defined as follows:

(B_{2S}): x begins$_S$ to exist during a closed interval $[t_0, t_n]$ or an open interval $(t_0, t_n] =_{df}$
(i) x exists at every t_i in the closed interval $[t_0, t_n]$ and there is no $t_j < [t_0, t_n]$ at which x exists; or
(ii) x exists at every t_i in the open interval $(t_0, t_n]$ and x does not exist at t_0 and there is no $t_j < (t_0, t_n]$ at which x exists.

We can then define the loose sense as follows, restricting ourselves (for simplicity) in the definiendum to closed intervals:

(B_{2L}): x begins$_L$ to exist during interval $[t_m, t_n] =_{df}$
(i) there is some closed interval $[t_0, t_k]$ $(t_m \leq t_0 < t_k \leq t_n)$ such that x begins$_S$ to exist during $[t_0, t_k]$; or

[14]Immediately one might worry about whether the object needs to exist at *every* moment during the interval, but we will see shortly that the concern is dealt with by distinguishing between strict and loose senses of "begins to exist during an interval" and by dealing specifically with intermittent existence.

(ii) there is some open interval $(t_0, t_k]$ $(t_m < (t_0, t_k], t_k \leq t_n)$ such that x begins$_S$ to exist during $(t_0, t_k]$

Armed now with a definition of "begins to exist" in the strict sense, defined as beginning to exist during an interval, we can define the beginning (*simpliciter*) of existence. But since we are incorporating the open interval model into our definition, we are not licensed to say that whenever a thing begins to exist it begins to exist *at a time*, because in the open interval case there is no actual moment that is the first moment of the object's (in the present case the universe's) existence. It is only by trading on the conflation between a thing's beginning to exist and its beginning to exist at a time that Grünbaum is able to level the charge that his open interval model precludes the universe's coming into existence. The formulations above, however, give us a general definition of beginning to exist during an interval that can then be used to provide a definition of beginning to exist *simpliciter*. The corollary is that in the *closed* interval case we can *also* say that the object does begin to exist at a time because there is an actual moment t_0 that is the first moment of its existence. So we can say:

(B_2): x begins to exist $=_{df}$ there is some interval such that x begins$_S$ to exist during that interval.

And we can add:

(B_{2A}): x begins to exist at $t_0 =_{df}$ there is some closed interval $[t_0, t_n]$ such that x begins$_S$ to exist during $[t_0, t_n]$.

Note that B_2 does not need to make reference to the loose sense of "begins to exist" since that is defined in terms of the strict sense. Further, there is no loose sense of "begins to exist at a time." More important, however, is the question of what, if any, ontological implications are carried by these new definitions. At one level, there are none: B_{2S} simply constitutes a formal representation of "begins to exist" that encompasses open and closed interval models and hence solves a formal problem. But formal definitions must cohere with ontology, so we need to ask whether the proposed definition of "begins to exist" has a metaphysical justification.

The first thing to note is that, as Grünbaum correctly insists,[15] the closed model is *not* a *bona fide* physical model of the "Big Bang." Contrary to the loose way in which many physicists and philosophers talk, the space-time singularity is *not* a point in space-time on the general relativistic cosmology since the laws of physics themselves would break down at such a point and there would be ontologically impossible property co-instantiations such as infinite density and zero volume. The space-time singularity is not, on general relativity, an event or a point—it is a *limit* or *boundary* towards which density approaches infinity and volume approaches zero. Hence, if general relativity is correct, the closed interval model is not a physical

[15]See, for instance, Grünbaum, "Theological Misinterpretations of Current Physical Cosmology," in *Philo* 1 (1998): 15–34, at pp. 25–26; and the papers cited in note 1 above.

possibility. Nor would it appear to be a metaphysical possibility in its own right either, given the properties t_0 qua singularity is supposed to possess, in which case the beginning of the universe needs to be defined by means of a notation that makes the absence of a first moment of time perspicuous, and the formal representation by means of the second limb of B_{2S} seems wholly suited to this task. Of course, Grünbaum thinks that this militates against giving a definition at all since the universe does not begin to exist on his view. But consider the situation in respect of the beginning of objects within the universe. Some bioethicists, for instance, have argued that the process of fertilization does not have a first moment since no matter how precisely one were able to observe that process, one would never find *the* moment at which it could be said that the egg and sperm had now become a new entity, viz., a zygote.[16] Note that the point is not merely one about the alleged vagueness of the term "fertilization," i.e., about whether a certain part of the sperm needs to have entered the egg before fertilization can be said to have occurred, or whether the DNA of sperm and egg need to have been fully or only partly merged, and so on; rather, so the objection goes, even if we settled on a plausible criterion we would not be able to locate the very first moment at which that criterion was satisfied. Now, whatever the merits of the position (and there are few), and leaving aside plausible anti-verificationist concerns, suppose that it was true not just of fertilization but of other events and of objects in general: suppose, that is, that we could never in principle locate the first moment of existence of any object or event. Grünbaum might cavil at the idea that the universe began to exist while lacking a first moment, but he could not say the same about a flash of lightning or the coming into existence of a block of ice. Even if material objects and events had no first moment, they still clearly would begin to exist, and so we would be faced either with providing a definition of "begins to exist" that they satisfy or with giving up on the idea of defining the beginning of existence altogether. (Note that the fact that such objects and events are embedded in larger spatio-temporal frameworks is irrelevant. We could certainly say that there was a time at which the ice cube did not exist and a time at which it did, but if there were no first moment we could still not say *when* it began to exist, which is absurd.) Rather than give in to hopeless definitional skepticism, however, we can use open intervals to represent such cases and hence define the beginning of existence of any object that lacks a first moment in terms of its beginning to exist during an open interval, more precisely an interval which converges backwards on a certain limit or boundary.

But suppose general relativity were wrong and that the best physical theory represented t_0 as the actual first moment of existence. And suppose that, within the universe, objects and events such as ice cubes and flashes of lightning did indeed have first moments. Then it might be thought that the first limb of (B_{2S}) brought in explanatorily superfluous material and that one could simply use a version of (B_1) to define the beginning of the universe or of any other thing without appealing to closed intervals. It is at this point that deeper metaphysical concerns intrude. The

[16]See, e.g., S. Buckle, "Biological Processes and Moral Events," in *Journal of Medical Ethics* 14 (1988): 144–47; see also my response in *Journal of Medical Ethics* 15 (1989): 166.

crucial question here is whether we ought to believe in the reality of *instants* (not just the reality of the space-time singularity). Should we, for example, regard time as literally composed of a series of instants modeled on the continuum of the real numbers?[17] If we should, then we do not need to define the beginning of any object's existence in terms of its beginning to exist during an interval: we can work with a suitably modified version of B_1.

I would argue, however, for familiar Zenoesque and other reasons, that we should think of time as infinitely divisible in merely a potential sense, i.e., as a *potential infinity* (to use the Aristotelian term). Instants should indeed not be countenanced as anything other than limits or boundaries rather than as real elements in the temporal series. On this view, we must recognize that *nothing* literally occurs *at an instant*. Nor does anything occur *simpliciter* without occurring during some time. Similarly, when we speak of synchronic identity, i.e., identity at a time, we must recognize that this notion is derivative from that of diachronic identity, i.e., identity over time, and should be seen only as parasitic upon that primary concept. So also there is no identity *simpliciter* that is not identity over some time (limiting ourselves to temporal objects, of course); just as there is no identity *simpliciter* without identity under some sortal. There would therefore be justification for defining the beginning of existence in terms of beginning to exist during an interval and for treating expressions of the form "begins to exist at *t*" as derivative from that. One could still maintain the distinction between open and closed interval beginnings: after all, whether the best physical theory should represent the singularity as real or not seems independent of whether instants in general are real or not. But the need to use intervals in our definition of the beginning of existence would be motivated by a general skepticism about whether instants were anything more than limits or boundaries. We would still need to have variables t_i ranging over the constituents of intervals, but the proper interpretation of the variables would involve the constituents' being just more intervals of arbitrarily small size; hence the t_i would range over intervals converging on limits rather than over actual points, and one could, for instance, identify the limits with sets of nested intervals. For an object to begin to exist, then, would be for it to exist during an interval which converges backwards on a certain limit; and this is representable using (B_{2S}). Ontologically speaking, nothing exists at an instant and nothing begins to exist at an instant—all existence and all beginnings are during intervals. However, we will still be able to utilize notions of *instantaneous* change and *instantaneous* beginning conceived in terms of the convergence of intervals upon limits: a world without instants is not necessarily a world without instantaneity.

It might be objected[18] from a purely formal point of view that if we take "*x* begins to exist at *t*" as primitive, we can use it to define "*x* begins_S to exist during an (open or closed) interval" (and also "*x* begins_L to exist during an (open or closed)

[17]For a recent attack on the reality of instants (framed in terms of anti-realism in general but not, it seems, dependent on the latter), see Michael Dummett, "Is Time a Continuum of Instants?" in *Philosophy* 75 (2000): 497–515.

[18]Raised by Graham Oppy in discussion.

interval"); and so the definitions given above do not show that it is the concept of beginning to exist during an interval that must be taken as metaphysically primary. In reply, it is true that metaphysical considerations, not definitional ones, are decisive on this point. The definitions of themselves do not prove anything as to metaphysical priority. But notice that the proposal to take "*x* begins to exist at *t*" as primitive does not reverse the definitional method adopted above. My proposal takes as primitive "*x* exists at *t*" (with *t* understood as referring to a limit, not a point, and with limits understood as sets of nested intervals). If the objector wishes to define "*x* begins to exist at *t*" in terms of "*x* exists at *t* and at no time prior to *t*" (à la Craig), then the proposal collapses into mine inasmuch as they both take "*x* exists at *t*" as primitive. Once this is taken as primitive, one can then use it to define the beginning of existence during an interval, followed by the beginning of existence at a time in terms of this, or vice versa, and we will not be any wiser as to which of the latter two are metaphysically primary.

The point of the present discussion, however, is that Grünbaum's open interval model warns us against taking "*x* begins to exist at *t*" as primitive since the model could not then be accounted for in those terms. The definitions I have given do not prove but they do suggest that if we take "*x* exists at *t*" as primitive we can give a wholly general definition of "*x* begins to exist during an interval" from which the more specific definitions of "*x* begins to exist at *t*" and "*x* begins to exist" (*simpliciter*) can be derived. What this *does* prove is that Grünbaum is wrong to think his open interval model precludes a definition of "*x* begins to exist" according to which the universe can indeed be said to have begun to exist. Taken in conjunction with the metaphysical considerations, there is a case for saying that the definition is in harmony with the view that beginning to exist during an interval *ought* anyway to be taken as primary and beginning to exist at a time as secondary.

Grünbaum's open interval cosmogonical model is therefore accommodated on this analysis of the beginning of existence by virtue of a definition that entails that, if the model is correct, the universe began to exist even though it did not begin to exist at a time. Furthermore, the general definition given above, though disjunctive, is not *ad hoc* but is based on plausible metaphysical intuitions that unite the elements of the definition by a common thread.

Since we should also allow for the possibility of intermittent existence, we need to incorporate this concept as well into our general definition. This is done as follows for closed intervals; *mutatis mutandis* for open intervals. We define intermittent existence thus:

> (*I*): *x* exists intermittently during $[t_m, t_n] =_{df}$ there is some interval $[t_i, t_j]$ $(t_m < t_i < t_j < t_n)$ such that *x* exists during $[t_m, t_i]$ and $[t_j, t_n]$ but not during $[t_i, t_j]$.

If we take $m = 0$ in (*I*), we cannot say that *x* begins to exist (by which I mean "strictly") during $[t_0, t_n]$ because *x* does not exist at every t_k in $[t_0, t_n]$. So we need to say:

> (B_{2SI}): If *x* exists intermittently during $[t_0, t_n]$, then: *x* begins to exist during $[t_0, t_n] =_{df}$ there is an interval $[t_0, t_m]$ which is a sub-interval of $[t_0, t_n]$ (i.e. $t_m < t_n$) and *x* begins_S to exist during $[t_0, t_m]$. (The loose sense can be defined accordingly.)

5. FURTHER METAPHYSICAL CONSIDERATIONS ON THE BEGINNING OF EXISTENCE

Suppose that one were to accept (B_{2S}) and the associated formulations as giving an adequate definition of the beginning of existence of something, such that the universe could then be seen to have begun to exist even on Grünbaum's open interval model. It might then be objected[19] that this now puts pressure on the second premise of the KCA, namely, the famous principle that whatever begins to exist must have a cause of the beginning of its existence. I do not propose to enter into an overall evaluation of this principle here[20] but instead only to ask whether the open interval model and broad definition of "begins to exist" that I offer as accommodating it count against the causal principle. In other words, assuming the principle to be true for the closed interval case, could it be plausibly applied to the open interval case so as to preserve the position that the universe requires a cause on either model?

At first glance, it is difficult to see why the open interval model militates against the causal principle. After all, on the model the universe is still admittedly finite (non-eternal, or "non-permanent" in Craig's terminology) and must still be seen to have arisen *ex nihilo* absent an efficient cause. So, if the causal principle has any plausibility, this does not appear to be diminished by the open interval model.

Nevertheless, it might be thought that an analogy with the case of an eternal universe can be drawn here. On the model of a universe metrically infinite in the past, it is commonly argued that the universe needs no cause since each of its states is causally explained in terms of a prior state. But this is exactly the same on the model of a finite universe open in the past. So, how can the causal principle have bite in the latter case any more than in the former? The answer is that the relevant features of both models are not exactly the same. The intuition in the case of a universe infinite in the past turns precisely on the *infinity* of the past, so that not only does no state lack a causal explanation in terms of a prior state, but the very series *itself* does not require a cause. In the finite, open interval case one might concede that there is a causal explanation for each state[21] but insist that there is no explanation for the very finitude of the series itself any more than in the closed case. The question to be asked is not merely "Why is the finite interval *this* long (e.g., fifteen billion years) rather than *that* long?" but also: "In virtue of what is there a finite series *at all*? In virtue of what did the universe begin to exist?" I am not, for the purpose of present discussion, urging that this question be seen as deeply puzzling (Grünbaum and Quentin Smith, for instance, find no puzzle in it at all; supporters of the KCA, including myself, do). I am only urging that *if* it is seen to be puzzling—and hence to cry out for an answer—in the closed interval case,

[19]I am grateful to Graham Oppy for raising this question.

[20]For Craig's recent thoughts on the causal principle, see his "Must the Beginning of the Universe Have a Personal Cause? A Rejoinder," in *Faith and Philosophy* (forthcoming), in reply to W. Morriston, "Must the Beginning of the Universe Have a Personal Cause? A Critical Examination of the Kalam Cosmological Argument," in *Faith and Philosophy* 17 (2000): 149–69.

[21]Note that for present purposes I am equating causation and causal explanation.

then so it should also cry out for an answer in the open interval case, while not having application in the infinite case.

One might, of course, cast doubt on the thought that merely being able to explain every term in a series by reference to a prior term or terms constitutes an explanation at all. Such a doubt would then undermine the view that the universe did not need an explanation in *either* the eternal *or* the open interval case. But we would then be leaving behind the distinctive feature of the Kalam argument, namely, its appeal to the beginning of existence of the universe, and looking instead to a feature of the universe that arguably required explanation whether it began to exist or not. Further, supporters of Leibnizian-style cosmological arguments or of Aquinas's Third Way argue that the universe, eternal or not, requires a cause on the ground of its very *contingency*, and so would not go along with the disanalogy I am indicating.

But I do not see an either/or choice here. It is perfectly legitimate for a supporter of cosmological arguments simultaneously to hold the following positions: (a) in the case of an eternal or finite universe, whether in the finite case the closed or open interval model is correct, it is its contingency that requires a causal explanation; (b) in the infinite and open interval cases there is either no or an incomplete explanation of each state of the universe in terms of a prior state or states, and therefore a further cause must be posited; (c) in the case of a finite universe, open or closed in the past, it is not just its contingency that calls out for a cause but its very finiteness as well.

What this means (ironically) is that the open interval model, originally postulated to deprive the universe of the need for a cause, may in fact require *more* in the way of causal explanation than the other two models, for the following schema could well be correct:

COSMOLOGICAL MODELS

FEATURES REQUIRING EXPLANATION	*Infinite in the past*	*Finite in the past, closed interval*	*Finite in the past, open interval*
	Contingency	Contingency	Contingency
	Explanation of each member of series	Finiteness	Explanation of each member of series
			Finiteness

Needless to say, the schema would be correct only if there were a sound argument from contingency to the need for an explanation of that feature, and if the explanation of each member of a series in terms of a prior member or members were only a partial explanation (if a genuine explanation at all). Moreover, one could also add to the model of a metrically infinite universe a further feature requiring explanation, since one must ask the question: Why, on such a model, does anything happen when it does? Such a question invokes the Principle of Sufficient Reason, and if that principle is true, then the fact that the question lacks an answer poses a serious problem for the very idea of a universe infinite in the past.[22] These issues will not be explored here. My point is simply that the supporter of the Kalam argument should not be diverted by consideration of an infinite universe into thinking that a finite, open interval model deprives the argument of its bite in that case. Rather, he should consider the possibility that when it comes to cosmological arguments calling for explanations of features of the universe, he may be, as Thomas Aquinas himself indicated with the first four of his Five Ways, spoilt for choice.[23]

[22]See, further, D.S. Oderberg, "Traversal of the Infinite, the Big Bang and the Kalam Cosmological Argument," in *Philosophia Christi* 4 (2002): 305–36; and also the reply by Graham Oppy, "The Tristram Shandy Paradox: A Response to David S. Oderberg," in *Philosophia Christi* 4 (2002): 337–51; as well as my rejoinder, "The Tristram Shandy Paradox: A Reply to Graham Oppy," in *Philosophia Christi* 4 (2002): 353–63.

[23]I am indebted to William Lane Craig for discussion of the issues raised in this article, to Graham Oppy for his careful and insightful remarks on a draft version, and to colleagues at the University of Reading Work in Progress seminar.